

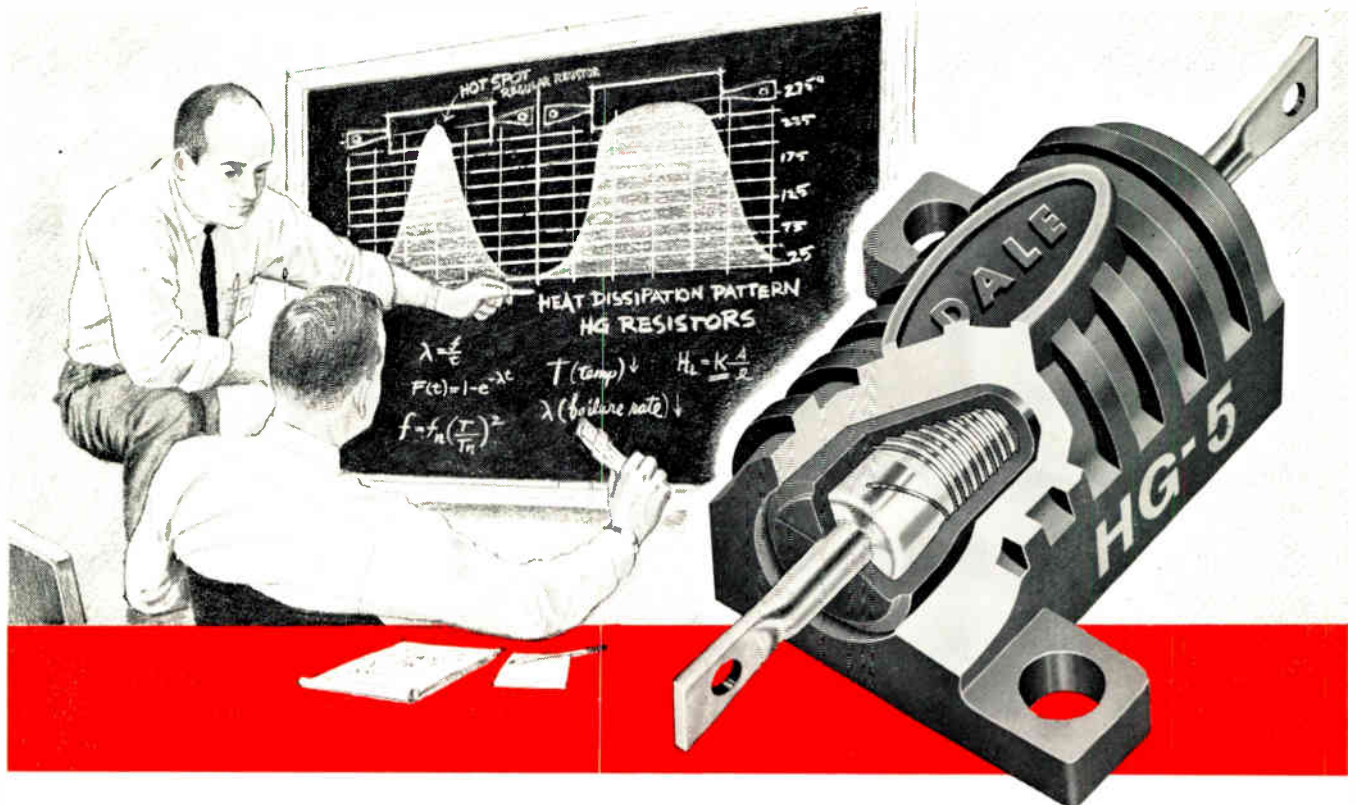


# ELECTRONIC INDUSTRIES

**THE STATE OF THE ART REFERENCE ISSUE  
JUNE 1963**

# DALE RELIABILITY

Put more power in less space with new  
**HG Series Precision Power Resistors**



Dale HG precision power resistors are a breakthrough in meeting the challenge of miniaturization where high power and precision tolerance are required. Dale uses an exclusive molding process to incorporate a precision wirewound resistance element into an aluminum radiator housing. The result is a solid unit from which heat is dissipated evenly and efficiently along the entire length of the resistance element. This eliminates the performance-cutting central "hot spot" and assures maximum reliability in minimum size. When derated to Mil. Rating, HG Resistors have unprecedented stability. The rigid quality control procedures and materials procurement standards used in the production of all Dale resistors have reached new levels of achievement as a result of Dale participation in the **MINUTEMAN** High Reliability Component Development Program.

#### SPECIFICATIONS

Three sizes: HG-25 (35 watts) and HG-10 (20 watts) meet requirements of MIL-R-18546C (RE-70 and RE-65 respectively) HG-5 (15 watts) meets functional requirements. Resistance range: .1 ohm to 60K ohms, depending on type and tolerance. Tolerances: 0.5%, 1%, 3%. Continuous operating temperatures: -55° to 275° C. Temperature coefficient: 0.00002/degree C.

#### Here's how Dale "builds in" reliability

- 1. RESISTANCE ELEMENT** consists of high purity ceramic core wound with resistance wire procured to rigid standards. Precise control of winding tension over centerless ground core assures that wire lays firmly and uniformly. This produces even power dissipation and eliminates local "hot spots". Element is untouched by human hands or foreign materials.
- 2. COMPLETE WELDED CONSTRUCTION** from terminal to terminal. Welds tested to destruction on sample basis. Non-corrosive stainless steel end caps assure good weldability and ideal mechanical properties. Standard terminals gold-plated copper. Also available with tin-plated copper terminals and 6-32 studs.
- 3. EXCLUSIVE DALE PROCESS** (patent pending) completely surrounds resistance element with high density jacket which bonds itself to the outer housing. The result is a solid, void-free mass which gives maximum heat conduction and affords complete environmental protection. Possibility of high voltage breakdown is eliminated by precise centering of resistance element within radiator housing.
- 4. RADIATOR HOUSING** of anodized aluminum mounts on chassis for maximum thermal transfer.

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**DALE ELECTRONICS, INC.**

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Circle 98 on Inquiry Card

World Radio History



# 1963/64 ALL REFERENCE & DIRECTORY ISSUE

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# ELECTRONIC INDUSTRIES

SHELBY A. McMILLION,  
Publisher  
BERNARD F. OSBAHR,  
Editor

## Your 1963 State of the Art Reference Issue

THIS IS YOUR 1963 STATE OF THE ART REFERENCE issue. It contains 34 survey or round-up type articles. Each of these has been written exclusively for ELECTRONIC INDUSTRIES by an outstanding industry authority. Our objective is to provide an up-to-the-minute review of the many technical fronts of our industry.

There are many new and interesting ideas expressed by our authors in these articles. For example:

On page C-38 Robert E. Moe describes how the vacuum tube industry has met the challenge of today's changing technology. This industry still remains a healthy and vigorous supplier of electron controlled devices in the entertainment, industrial, military and space fields.

General Bernard A. Schriever, commenting on national security, page B-6, writes that although we passed a major milestone when the first Minuteman squadron became operational, Minuteman is still not the ultimate weapon system. Technology is not standing still and new systems will always be developed on the basis of new requirements.

Of all basic parameters used in science and engineering, frequency continues to be the one that can be measured to the greatest precision and accuracy. So writes Ivan E. Easton, page E-2. He also points out that today modern molecular oscillators are better time keepers than astronomical movements. You might also wish to read about the discovery of a fundamental new theorem in electrostatics.

Dr. John Bardeen, Nobel prize winner, writing on semiconductor research, page C-12, states "Progress in transistors can be characterized by increasing frequencies, power, reliability, smaller size and lower prices." He predicts truly integrated blocks which will give desired overall circuit functions.

Robert C. Sprague discusses microelectronics, page B-10, and discloses that the development of semiconductor integrated devices has progressed to

the point where it appears that they will make possible the smallest electronic circuits which are likely to be made by any technique in the future.

Circuit design, according to Dr. Daniel Noble, page C-2, has become progressively complex because of the advent of integrated circuitry. Involved now for each circuit are circuit theory, mathematics, physics, metallurgy, chemistry, electronics, semiconductor processing, thin-film processing and photography.

Admiral Charles F. Horne, on page B-2 states, "After more than a decade of defense and later space programs the consumer products industry has dropped from a quarter of a century of leadership to less than 20% of total electronics production. The government (thus) has become . . . the biggest buyer of electronic equipment and components."

Dr. Robert Johnson points out, page K-2, the trend toward more economical computers through multiple programming techniques—the interlacing of portions of different simultaneous programs in various computer elements. Such new developments as thin films forecast still greater economies and performance.

This issue, in addition, contains our 21st Annual Directory. Names and addresses of more than 6000 electronic manufacturing plants are provided, as well as information on the more than 3000 products manufactured at these locations.

We think you will agree that this month's cover design is quite a startling and interesting creation. Our cover designer developed it as an answer to our question, "How can you depict the world of the electron?"

Developing and producing your State-of-the-Art Reference issue has been a fascinating challenge for us. We enjoyed it greatly. It is our hope that you will obtain many immediate benefits and find it a useful year-round reference. Your written comments are always welcome.



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# SECTION **B**

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## **OUR ELECTRONIC INDUSTRY— TODAY AND TOMORROW**

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Except for a few problems and rabbit holes here and there, electronic industries appear to have a rosy future.

The electronics "industrial revolution," sired by World War II, and fed by the war in Korea, has taken giant steps—and the steps get bigger as R&D accelerates.

Declining profits, increasing costs and import competition are causing headaches in the industry, but larger, diversified firms are learning the cures.

# PREDICTIONS FOR THE FUTURE OF THE ELECTRONIC INDUSTRY

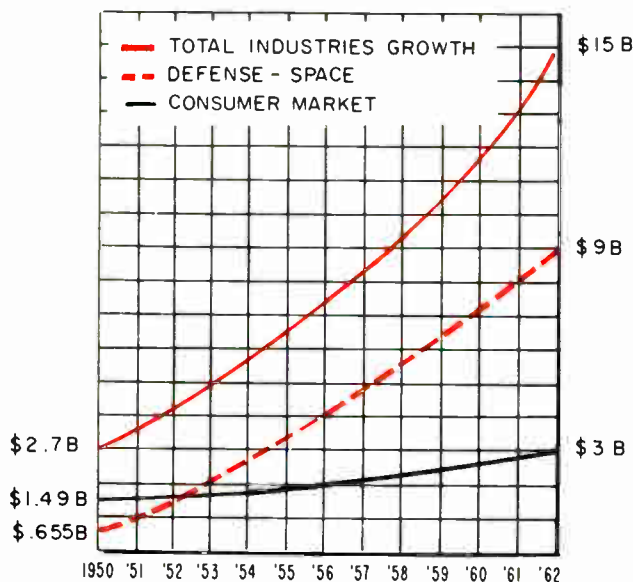
AN INDUSTRIAL REVOLUTION HAS OCCURRED in this country during the last 13 years. In this relatively brief span of time, what was once known as the radio industry has become the electronics industry. Perhaps there is need for an explanation.

When World War II ended on V-J day, radio manufacturers joined in the public rejoicing with enthusiasm. The fifty-odd radio producers and their component suppliers were eager to return to the free enterprise market where the consumer calls the shots.

As soon as price and material controls could be discarded, the radio industry set about fulfilling the pent-up wartime demand for new radios for the home and the new car—when you could get it. As a consequence, 20 million radios were produced in 1947

## GROWTH OF ELECTRONIC INDUSTRY: 1950 TO 1963 Consumer and Government Markets

Government's defense-space electronics rose from 24% of industries total in 1950 to about 60% in 1963. The consumers' market, which held at 55% in 1950, fell below 20% by 1963.



to set a numerical record that has not been matched since.

The radio industry, it seemed, had returned to "normalcy" and was glad of it. But this "normalcy" was not to last; television was beginning to crowd into the living-rooms of America.

By the end of 1950, TV set sales had skyrocketed to 7.5 million, and a new industry boom was in full swing. The big customer was still the American family.

### Korean War Expands Industry

It was on this scene of industrial tranquility that the North Korean invasion of South Korea and the subsequent American intervention came with a rude shock. What the radio-TV manufacturers—and hardly anyone else—did not realize in 1950 was that a new industry was being born even though the radio industry of World War II was its father.

Today, after more than a decade of defense and later space programs, the consumer products industry has dropped from a quarter of a century of leadership to less than 20% of total electronics production. The Government has become without question the biggest buyer of electronic equipment and components. By taking about 60% of the electronic industry's output, the Government's purchases in 1963 will exceed the total volume of the radio industry's sales to the Government throughout World War II.

This metamorphosis was much more significant

By ADM. CHARLES F. HORNE

President  
Electronic Industries Association







Today's electronics industry, born out of the debris of World War II, and nurtured by the needs of the war in

Korea (above) is "firmly established in the national economy and will continue to grow with it, if not ahead of it."

than the tremendous increase in the dollar volume. It brought vast forward strides in technology, a re-orientation of marketing objectives, and a new kind of manufacturer who was a stranger to the pre-1950 radio manufacturer.

A favorite quip of the old radio days was that anyone with a screw driver, a loft, and a set of blue prints could get into radio manufacturing. Today, it not only requires substantial capital, but also a technical capability which surpasses that of the old-time radio engineer to about the same degree as a Ph.D. does a high school diploma. The number of engineers required in any company likewise has multiplied at about the same rate. Today the industry has about 130,000 engineers and scientists.

#### **Dissimilar Firms, Similar Interests**

The electronic industries are a heterogenous group of manufacturers held together by their use of similar techniques and components in the development and production of equipment and systems. These products range from the highly complex for military and

space and some industrial uses to the relatively simple radio for the home or car.

The Electronic Industries Association, which grew out of the Radio Manufacturers Association into the Radio-Television Manufacturers Association and the Radio-Electronic-Television Manufacturers Association, has defined this new assembly of industries thus:

"Electronic industries comprise industrial organizations engaged in the manufacture, design and development, and/or substantial assembly of electronic equipment, systems, assemblies, or the components thereof."

Some, but not all, of the industries which have entered the electronic field since 1950 are: aircraft, watch, business machine, auto, chemical, camera, glass, and food. Other industries have merely bought into the electronic industries for the purpose of diversifying their products and markets.

Despite the seeming incongruity of industrial background, the electronic industries break down into four major categories of manufacturers:

*(Continued on following page)*

## PREDICTIONS (Continued)

1. Consumer goods (radio, TV, phonographs, tape recorders, etc.).
2. Military and space equipment and systems.
3. Industrial and commercial equipment.
4. Components of all types including microelectronic units.

### Number of Producers Varies

There are varying estimates of the number of producers, and the figures depend upon the definition of a company. A conservative estimate of 4,000 companies would be made up approximately of the following groups:

- 1,300 equipment manufacturers and major assemblers.
- 2,000 component producers.
- 700 hardware manufacturers (switches, wire, cabinets, etc.).

Many companies have divisions or subsidiaries which fall within several or all categories of electronic manufacturing. A diversified producer may make radio and television receivers, military and space systems, industrial and commercial equipment, and a variety of components. A less diversified company may choose to produce only one category of products. Many small firms are one-product specialists.

By reason of a wide dispersion of plants, the indus-

try is truly national in character. There are, however, heavy concentrations in a few areas and a thin scattering in others. The heaviest concentrations are in what may be loosely called the Atlantic-Coast Northeast region and the Southwest-Coast area. The former runs from Washington, D. C., to Maine, while the second include Southern California, Arizona, and San Francisco and its environs.

The Chicago-Indiana area remains the stronghold of the older radio industry—manufacturers of radio-TV-phono equipment and standard components. Among the newer zones of electronic industrial development are Florida, Texas, and North Carolina.

### Employee Figures Estimated

Employment figures are of necessity estimated due to the over-lapping of electronic manufacturing with other related industries. The Business and Defense Services Administration, Department of Commerce, earlier this year said: "Employment in the electronic industries is expected to pass the million mark in 1963, up almost 10% from the estimated 1962 figure."

This figure, of course, applies only to employees in manufacturing and R&D companies. Thousands more are employed in merchandising outlets, servicing, and broadcasting.

Factory sales, calculated by EIA Marketing Services Department, amounted to just under \$13 billion in 1962 and are expected to approach \$15 billion in 1963. They may be classified in four general categories:

|                        | 1962          | 1963     |
|------------------------|---------------|----------|
|                        | (add 000,000) |          |
| Government             | \$7,600 (1)   | \$9,000  |
| Consumer               | \$2,340       | \$2,400  |
| Industrial             | \$2,400       | \$2,700  |
| Replacement Components | \$ 620        | \$ 650   |
|                        | \$12,960      | \$14,750 |

(1) Gross Government sales are estimated by EIA as \$500 million greater than this, but as they are included in the industrial category as standard commercial products they are not repeated here.

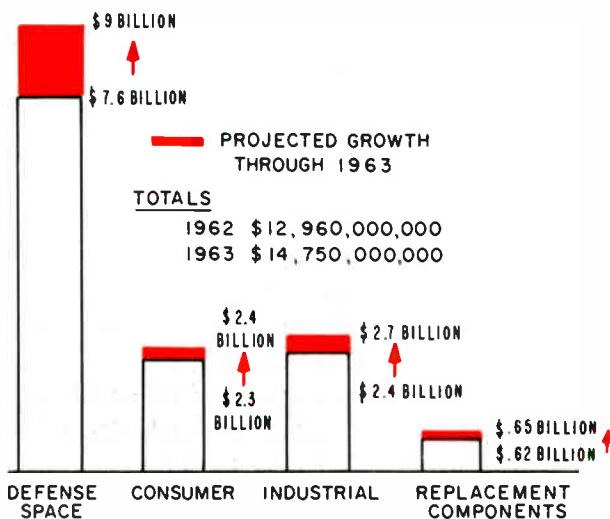
The electronic industry, now fifth largest on the nation's industrial scene, may move into fourth place by the end of 1963. By the close of 1970, annual factory sales could climb to about \$20 billion—perhaps even to \$25 billion or more.

Indicative of changes in electronic industries since 1950 are the shifts in dollar volume among the above categories. In 1950 consumer goods accounted for about 55% of total electronic production, whereas in 1962 Government sales—a mere \$655 million in 1950—represented about 60% of the dollar volume.

### FACTORY SALES FROM 1962 TO 1963 FORECAST

Growth comparisons in defense-space, consumer, industrial and replacement component markets.

Factory sales in four general categories neared \$13 billion in 1962; are expected to bring \$15 billion in 1963. Defense-space still holds 60% line; consumer market is less than 20%.



During the same period industrial electronic products rose from \$350 million to \$2.4 billion to surpass consumer goods. Component replacement sales, as might be expected, closely paralleled industry growth by almost tripling in volume.

### Greatest Gov't Market Change

Perhaps the greatest change occurring in the Government market is the rapid growth in space requirements. The National Aeronautics and Space Administration (NASA) request for fiscal year 1964, which begins July 1, 1963, was for \$5.7 billion, which is \$2 billion above the previous year. Military requirements, on the other hand, showed a slight decline in categories heavily electronic so far as production is concerned; but R&D programs, which increasingly involve electronics, are up \$521 million to \$7.1 billion.

During the fiscal year 1963, and for several years thereafter, the Department of Defense will concentrate on building up American capacity for limited warfare. The command and control requirements of this program rely heavily on the electronic industries.

The total dollar value of factory sales for consumer products increased 12% in 1962 somewhat to the surprise of everyone. It had been generally accepted by 1960 that the television market was leveling off and could be expected to grow only as the population expands. As for radios, just as the book salesman discovered on his first house calls, everyone has a radio. The only market seems to be for extra sets and replacements.

But these forecasts failed to anticipate the impact of stereophonic FM Broadcasting which has made remarkable strides since it was authorized by the Federal Communications Commission in June, 1961. More than 225 FM stations have converted to stereo, and sales of stereo FM receivers may reach a million units in 1963.

Just what effect the All-Channel Receiver Act—effective April 30, 1964—will have on TV set sales is open for conjecture. The television industry has joined with the FCC in preparing the retail and servicing trade, broadcasters, and the public for the change-over. If successful, this program eventually should expand television broadcasting services in many areas where the scarcity of VHF channels has limited the number of stations and hasten the consumer's conversion to the all-channel receiver.

### Military Needs Slowed Market Down

It is universally conceded that the industrial and commercial markets offer the greatest growth potential for electronic industries. That sales of industrial electronic products have multiplied seven times since

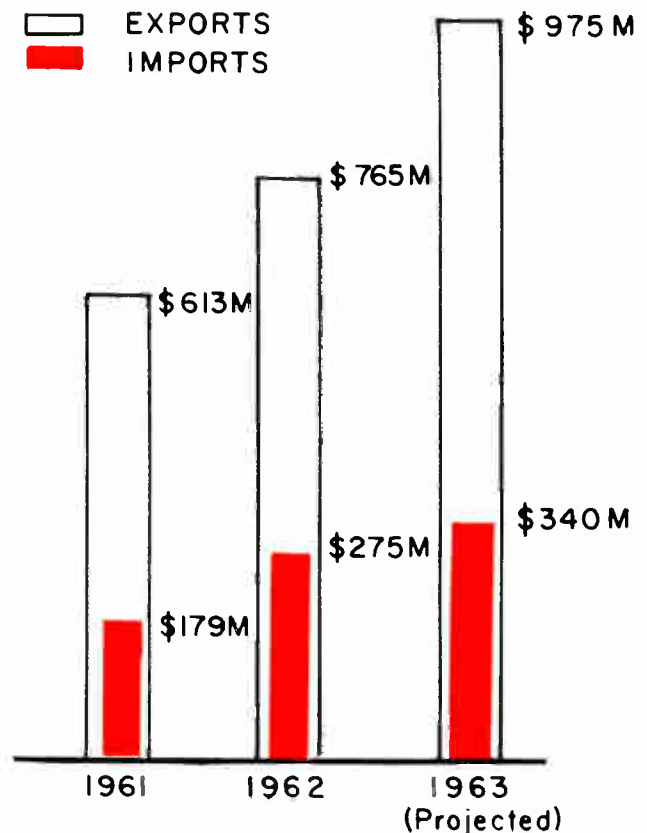


"Government's purchases in 1963 will exceed total volume of radio industry sales to Government throughout World War II."

1950 is indicative of the future. The priority of military requirements undoubtedly has slowed the growth of the market. However, the development and improvement of many industrial-commercial devices  
(Continued on page B16)

### EXPORT-IMPORT GROWTH AND FORECAST: 1961-1963

U.S. exports of electronic systems, equipment and components may reach \$975 million in 1963. Imports also are rising but at a faster rate to an estimated \$340 million total in 1963.





The continuing threat to our national security puts increasing demands on electronic-aerospace technology. Gen. Schriever spells out here the current and future requirements for more effective striking forces and defensive systems, on earth and in space. He suggests components and systems that may be developed to fit those needs, with accent on reliability.

# NATIONAL SECURITY AND ITS TECHNOLOGICAL REQUIREMENTS

THE SECURITY OF THE UNITED STATES depends heavily on our possession and application of superior technology. Throughout military history, technology has made vital contributions to victory in battle. Its role is paramount today. Our national survival hinges on a vast array of highly complex and sophisticated systems that have been created by the joint efforts of the armed services, science, and industry.

Continued advance in every area of technology is essential to maintain our national security in the face of a wide-ranging threat. We must be prepared for aggression on any scale—in the jungles of Southeast Asia, in the emptiness of space, or anywhere in between. Wherever freedom is threatened by military action at any level, we must have the capability to make the appropriate response. As President Kennedy said shortly after the Cuban crisis last fall, "Regardless of how persistent our diplomacy may be in activities stretching all around the globe, in the final analysis it rests upon the power of the United States."

Many of the systems we depend on today—advanced manned aircraft, intercontinental and intermediate range ballistic missiles, electronic early warning systems, and rapid and reliable communications systems—were not even invented twenty years ago. A number of them were dismissed as "fantastic" or "impractical" when they were first suggested. Serious development of intercontinental ballistic missiles did not begin until we had obtained solid evidence that the Soviets were building similar weapons.

## Ballistic Missile Progress

The rapid progress of the ballistic missile program has been due to the close partnership between science, industry, and the armed forces. New methods of management enabled us to cut lead times and surpass the

most optimistic predictions made at the start of the ICBM program in 1954. In December 1962 we passed a major milestone when the first operational Minuteman squadron was turned over to the Strategic Air Command. The national inventory of operational missiles will greatly increase during 1963.

These new weapons are greatly augmenting the Nation's deterrent strength, but it would be a mistake to regard any system—even the most advanced—as "the ultimate weapon." Technology is not standing still. New systems will always be developed on the basis of new technology and new requirements.

If we are not the first to develop them, we must expect that another nation will be. This is a major problem. How do we insure that the Soviets will not achieve superiority in a decisive area of technology? There are no easy answers. When we attempt to evaluate Soviet technical capabilities or specific weapon developments, we are dealing either with estimates or with virtual unknowns.

## Three Facts About the Soviet

However, there are three things we know for certain about the Soviet Union, and these indicate the general developments that are likely to occur in military technology. First of all we know the basic Communist hostility toward the Free World. Events of the past several months have shown this very clearly. They talk of "peaceful co-existence" until they are blue in the face—while their actions continue

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By **GEN. BERNARD A. SCHRIEVER**

Commander, Air Force Systems Command  
Andrews Air Force Base, Md.





"There is a great and immediate need for improved technology in limited war activity. In many areas we are already late."



"We sometimes neglect military technology advancement, misjudging capabilities and intentions of potential aggressors."

"Technology is not standing still. New systems will always be developed based on new technology, new requirements."



"The Soviets are fully aware of the importance of technology in their drive for world domination. Education is stressed."



"It would be a mistake to relax efforts in any area of technology. Space calls for our best thinking and best efforts."

to be anything but peaceful. As Chancellor Adenauer told the National Press Club last November, "When anybody talks to me about 'co-existence,' I think of Cuba."

Secondly, we know that the Soviets are fully aware of the importance of science and technology in their drive for world domination. They place great emphasis on technical education, and they reward their scientists and engineers with both pay and prestige.

Third, we know that the Soviets have made significant achievements in some aspects of space technology. They have shown clearly that they are aware of both the military and the psychological possibilities of space vehicles. In 1961, they launched Major Titov in a 17-orbit flight. Last summer they launched concurrent multi-orbital flights. We have yet to duplicate these two feats.

Consider those three factors—the basic Soviet hostility, their emphasis on technology and education, and their achievements in space. It would be a mistake to relax our efforts in any area of technology.

## NATIONAL SECURITY (Continued)

Space is certainly one area that calls for our best thinking and our best efforts.

### New Environments—Many Problems

Space activities pose many problems for our technology today. We will be operating in a completely new environment that has many unique characteristics. For instance the hard vacuum of space, radiation, and extreme changes in temperature affect the properties of many materials. New materials must be developed to withstand these conditions for prolonged periods of space flight.

All space systems demand an extremely high standard of reliability. In most cases normal maintenance will be extremely difficult, if not impossible. Limitations on payloads weights will make it difficult to provide adequate spare parts or to compensate for failures through redundancy. The reliability problem is complicated by the fact that space systems will be operating in new and largely unknown environments at progressively greater distances from the earth.

Many requirements apply equally to military and civilian aspects of the national space program. But for military space operations, there will be several unique requirements. These include the capability for fast reaction and repeated operations, the ability to conduct missions at times and places dictated by mission objectives, and the capability to inspect uncooperative objects in space. Other needs are the ability to survive in a hostile environment, and in general, the same kind of flexibility we have in present aerospace operations.

### Specific Electronics Needs

In addition, there are specific military requirements in electronics. One of these is for reliable and secure communications systems between the earth and points in space, and between two or more points in space. These systems should be able to function during natural or man-made interference.

Extensive development is needed in this area to meet the unique requirements of the space environment.

Space communications systems may need to make use of infrared and visible light frequencies in order to provide high-volume capacity and high reliability over long distances. We must continue to explore the possibility of new ways to transmit energy and signals in space.

We will need systems that are capable of detecting, tracking, identifying, and cataloging all space traffic.

These may include new ground-based radars, which could be supplemented later by satellite-borne instruments. This is an area in which many technical advances are needed.

As space operations increase, another function will be needed. This is a system for programming and controlling launch, flight, and recovery operations through special electronic facilities. At the heart of the system would be a central control facility that would program the re-entry flight paths for space vehicles. It would be fed data continuously by tracking stations and would use computers on the ground and in the vehicles to insure that ground and air control systems were perfectly synchronized.

### Special Weapons Controls

We may also need a special space weapon control system, integrated with other space systems. Such a system would analyze and evaluate vast amounts of information, in somewhat the same manner as SAC and NORAD Operations Centers now use information fed to them by the Ballistic Missile Early Warning Systems (BMEWS) and the Space Detection and Tracking System (SPADATS). This control system would play a key role in our defense against possible aggression which might be launched through space.

Our needs are equally great in other areas. In spite of the great potential in ballistic missile and space technology, we have no intention of neglecting developments in aerodynamic flight. In terms of technical feasibility, military aircraft definitely have a future. During the next ten years it will be possible to provide significant improvements in aircraft range, speed, and versatility. Development and use of boundary layer control, improved engine inlet designs, and advanced combustion technology are all feasible in this period.

A great variety of advanced aircraft types, including conventional design, V/STOL, variable geometry, and paraglider configurations, could afford many new mission capabilities. That such aircraft may be feasible does not guarantee their development, but at least there seem to be no technical barriers. These advanced aircraft can be developed if they are needed to meet military requirements.

### Limited War Technology

There is also a great and immediate need for improved technology in limited war and counterinsurgency operations. In a number of areas we are already late. We need methods of finding people from the air when they are hidden by jungle cover. We need weapons that are effective through trees and brush.

There are logistic problems, such as the need to pinpoint drop zones securely and deliver material to the exact spot.

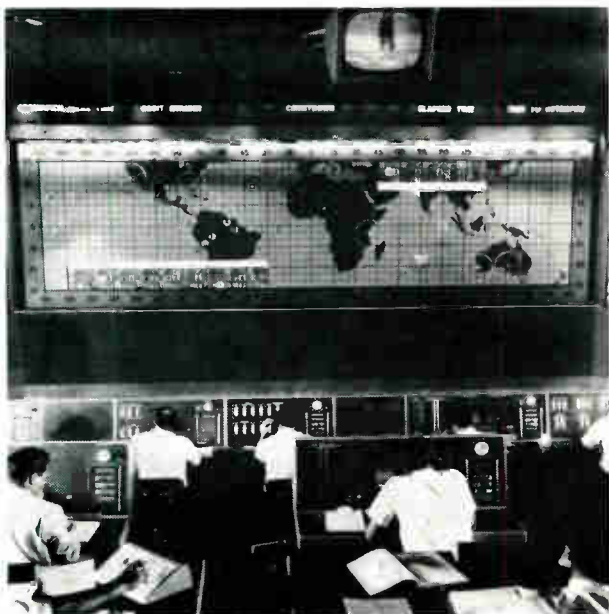
We would also like to have a practical means of securing large areas from the air, particularly at night, so that we can detect the movement of troops and preferably be able to tag them for identification. In addition, we need to improve command and control systems required in these types of operations.

Our nation has sometimes tended to neglect the advancement of military technology. We have been guided by our own peaceful intentions and have either misjudged or ignored the intentions and capabilities of potential aggressors. We can no longer afford this. If the Soviets should attain a commanding lead in military technology, we might have little chance of catching up.

In recent years, we have been surprised more than once by Soviet technical achievements.

We must not underestimate the capabilities of Soviet technology. It is equally important that we do not underestimate our own capabilities. We have vast natural resources, a broad and diversified industrial base, and an immense pool of scientific talent and experience. In all of these we are far more than a match for the Soviets. We must use all these capabilities wisely, and continue to stimulate the advance of technology in operational systems.

"There are specific military requirements in space electronics. One is for reliable and secure communications systems between earth and space, and between points in space. They should be able to function during natural or man-made interference."



## Air Force Strengthening Labs

The Air Force is making a maximum effort to strengthen its in-house laboratories, an important source for the initiation and evaluation of new technical efforts. Through the Research and Technology Division of the Air Force Systems Command, formed in July, 1962, the direction of Air Force applied research effort is being improved and centralized. Applied research and advanced technology programs will be compiled in seven major areas: electromagnetics, rocket propulsion, flight dynamics, aero propulsion, avionics, weapons, and materials. The laboratories working in these seven areas will be the principal Air Force points of contact with other government agencies and with industry.

The Air Force will continue to look to industry as a primary source of new ideas and proposals. The imagination, initiative, and creative efforts of American industry are vital to the direction and rate of technological progress. That technological progress, in turn, may play a determining role in our future.

Our opponents are confident they can use technology to destroy freedom and spread their system throughout the world. We must be dedicated to the use of technology to defend freedom wherever it is attacked. I am convinced that we have both the resources and the dedication to meet the challenge that confronts us.





While some designers envision a distant "ideal circuit," industry finds that it cannot wait. Custom circuits is the trend, and engineers have their choice of three approaches in microcircuit design, each with its own advantages. There are too many innovations and requirements in circuitry; the search for the "ideal" may be an endless one, and the author presents reasons why.

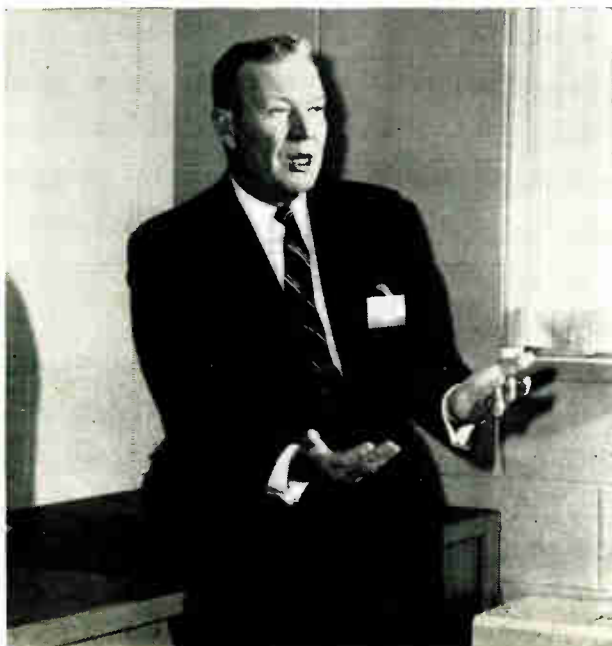
# MICROELECTRONICS: IN SEARCH OF THE IDEAL CIRCUIT

THE WORD "MICROELECTRONICS" conjures different images to many of us associated with the electronics industry. These images are so diverse that this word, and its associated term "integrated circuits," are good words to start a controversial discussion whenever electronics people, in industry or in government, get together.

About a year ago, I pointed out that the new concepts in circuit fabrication that have stimulated this widespread interest represent not a revolution but a continuing evolution of electronic technology in its search for the ideal circuit. This ideal circuit will occupy virtually no space, cost practically nothing, and be readily available to perform a wide variety of functions with almost perfect reliability.

In the ensuing year this evolution has proceeded apace, but despite rapid gains in technical knowledge

"At this time, the trend seems definitely toward custom circuits . . . the day of standardized, off-the-shelf "ideal" circuits will be a long time coming, if ever," says Bob Sprague.



and skill in applying new techniques, the ideal circuit remains largely a vision of the future. This is not to say, however, that the effort has been in vain. Good progress has been made: microelectronic techniques are on the verge of providing the designer with a powerful tool in the further miniaturization of his circuits.

## Microelectronics Has Advantages

A variety of advantages are usually cited for microelectronics, and in using the term here I include both microcircuits and microcomponent assemblies. I am aware that in talking about microelectronics, some people exclude microcomponent assemblies on the ground that they do not employ "integral" processing techniques. However, there are today, and in all probability will continue to be, many applications in which microassemblies of miniaturized components in disciplined geometries offer significant advantages. It seems to me, therefore, that the frequent use of the phrase "integrated circuits" as a synonym for microelectronics is both inaccurate and misleading.

Regardless of terminology, the microelectronics field appears to be settling down into three general circuit design approaches which often appear to be competitive, but which will probably prove in the long run to be more complementary than competitive.

At this time the two major microelectronic circuits receiving industry attention are semiconductor-substrate microcircuits, and passive-substrate, thin-film hybrid circuits. The latter are called "hybrid" because they employ discrete active devices, which can not easily be made by thin-film methods in today's state of the art.

By **ROBERT C. SPRAGUE**

Chairman and Chief Executive Officer  
Sprague Electric Company  
North Adams, Mass.



## Use of Discrete Components

A third approach is miniaturized discrete components in a variety of packaging schemes of which the cordwood, "swiss cheese" substrate, and the Micro-Module are the best known. Let us look briefly at these three approaches in terms of the advantages usually claimed for microelectronics—size, cost, versatility, and reliability. Each of the three design approaches excels in one or more advantages but there is no solid evidence that any one excels in all.

As to reductions in size and weight, the development of semiconductor integrated circuits has already progressed to the point where it seems safe to say that this type makes possible the smallest electronic circuits which are likely to be made by any technique in the future. As for costs, these have been coming down, which would be expected as technical competence is gained by companies, including my own, who have extensive development efforts underway on silicon-based integrated microcircuits.

Thus, there is reason to be optimistic that the cost of these devices, when produced in substantial quantities, will ultimately be competitive with circuits assembled by any other means. There is, however, one important qualification to be kept in mind. Namely, costs become favorable only after sizable initial tooling charges have been absorbed.

### Moderate Supply—Premium Cost

Companies interested in moderate quantities of non-standard modules are now beginning to realize that a substantial premium must be paid to have their circuits transformed into semiconductor integrated circuits; quotations ranging from \$5,000 for the simplest circuits up to \$30,000 where moderate amounts of development work are required are not unusual.

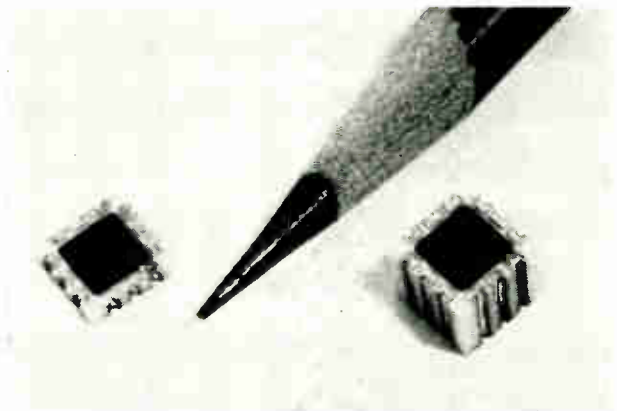
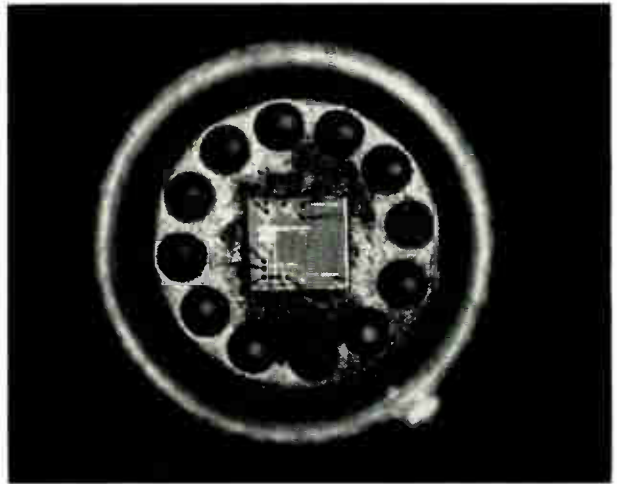
Whether these changes are absorbed by the producer or the user makes little difference. In either case, they are bound to affect the price of the circuits for any but very large quantities of identical circuits.

As to versatility, pure diffused semiconductor-based circuits still suffer from severe limitations on component types and tolerances. Active devices can be produced with relative ease, and diffused resistors are practical within certain limits of temperature coefficients. Large values of capacitance are very difficult to produce, and inductances virtually impossible.

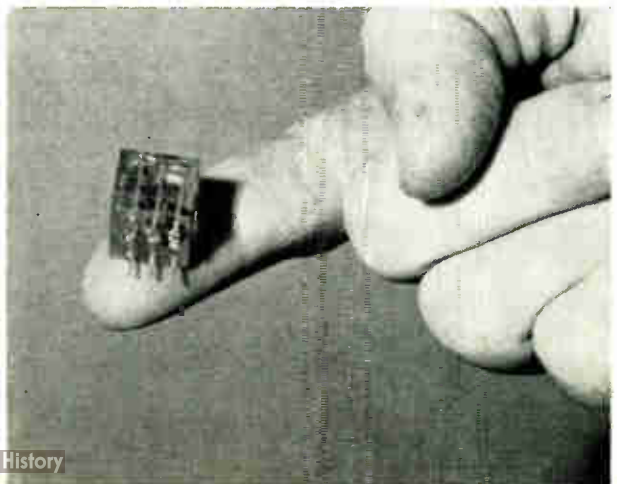
For these reasons, presently available devices are suitable in the main for digital circuits. These are undoubtedly a very important class of circuit, but they can not perform all of the critical functions in



"The two major microelectronic circuits receiving attention from industry at this time are semiconductor-substrate circuits (below), passive-substrate, thin-film hybrids (above)."



"Another approach is miniature discrete components in varied packaging schemes of which the cordwood "swiss cheese" substrate (below) and micro-modules (above) are the best known."



## MICROELECTRONICS (Continued)

either military or commercial electronic systems, or else can perform them only at the sacrifice of efficiency. However, thin-film components deposited on the silicon-chip surfaces promise increased versatility for diffused-base semiconductor surfaces.

### Reduced Power Advantage

It is often said that in addition to size and weight reductions, semiconductor integrated circuits offer the advantage of reduced power consumption. This is a relative matter. When compared to the numerous transistorized circuits which operate in the 100-500 milliwatt power range, an integrated circuit operating at 5 milliwatts does have considerable advantage.

For some applications, however, where their small size would otherwise strongly recommend them, they are at an equally serious disadvantage. For example, digital logic circuits assembled from discrete components for NASA typically operate at a power drain of less than 1 milliwatt and some at less than 0.1 milliwatt. Thus, there is something like a 5-to-1 advantage in favor of discrete components for these critical applications.

I am told that NASA ranks size but third after reliability and power consumption in evaluating circuit techniques.

### Thin-Film Hybrid Circuits

Before turning to reliability, let us look at thin-film hybrid circuits. Thin layers of metal are deposited by various means on an insulating substrate to comprise most of the passive elements of the circuit, including more precise values of resistance and larger capacitance values than are attainable with semiconductor-based circuits.

In the thin-film circuits presently being manufactured, uncased semiconductor elements are usually

inlaid in recesses in the substrate. This present production inability to fabricate active elements using thin-film techniques is the only thing which prevents these devices from being true integrated circuits.

Thin-film hybrid circuits also are not capable of the extremes of size reduction possible with semiconductor microcircuits, and it appears unlikely that they will ever be entirely competitive in this respect.

### Greater Design Freedom

Nevertheless, I believe thin-film circuits will play a somewhat more important role, for some years at least, than they have generally been credited with. For one thing, they allow the designer greater freedom in balancing circuit values to produce highly precise circuits, including a number in the important linear class as well as the digital class.

It also seems possible that the closer control of tolerances which they afford will enable them to more closely approximate the very low power levels for which it is possible to design circuits with conventional discrete components. As to cost, while they may not be as economical in the long run in very large quantity production, they will probably be available at a significantly lower cost for many short-run to medium-run applications, where high initial design and tooling costs work against the semiconductor microcircuit.

Although I am inclined to agree with prevalent estimates that in the long run the volume of semiconductor circuits will be considerably greater than for thin-film circuits, I nevertheless believe the latter have been underestimated by many. After all, there is no magic in the use of integrated techniques, and there seems to be an increasingly widespread recognition among users that thin-film hybrids have a great deal to offer in the proper place.

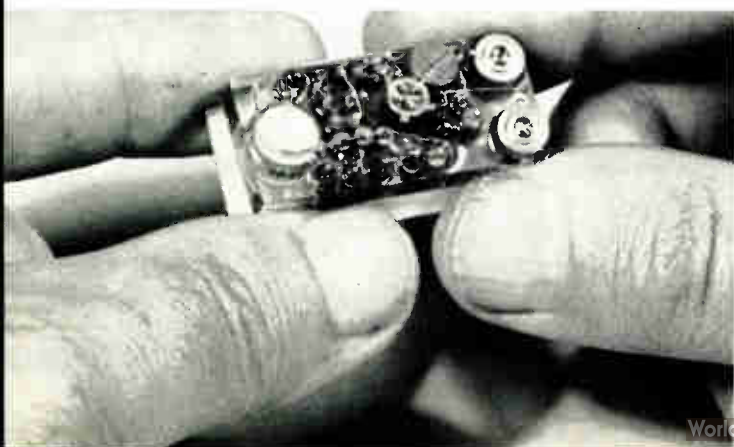
For the longer term, it seems possible, even probable, that semiconductor and thin-film circuits may be used side by side in "hybrid-hybrid" circuits which take advantage of the strong points of both.

### The Question of Reliability

Turning now to reliability, the first few equipments made in substantial quantities from semiconductor-based microcircuits are yet to be built. The tens of millions of unit hours of life test to prove their reliability are yet to be clocked off. Much improvement in reliability claimed for these circuits is based on the reduction of the number of internal connections they make possible, and indeed it seems probable that this may turn out to be a major advantage.

It would be dangerous, however, to rely on this reliability until it is proved by statistically valid tests,

Ultra-high component density semiconductor logic module has honeycomb body, inserted components, and welded connections.



and there are as yet unresolved questions as to what constitutes such tests.

Reliability expectations for thin-film circuits are also good, and because they have already been in regular production for a number of years, more complete field data are available today for the less complicated of such devices than for the semiconductor microcircuits.

Thus, I believe that for the present the thin films have the edge in proven reliability. For the longer term, with more development work and extensive testing, both types will probably prove to be capable of sufficiently high reliability to meet virtually any practical requirement.

### Can't Wait for Ideal Circuit

From the standpoint of versatility and proven reliability, no microcircuit can yet equal the assemblies of discrete microcomponents, including the many new form factors available today to the systems designer who can not wait for the ideal microcircuit to come along. Where extreme miniaturization is not necessary, they offer great flexibility and a much wider range of circuit values than are attainable with microelectronic circuits.

Millions of miniaturized assemblies have been in operation long enough to demonstrate that very high orders of reliability are possible with them. A trip around the recent IEEE Show revealed the wide variety of discrete components available for microassemblies. With initial tooling costs even lower than for thin-film circuits, it seems entirely possible that for many applications, especially in commercial and industrial electronics, microassemblies will continue to be used in growing volume for many years to come.

In using this approach, the designer of equipment will find that if he chooses carefully the proper components, from suppliers who have technical competence, production capability and quality integrity, that his equipment will be functioning on schedule and with impressive reliability.

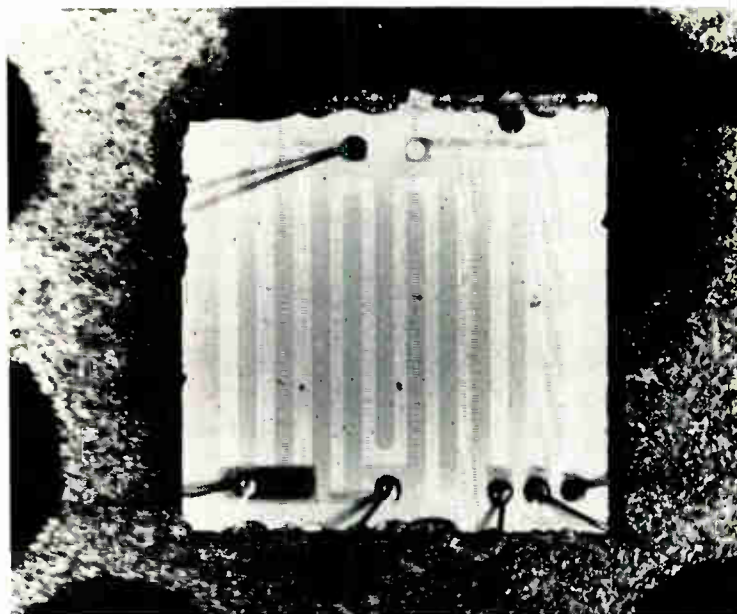
### Choice Up to Designer

Which of these approaches or combinations of them the designer should use in quest for the ideal circuit is up to him. The choice will surely be wide enough that he need concern himself less with the possible surrender of his prerogatives as a designer, than with the difficult task of evaluating the alternatives from the standpoint of his overall objectives of availability, cost and proven reliability.

My own company, Sprague Electric, has intensive development work underway in all three major types of microelectronic circuits, and is a major producer



Hybrid microcircuit (above) on a transistor includes silicon epitaxial planar transistor bridge-mounted on pins and silicon chip with 5 thin-film resistors fixed to header (below).



of microcomponents and assemblies, as well as of thin-film circuits. I do not pretend to know which of these approaches, or perhaps others not yet developed, will be the most widely used in the long run.

One thing which seems to be increasingly clear is that the manufacturer of electronic systems will not be content to assemble his products from a relatively small number of stock microcircuits, whether made by outside suppliers or by his own in-house facilities.

There is still too much room for circuit innovation and too much of a proprietary nature at stake for the systems designer to make such an outcome likely.

At this time, the trend seems definitely to be toward custom circuits, which is perhaps another way of saying that the day of the standardized off-the-shelf "ideal circuit" will be a long time in coming, if ever.



## PREDICTIONS (Continued)

have been expedited by Government-financed R&D aimed at military and space objectives.

The industrial market, like the industries which serve it, covers a wide diversity of products. Computers, communications equipment, navigation aids, test equipment, and closed circuit television are perhaps the best known, there are many more. The EIA Marketing Service Department estimates that more than 2,000 companies produced a thousand different types of industrial-commercial electronic products in 1962.

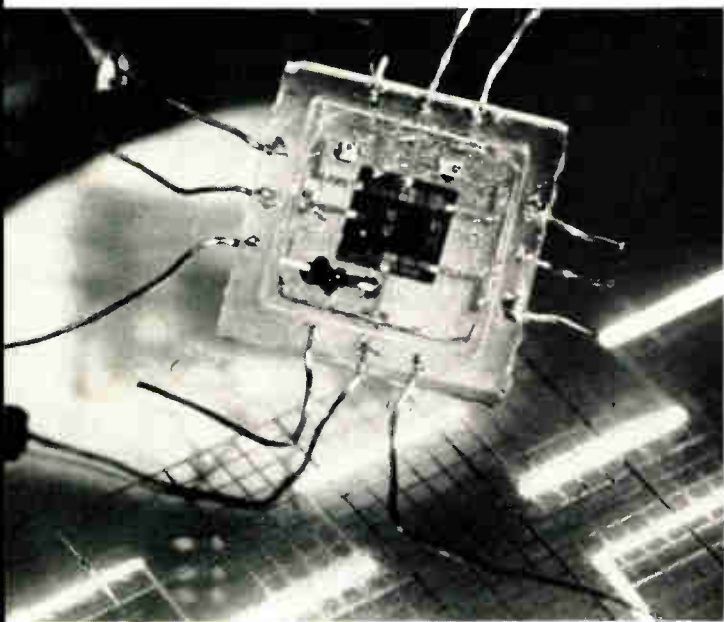
One of the chief attractions of electronic devices to industry and commerce is their promise of cost cutting and the speeding of production processes. While many electronic devices are initially very expensive, they open the way for cost-cutting automation techniques which more than offset original investment.

The electronic components industry has grown with the equipment markets, as might be expected, but it also has been forced to change as the complexity and sophistication of end products have increased. It also is the electronic area most likely to undergo even more drastic transformations.

### Micro-Miniaturization One Reason

One reason for the expected changes may be found in the remarkable technological developments of micro-miniature components and integrated circuitry. By combining the functions of many standard components into one consolidated device with resulting economies in space requirements, these new compo-

"Microelectronics will make possible within a few years many consumer products once a dream of science-fiction writers."



nents are understandingly attractive to equipment manufacturers.

Microelectronics, or micro-miniaturization processes will surely make possible within the next few years numerous consumer products that were once a mere glint in the eyes of science fiction story-tellers.

The EIA Marketing Services Department and the Engineering Department are both engaged in activities designed to define and standardize this new electronic component market. The former estimates that by 1965 about 10% of the dollar value of component sales will be in this category.

Many parts and semiconductor manufacturers are in microelectronic research from which a new component market may be developing. While some persons see this development as a threat to existing parts manufacturers, I believe that it rather represents a challenge which will be accepted by the more alert and resourceful component producers. It also would appear that most of today's standard components will be in demand for some years to come.

The dollar volume of electronic components in 1962 exceeded \$3.5 billion and is expected to reach \$3.7 billion in 1963. Transistor sales have increased in unit production but declined in dollar volume due to intense competition among the large number of producers. Total semiconductor output rose \$63 million in 1962 to reach \$628 million and is expected to approach \$780 million in 1963.

### Component Sales Increases

Receiving and picture tube sales declined in 1962, while special purpose tubes—used heavily in military and space programs—rose 14% to \$325 million. All other parts sales rose about \$200 million to \$2.3 billion in 1962 and are expected to increase to at least \$2.4 billion in 1963.

With so many encouraging sales reports, it would appear that the electronic industries have few problems and need have no apprehension about their future.

Unfortunately, this is not true.

While I have no doubts as to the economic soundness of the electronic industries and their prospects for continuing growth, I am concerned over the following: (1) declining profits and increasing costs, particularly in Government business; and (2) increasing competition of imports, especially from Japan, and their effect on the consumer industry.

The EIA, by providing a national forum for these industries, offers a mechanism for solving some of these problems by means of a united attack on them. It must be admitted, however, that the Government probably holds the trump card. (Continued on B18)



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## PREDICTIONS (Concluded)

### Gov't Relies on Industries

The Government's progress in the space race, as well as maintenance of its dominant position in national defense, is dependent on the ability of the industries.

The electronic industries have a creditable record in meeting U. S. requirements and hope to continue. But they will be severely handicapped if they can't make reasonable profits for stockholders and capitalize on their technical ingenuity. No one will gain if the Government supplier is denied free enterprise benefits.

The extent of foreign competition in the domestic electronic market also is a problem. The electronic industries, especially component manufacturers, are learning to meet this competition in some cases by concentrating on technical advances. But American manufacturers often find themselves on a treadmill—running just to stay where they are in the domestic market.

EIA has never followed a "protectionist" policy in international trade. In fact, the electronic industries benefit from increasing exports and hope to make further gains from contemplated negotiations under the Trade Expansion Act.

### Exports May Hit \$975 Million

The Department of Commerce has reported that the total value of U. S. exports of electronic systems, equipment, and components may reach \$975 million

"It is universally conceded that the industrial commercial markets offer the greatest growth potential for electronics."



"Defense Department will concentrate on building up capacity for limited war. Program needs rely heavily on electronics."



in 1963 compared with \$765 million in 1962 and \$613 million in 1961. However, it candidly admits that "imports of these products are rising even faster: \$179 million in 1961, \$275 million in 1962, and an estimated \$340 million in 1963."

A factor that Congress and the Executive Establishments should not overlook in their comparisons of exports and imports is that the larger diversified company usually benefits most from exports and suffers least from imports, while the smaller manufacturer is the first victim of the invading importer because of his inability to shift his marketing emphasis. This effect would seem to run contrary to the American pattern under which the smallest business organization has an opportunity to become larger.

Yet, despite these and other problems, the electronic industries are firmly established in the national economy and will continue to grow with it if not ahead of it. These markets—both civilian and Government—are certain to grow as new uses for electronic techniques develop.

The contributions of the electronic industries to national defense are widely recognized. Their increasingly important role in space exploration is becoming more apparent as the nation's program expands.

Electronic engineers, manufacturers and workers will all help to put our astronauts on the moon and other points in outer space. And yet, many examples of new products and industrial processes—spin-off benefits—for the consumer market can be traced directly to some part of our massive aerospace and defense effort.

The time may not be too far distant when electronic technology will perform many current jobs. Electronic developments could range from devices that would design and build other electronic devices—such as computers and picture-frame TV sets—to the simple task of shopping for groceries through community-wide automation.

The greatest days of the electronic industries are still ahead.

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the manual feed for medium size runs, and the automatic feed for high volume production runs. There are no operator adjustments — ever! Buchanan tools are available for electrical, electronic and mechanical applications to meet various military specs . . .

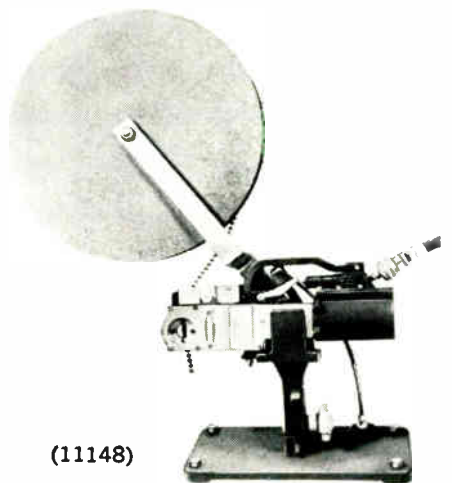


(MS 3191-A)

## CYCLE-CONTROLLED HAND TOOL

This one tool and inexpensive positioners can crimp almost any proprietary or MIL-Spec contact — in wire sizes from #12 thru #30. By selecting the positioner, you program the tool to provide crimp depth, crimp location, and point of ratchet release. And there are no operator adjustments. Meets all requirements of MIL-T-22520A, Class I.

Write today for catalog and the new manual on crimping pin and socket connectors.



(11148)

## CYCLE-CONTROLLED AUTOMATIC FEED TOOL Portable or Bench Mounted

The speed of this automatic feed tool is limited only by the operator's ability to insert contacts and wires. There are no operator adjustments. Tool automatically feeds contacts in disposable, inexpensive carriers. Carriers can be modified to accommodate almost any contact size thru #30 (also protect contacts from mechanical damage). Tool meets performance requirements of MIL-T-22520A.

In bench mounted units (shown above) carriers in reel hold up to 2000 contacts. Crimp depth is automatically controlled by interchangeable snap-in blocks. Tool accommodates foot valve control.

This tool can be used for portable application. Carriers in self-positioning "see-thru" magazine hold up to 102 contacts. The magazine automatically selects the proper crimp depth.



(10967)

## CYCLE-CONTROLLED MANUAL FEED TOOL

This pneumatic tool and associated types can accommodate most contacts #12 thru #30, screw machine and stamped. Crimp depth can be adjusted by qualified personnel for a specific job. Speed is limited only by operator's ability to operate contacts and wires. Replaceable inexpensive contact locator properly positions crimp on contacts and can be drilled to accommodate specific contact sizes and types. Indenter configuration conforms to MS-3191 Geometry. Meets performance requirements of MIL-T-22520A.



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# NEW TECH DATA

for Engineers.

## Portable Standards

"Weston Portable Standards," a 12-page brochure which describes in detail a line of light-beam portable wattmeter, ammeter and voltmeter standards, is available. Complete specs., photos, schematics, cross-section views, etc., are provided. Specs. include accuracies and ranges of the various instrument models and descriptions of accessories which are available for special measurement requirements. Weston Instruments and Electronics Div., Daystrom, Inc., 614 Frelinghuysen Ave., Newark 14, N. J.

Circle 609 on Inquiry Card

## Differential Pressure Cell

Bulletin PD-4381 gives data on Type MM differential pressure cell for aerospace wind-tunnel research. Cell is a low-capacity, low-line, bellows unit to measure static and low-freq. differential, absolute or gauge pressures of gases. Bulletin illustrates unit, including a dimensional drawing, describes features, specs., dynamic characteristics and prices for available capacities from 5 through 100 $\mu$ st. Electronics Div., Baldwin-Lima-Hamilton Corp., 42 4th Ave., Waltham 54, Mass.

Circle 610 on Inquiry Card

## Program Timers

Cramer types 511 and 521 field-adjustable program timers are described in a new bulletin. Complete specs., operating description and schematics are included in the bulletin, describing the units, which are designed to control a series of operations in any desired sequence. Bulletin No. 511/521, Publications Dept., Cramer Div., Giannini Controls Corp., Old Saybrook, Conn.

Circle 611 on Inquiry Card

## P-Channel Transistor

The 2N2386 P-channel planar-diffused unipolar field-effect transistor is contained in a TO-5 package. Designed for low-cost industrial uses, it offers 1000 $\mu$ mho min.  $g_m$  and a typical pinch-off voltage of 4v. Applications include high-impedance voltmeters, operational amplifiers, sample and hold circuits, choppers, commutators, and other circuits requiring high-input impedance devices. Siliconix Inc., 1140 W. Evelyn Ave., Sunnyvale, Calif.

Circle 612 on Inquiry Card

## Pulse Height Analyzer

Tech. data is available on the 400-channel transistorized Model ST-400K pulse height analyzer. The Model ST-400K is tailored to fit restricted budget needs yet retain all the features needed for research uses. Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 613 on Inquiry Card

## Magnetic Field Regulator

Brochure describes new laboratory magnet systems featuring Fieldial<sup>®</sup> magnetic field regulator. With direct readout feature, any desired field intensity can be set and maintained in a magnet air gap without the need for more measuring equipment. Included are charts of tests made to show the improved sweep linearity of field-regulated magnet systems compared with ordinary current-regulated systems. Condensed product specs. are also included. Instrument Div., Varian Associates, 611 Hansen Way, Palo Alto 5, Calif.

Circle 614 on Inquiry Card

## Geophysical Instruments

Revised catalog on geophysical instruments describes, illustrates latest test gear in the line. Details are given on sensitive, rugged battery-operated ac microvoltmeters for resistivity surveys with base lines up to 5 miles long. All weather, battery-operated dc potentiometers without standard cells or suspension galvanometers are also shown. A complete line of accessories, including stakes, electrodes, and wire reels is described. Canadian Research Institute, 85 Curlew Dr., Don Mills, Ont., Canada.

Circle 615 on Inquiry Card

## Zener Diode Chart

A third edition of the zener reference publication which lists all types presently registered under EIA numbers is available. The publication lists specs., package dimensions and other pertinent information for all zener diode types. Request on company letterhead to Dickson Electronics Corp., 248 So. Wells Fargo, Scottsdale, Ariz.

## Integrated Circuits

The 8-page 2-color Condensed Catalog gives specs. of 26 Signetics integrated circuits 14 of them new. Also described are DTL elements; NAND/NOR gates, diodes and gates, power gates, binary elements, line drivers, 1-shot multivibrator, and several buffer circuits. Catalog has articles on Signetics' quality control and R&D programs. Signetics Corp., 680 W. Maude Ave., Sunnyvale, Calif.

Circle 617 on Inquiry Card

## Test Instruments

This 97-page catalog lists a line of sweeping oscillators, audio spectrum analyzers, noise generators, attenuators, oscillators, etc. Accompanying each component is a photo, description, specs., and price. Kay Electronic Co., Maple Ave., Pine Brook, Morris County, N. J.

Circle 618 on Inquiry Card

## Deep-Sea Testing

Comprehensive illustrated 20-page brochure describes the facilities and capabilities of Daystrom's Electric Div. in the development of deep-sea oceanographic instrumentation and in anti-submarine warfare work. Brochure describes the extensive background of Daystrom in research, oceanography, ASW, circuit techniques, component design, ordnance components, and electro-mechanical and mechanical systems. Many ordnance items are shown. Electric Div., Daystrom, Inc., Manchester Rd., Poughkeepsie, N. Y.

Circle 619 on Inquiry Card

## Transistor Guide

How to choose the best field-effect transistors for ac amplifiers is the theme of this bulletin. Included in this comprehensive article are schematics and equations that will help solve many problems encountered in amplifier design. Siliconix Inc., 1140 W. Evelyn Ave., Sunnyvale, Calif.

Circle 620 on Inquiry Card

## Transistorized Readouts

Two data sheets (270 and 292) describe 12 models of the Tec-Lite TNR Series transistorized readouts. They are designed to control Nixie tube numeral displays from signals down to 2v. Self-contained driver circuitry is packaged behind rectangular Nixie tube and allows mounting on 1 in. centers. Both sheets contain outline drawings, panel mounting hole dimensions and electrical and terminal connection diagrams. Applicable military and environmental data is also included. Tec-Lite Dept., Transistor Electronics Corp., Box 6191, Minneapolis 24, Minn.

Circle 621 on Inquiry Card

## Ceramic Capacitors

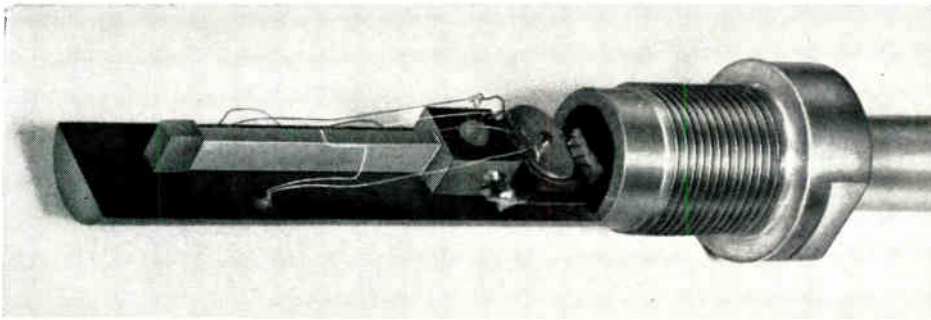
Data available on capacitors includes 36-page catalog on new fixed, ceramic dielectric dc capacitors, 47-page catalog on fixed, porcelain dielectric capacitors, separate photos of them, "Reliability Calculator," a facilities brochure and other information on the manufacturing firm. Vitramon, Inc., P.O. Box 544, Bridgeport, Conn.

Circle 622 on Inquiry Card

## Flame Detectors

A 12-page illustrated brochure, "Capabilities for Defense and Industry" is available from Pyrotec, Inc., Hingham, Mass. Brochure gives information on optical flame and smoke detectors for the aerospace industry, on commercial and industrial products, including home and industrial smoke detectors, battery chargers, emergency lights and marker beacons. It describes the concept of "putting light to work."

Circle 623 on Inquiry Card



An elegant, but tiny refrigerator, utilizing the Nernst-Ettingshausen effect, has been demonstrated in the Solid State Physics Laboratories at Lockheed Missiles & Space Company. This type of cooling is applicable below 200° Kelvin, where thermoelectric cooling is no longer efficient. It shows particular promise for space application because of the reliability inherent in its all-solid state construction.

In the Nernst-Ettingshausen effect, heat is pumped as a result of an electrical current flowing in a magnetic field. The heart of the present device is a bismuth antimony single crystal. Other crystal systems are also being investigated.

This thermomagnetic cooling device is one of the results of the Lockheed research program in transport phenomena in solids.

Another investigation concerns the quantum theory of the electronic structure of crystals. An ingenious computer program has been devised for determining the essential features of the energy band structure of a wide variety of crystals. Results for a given case can be obtained in an hour or less. Conclusions drawn from the theoretical solution elucidate many of the electronic properties of crystals, and have widespread significance.

Lockheed scientists and engineers are also studying: Electron spin echo phenomena; the interaction of electrons with microwave phonons; coupled traveling waves in crystals; semiconductor lasers; antiferromagnetic resonance; various theoretical and experimental aspects of superconductivity.

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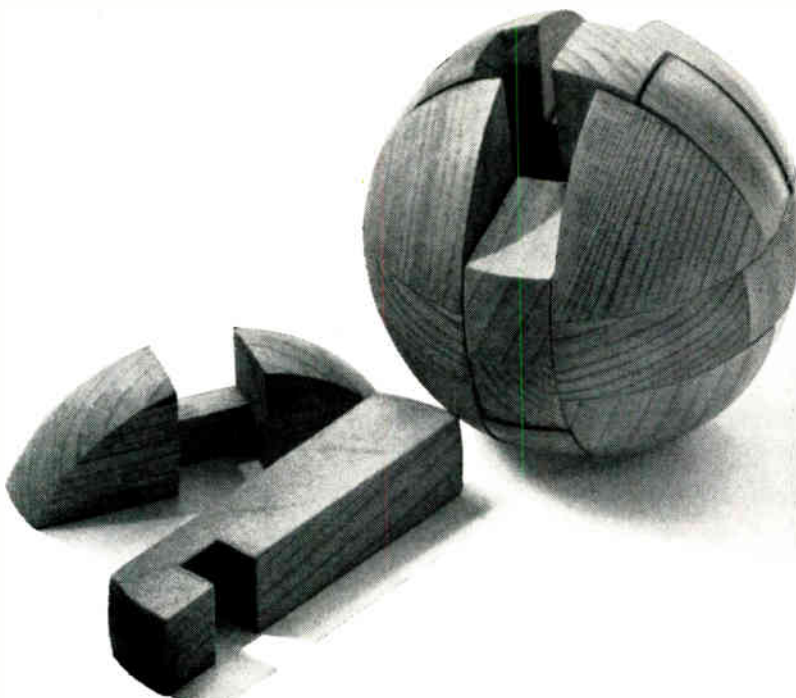
Then write for a brochure that gives you a more complete Look at Lockheed. Address: Research & Development Staff, Dept. M-45C, P.O. Box 504, Sunnyvale, California. Lockheed is an equal opportunity employer.

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# THE CLASSIFIED ENGINEER



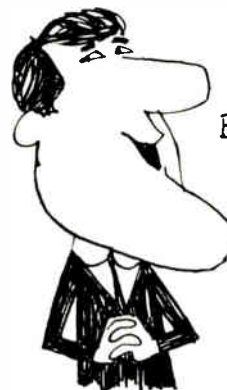
ACTUALLY, THE  
STORY OF MY CAREER  
AT HUGHES BORDERS  
ON THE FANTASTIC



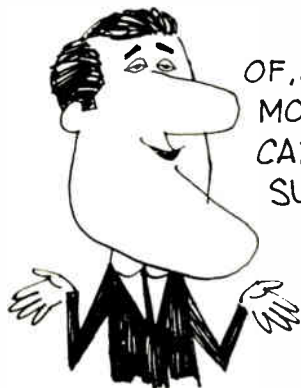
IN 1958, I WORKED  
ON THE [REDACTED]  
THE ONE THAT  
[REDACTED]



LAST YEAR, I WAS  
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ON [REDACTED] [REDACTED]



AND LARGELY  
BECAUSE OF ME,  
MANKIND WILL [REDACTED]  
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| <input type="checkbox"/> Differential Amplifiers        | <input type="checkbox"/> Controlled Avalanche Rectifiers | <input type="checkbox"/> High Power Diodes                  |
| <input type="checkbox"/> Video Amplifiers               | <input type="checkbox"/> Selenium Rectifiers & Stacks    | <input type="checkbox"/> Encapsulated Assemblies            |
| <input type="checkbox"/> Choppers                       | <input type="checkbox"/> Zener Diodes & Regulators       | <input type="checkbox"/> Special Products                   |
| <input type="checkbox"/> High Voltage Nixie Transistors | <input type="checkbox"/> Silicon Diodes                  | <input type="checkbox"/> Other _____                        |
| <input type="checkbox"/> Microdiodes                    | <input type="checkbox"/> Germanium Diodes                | _____   |

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| <input type="checkbox"/> Darlington Amplifiers          | <input type="checkbox"/> Silicon Controlled Rectifiers   | <input type="checkbox"/> UHF Mixer Diodes                   |
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| <input type="checkbox"/> Video Amplifiers               | <input type="checkbox"/> Selenium Rectifiers & Stacks    | <input type="checkbox"/> Encapsulated Assemblies            |
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# SECTION C

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## SEMICONDUCTORS & TUBES

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### Part One—Semiconductors

|                                     |     |
|-------------------------------------|-----|
| The Future of Integrated Circuits   | C2  |
| The Future of Semiconductor Devices | C6  |
| Trends in Semiconductor Research    | C12 |
| The Status of Microelectronics      | C18 |



Not since the introduction of transistors has the industry experienced an impact like that caused by integrated circuits. Although a relatively new art, integrated circuits have made startling advances in circuit miniaturization, and promise even greater advances in the future.

# THE FUTURE OF INTEGRATED CIRCUITS

IN ABOUT TWELVE YEARS, a revolutionary, brashly vigorous, new solid-state electronics technology has been developed. Only a few years ago the great transition from vacuum-tube circuitry to transistor circuitry was begun; and now, before we have fully digested the new approaches offered by transistors, electronic ceramics, and the other solid-state devices and materials, we find ourselves faced with additional changes wrought by the future widespread use of integrated circuits. Integrated circuits which use materials in *inseparable* association (as contrasted to interconnected components) form a radical departure from former fabrication techniques. This is a change from component orientation to materials orientation.

## Coordination

Heretofore, the circuit engineer's concern with materials was secondary. By blending theory and experience, they developed circuit configurations of interconnected components to perform the needed functions. Although a number of disciplines were involved in component preparation, they were developed independently by specialists who were not concerned with the daily problems of each circuit designer. Now, with integrated circuits, there is a coordination and synthesis problem. For each circuit we must include circuit theory, mathematics, physics, metallurgy, chemistry, electronics, semiconductor processing, thin-film processing, and photography. The successful development of integrated circuits requires a high level of intensely coordinated, sophisticated engineering; but much work must be done before the necessary levels of experience and maturity are reached. Although progress has been made in the fabrication of digital-logic integrated circuits, only a few of the estimated thirty functions performed in modern airborne electronic equipment subsystems can be done with mature, integrated-circuit modules. Although the use of integrated circuits will help support a continuing rise of electronic-systems complexity without approaching unacceptable reliability lim-

its, the sensational claims (however understandable) associated with the introduction of integrated circuits have exceeded the performance and the production-and-price availability of useful integrated-circuit components. These poorly timed claims are a natural result of the infection of marketing managers by enthusiastic engineers who have limited equipment experience. Eventually disciplined engineering approaches will fulfill the optimism and the amplification factor of the marketing managers. Digital-circuit logic components are rapidly approaching expectations.

There are three major steps which must be taken before we graduate from the highly promising but still experimental pattern of integrated-circuit technology.

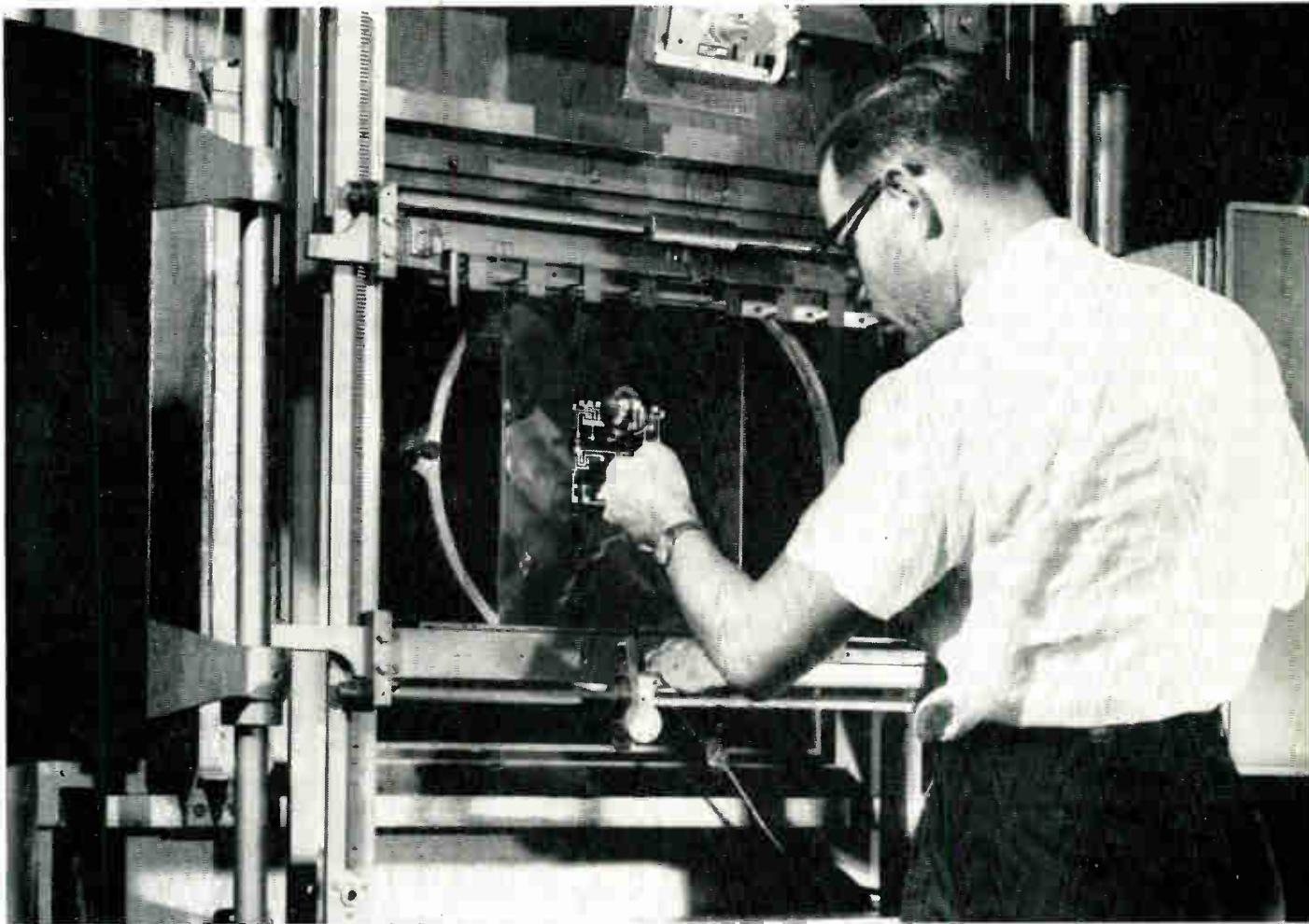
1. Integrated-circuit engineers must develop methods of eliminating, controlling, or compensating for the stray couplings which are frustratingly "integrated" in integrated circuits. These couplings are far more difficult to control than those associated with component circuitry.

2. There must be an effective merger of the skills of the experienced equipment engineers with those of semiconductor and integrated-circuit specialists. Operating integrated circuits have been produced under ideal laboratory conditions, but design maturity, which must include means for controlling reproducibility, circuit-element parameters, and environmental performance within acceptable specifications limits,



## By DANIEL E. NOBLE

Executive Vice President  
in Charge of Communications,  
Semiconductor, Solid State  
and Military Electronics Division,  
Motorola, Inc.  
5005 E. McDowell Ave.  
Phoenix 8, Ariz.



Fabrication is an important step in the manufacture of an integrated circuit. Here, a photomasking technique is inspected.

will be accomplished only when the integrated-circuit engineers and equipment systems specialists understand each others problems. Thus an exchange of ideas between the two groups is essential to progress.

3. Processing techniques must be developed that would allow fast circuit-parameters adjustments while the circuit is being developed. Processing must be refined to allow mass production of the prototype circuits at acceptable levels of yield within reasonable performance limits. Despite general optimism, the fact remains that the production of integrated circuits other than comparatively simple switching digital networks is costly and the yield is low. Extensive production experience must illuminate the major problem areas, and research must find practical solutions to the problems.

### Chips

The chipped semiconductor circuitry seems to be a practical, effective means for developing microelectronics, and it should provide a necessary and highly

desirable interim step leading from microelectronics to the final, single-chip integrated circuit form. With chips, the stray coupling problem can be minimized and individual component chips can be selected to meet component tolerances. The chips allow traditional component circuit design approaches, and it affords a means for gaining experience with equivalent resistance, capacitance and active elements in forms comparable with those to be used in the single-block integrated circuits. The path from chips to single-module "integrated" construction involves the solution of the stray couplings problem introduced by the "inseparable association." Chip circuits allow the exploration of patterns of reliability, reproducibility, and parameter control. Transistor cans provide protection and connection while the work on new packaging forms is progressing. While some digital circuits may progress without the intermediate step, the chipped approach can speed the evolution toward more and more single-chip or single-module analog integrated-circuit designs.

## INTEGRATED CIRCUITS (Continued)

When experienced equipment engineers get involved, the best of the available circuit approaches will be selected for use in optimum combinations. Equipment reliability, performance, reproducibility, and cost will be some of the guidelines for selection. There is no virtue in the use of "pure" integrated circuits if the equipment performance is not acceptable. During the transition period, mature integrated circuits should not be used in combination with immature integrated circuits to produce an overall inelegant solution. It is better to use a hybrid approach which uses the mature integrated circuits in association with conventional component circuitry. "Trade-offs" will always be necessary. It may be necessary to trade off tight performance specifications in favor of substantial improvements in reliability, size and weight reduction, and power requirements when many integrated circuits are used.

### Cooperation

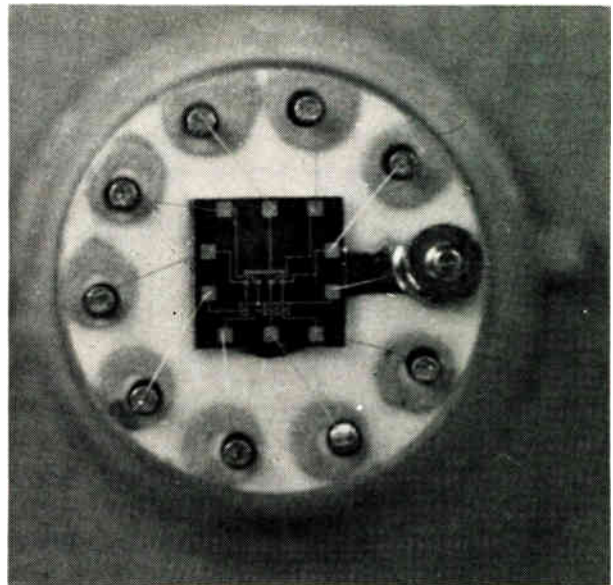
Progress in integrated-circuit applications needs, at this time, the joint, effective cooperative efforts of the integrated-circuit specialist and equipment engineers. Since most integrated-circuit specialists are isolated in thin-film or semiconductor research or development laboratories, and the equipment men are designing component configurations to satisfy their customers' needs, there exists a rather large gap which is not easily closed. Many equipment engineers are reluctant to use radically new components without extensive testing and knowledge about reliability, costs, and production availability. But adequate information in these categories will not be generated until the interaction between the equipment engineers and the integrated circuit designers is effective and continuous. The job cannot be done rapidly without the help of the equipment engineers. The rather slow process of developing and fabricating experimental integrated-circuit designs; the delays incurred in testing and modifying; and the slow interaction between equipment and integrated-circuit engineers when they are not in the same laboratory present barriers to rapid progress. We need only look at the ten or more years of transition from tube to transistor applications to understand the delays inherent in the change from transistor component circuitry to integrated circuitry.

### Conclusion

As is the case with most complex industry approaches, there will be several working solutions to

the total integrated-circuit problem. No doubt standard supplier-proprietary integrated circuits will be developed and sold to customers for use in equipment. It is also true that many equipment organizations will work closely with the integrated-circuit suppliers to custom design and develop the unique integrated circuits required. After the circuits are developed through the cooperative efforts of both groups of engineers, the production run of the customer-proprietary circuit will be accomplished under contract with the supplier. No doubt some preliminary circuit design work will be hastened by using either component circuit prototypes or chipped-up module circuitry to establish circuit performance parameters.

As the processing equipment is developed and the procedures approach an easily controlled automatic-equipment routine, the larger equipment manufacturers will use integrated-circuit laboratory equipment to develop their own prototypes. When these are finalized, the full specifications can then be passed



Advanced techniques can produce either digital circuits or, as shown by this high-frequency integrated amplifier, linear devices.

to the integrated-circuit supplier who will process the circuit for mass production.

Ultimately, some of the larger equipment manufacturers will equip themselves for both the circuit development and production of integrated-circuit modules, but the stage may not be reached until push-button processing equipment is marketed.

The final pattern will include all four approaches to integrated circuits: the sale of standard modules; the joint custom development of proprietary units which will be mass produced by the supplier; the equipment manufacturers in-house development of the integrated-circuit prototypes, which will then be



vended for mass production by the semiconductor manufacturer; and eventually the in-house development and production of integrated circuits by some of the larger equipment manufacturers.

During the next five years the industry will be concerned with the refinement of the diffusion, epitaxial growth, and thin-film processing techniques. The refinement of all processes will add new degrees of freedom to both the designs and control of integrated-circuit parameters.

If the art is to be speedily developed, integrated circuits must be used immediately in all possible practical equipment applications. The refinement of integrated-circuit technology is not only important to the continuing growth of the electronic industry, it is essential to the achievement of the necessary substantial reliability improvement for all military electronics equipment.

Massive engineering and quality-control efforts will cause every art to mature to an asymptotic relationship which, in the final analysis, yields only slight improvements in reliability or performance. This asymptotic relationship has been reached for traditional component circuitry in complex systems, and substantial efforts directed to quality-control improvements will produce only minor reliability improvements. When results of refinement of techniques are no longer significant, a *radical* change in the performance and reliability can be achieved only through a *radical* change in the art itself. For the electronic industry, this radical change appears to be the material-oriented integrated-circuit approach. Hopefully, this discontinuity or step function in the electronic-industry development curve may provide a new steep slope of potential advance before it levels off to its ultimate asymptotic relationship. Nevertheless, the integrated-circuit approach is the only promising "step-function" technique on the horizon, and if the problems of yield can be solved, the extrapolation of transistor experience promises that circuits produced will be both more reliable and less costly than those made by the traditional methods.

The next five years should produce a turmoil of activity in the industry which, hopefully, will yield practical and economical solutions to encourage the wide use of integrated-circuit modules in new equipment designs. In continuing this most important work we should not be pessimistic, but we should also avoid unwarranted high levels of optimism which confuse the realities of the reproducibility, production, and cost problems. We move faster when we accept the obvious need for the old reliable, successive approximation pattern of progress. No doubt integrated-circuitry technology will revolutionize the electronic industry; the only question is "when?"

## Some Views On . . .

### RELIABILITY

The reliability of all forms of microminimization depends greatly on the interconnections. The advantages that integrated circuits offer over all the other approaches is that there are fewer interconnecting wires. The great majority of the interconnections are achieved by using evaporated thin-aluminum films over the top of the circuit itself. These, in turn, become an integral part of the block and are completely stable. They adhere to the silicon-dioxide covering, and there appears to be no serious mode of failure of these aluminum interconnecting films except, of course, gross overload which could fuse them. The interconnections from the circuit to external components are usually made by conventional thermocompression bonding techniques. But again, these are so greatly reduced in number over the number that would be used if the circuit were assembled from conventional transistors and diodes, resistors and capacitors, that the probability of failure is correspondingly reduced.

### FABRICATION

One of the major problems in fabrication is the control of contamination and foreign material in the process itself. Another major problem in construction is the control of the diffusion processes. With the present diffusion techniques, there are many variables in the process. Therefore the control of as many of these variables as possible is essential. Photo masking is another area of concern. Accurate photo-masking processes and techniques are required to eliminate variations in the components that can be produced by variations in the photographic masks or in the way they're applied.

A prevalent problem is the design of the components. Here the circuit designer must be familiar with the process, diffusion, the masking and the assembly processes in order to better design a circuit that is compatible with the process. A close relationship between the circuit-design group and the process group will encourage a lot of cross training and education in both groups.

The semiconductor industry has grown from an annual business of a few million dollars to one of nearly half a billion dollars in less than a decade. This article discusses the technological revolution in the semiconductor field which brought about this rapid growth. It covers the present status of this technology and tries to forecast the near future.

# THE FUTURE OF SEMICONDUCTOR DEVICES

TODAY, THERE ARE TWO DIVERGENT TRENDS in semiconductors. One is the rapid change in certain areas [e.g., high-speed silicon ( $S_i$ ) transistors for switching]. The other is the ability of many of the oldest devices to hold on tenaciously. Even the point-contact transistor is still being used in certain equipments (but not in modern designs). In this case, cost of re-engineering to adapt newer types cannot be justified.

This same pattern of long use life is true for  $S_i$  grown-junction and germanium ( $G_e$ ) alloy-junction transistors. These types are built into a wide range of both military and commercial equipment. As long as these equipments are made, a market will exist, even though both types are technically obsolete by today's standards. In both cases, it is hard to substitute a more modern type directly without a good deal of redesign. In the case of the  $G_e$  alloy types there are other factors. These types have reached peaks of refinement in characteristics and reliability. Circuit designers know what to expect from them under every operating condition. Also, many circuits have been developed whose performance and reliability have been proven over the years. Where speed or frequency is not a factor, the  $G_e$  alloy transistor will continue to be used for years to come.

## Low-Power Transistors

In the area of low-power transistors having frequency responses greater than 5 or 10  $\mu$ c, the situation is more fluid. In  $G_e$  the first attempt to provide a low-power r-f device consisted of the so-called micro-alloy types. In this approach the base width is carefully controlled to obtain a narrow base width and, thus, an h-f response. The micro-alloy type was for a long time the only h-f transistor available, but it is now nearly obsolete.

**Drift Types:** Development of drift transistors was the next step towards higher frequencies. This

approach uses a graded region in the base just below the emitter, plus an intrinsic region near the collector. For use as an amplifier, where low output capacitances and low base resistance are needed, the resultant characteristics are nearly ideal. If the drift approach is combined with that of the micro-alloy types, the resultant micro-alloy diffused transistor (MADT) is useful as an amplifier up to frequencies in the gc range. For a period these types dominated the h-f and the high-speed switching fields. They will probably continue to be widely used in many entertainment and commercial equipments at frequencies in the low  $\mu$ c range. However, for fast switching and for very high frequencies they are being superseded by mesa and planar types. Smaller geometries can be used in mesa or planar transistors without serious sacrifice of power capability and mechanical reliability. Recent advances in mesa and planar methods, particularly the use of epitaxial material, permit these types to compete both technically and economically with the MADT in all respects.

**Mesa Transistors:** Mesa transistors differ from alloy and alloy-drift types in that the starting material is the collector rather than the base. The base of the mesa is diffused into the collector, and the emitter is either diffused or alloyed into the base. A mesa is then etched to reduce the collector area at the base-collector region.

The mesa structure has several advantages. The base width can be closely controlled, especially when shallow emitter alloying or emitter diffusion is used. With this narrow base width, there is no loss of mechanical strength or power dissipation, as in the

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MADT. The diffused base-collector junction allows a higher voltage breakdown with a given collector resistance. This feature has made the mesa method invaluable in making high-voltage transistors.

There are, however, some drawbacks. Because of the need for a base contact, the collector capacitance is larger than that of an MADT having the same emitter size. Also, the collector thickness needed for mechanical handling produces a voltage drop across the collector and increases the stored charge in saturation. However, recent developments have made the mesa transistor competitive with the MADT in every way and have placed it in a power and reliability class by itself.

**Geometry Control of Mesas:** Some of the geometry control that permits the collector area and capacitance to be reduced has been done by brute force. The alloyed dots have been made smaller for mesas that use alloyed emitters and base contacts. Because the mesa has no lineup problem between the emitter and collector dot, dot sizes are limited only by the need for making contacts to them. Present limits for dot diameters are 3 or 4 mils. The mesas are etched right to the edge of these dots to keep the collector capacitance to a minimum. Mesa types having gains up to 20 db at 200 mc have been made for amplifier uses. Further advances are being pursued by the possible use of smaller dots.

With special methods such as that of "split dots," transistors have been made with useful gains at 800 mc. Because of the low-cost possibilities, alloy-dot mesas will continue to have commercial use. This type has had even wider acceptance in the European market.

Mesas using evaporated emitters and base contacts are limited in area only by the lead-attachment problem. Emitters as small as 1 by 2 mils are possible when 1/2-mil connector wires are used. These mesas provide gains of 20 db at 200 mc. Laboratory units with small areas have shown much gain in the gc region. These types are being used in two areas—amplifiers at UHF's, and high-speed switches. They are the most popular types for high-speed computers. However, in the future they will receive strong competition from  $S_1$  planar types.

**Double Diffusion:** A more elegant method of controlling base and emitter areas is by masking and double diffusion. To date, this method has been carried further with  $S_1$  than with  $G_e$ . The oxide deposit formed by heating  $S_1$  to a high temperature masks the transistor against either an n-type or a p-type impurity. The oxide can be removed by the usual photoetching methods in areas where diffusion is

Fig. 1: The germanium alloy-junction type transistor has a pattern of long use life.

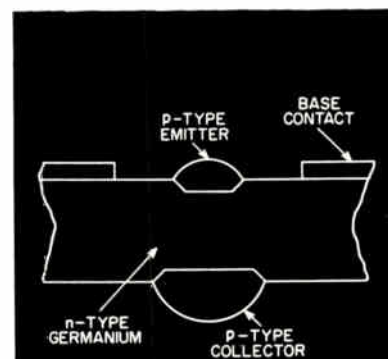


Fig. 2: Drift transistor approach uses a graded region in the base just below the emitter, plus an intrinsic region near the collector.

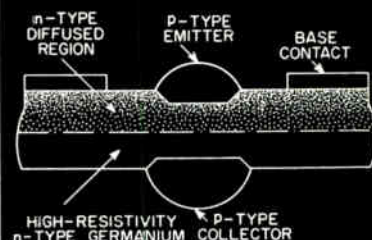


Fig. 3: Mesa types differ from alloy and alloy-drift types in that the starting material is the collector rather than the base.

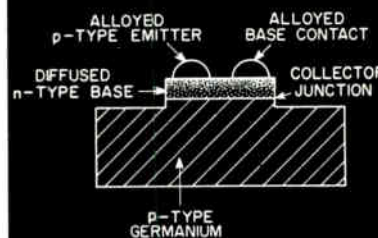


Fig. 4: Mesas using evaporated emitters and base contacts are limited in area only by the lead-attachment problem. They are now the most popular types for present-day high-speed computers.

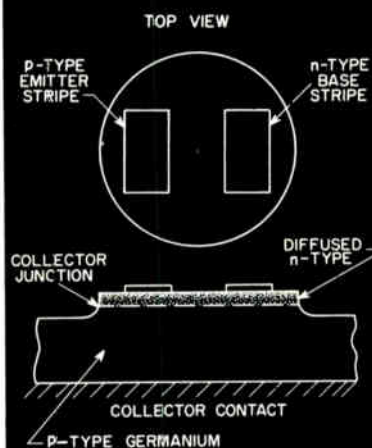
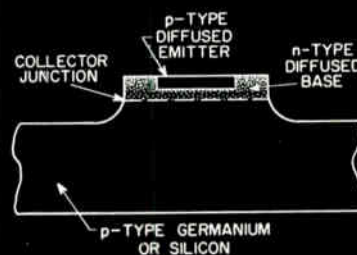


Fig. 5: A method of controlling base and emitter areas is by masking and double diffusion—a typical p-n-p device is shown.





## SEMICONDUCTOR DEVICES (Continued)

needed in a base or an emitter. These methods have been so well refined that lines 0.1 mil wide can be etched in the oxide. This permits emitters and base-contact areas as small as the wires that can be attached to them. Amplifier transistors with 1-mil-dia.

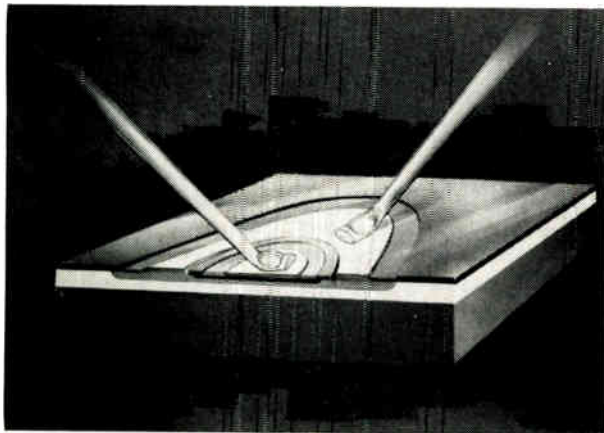


Fig. 6: The planar type is the method which the entire industry is currently adopting. An advantage is greater stability.

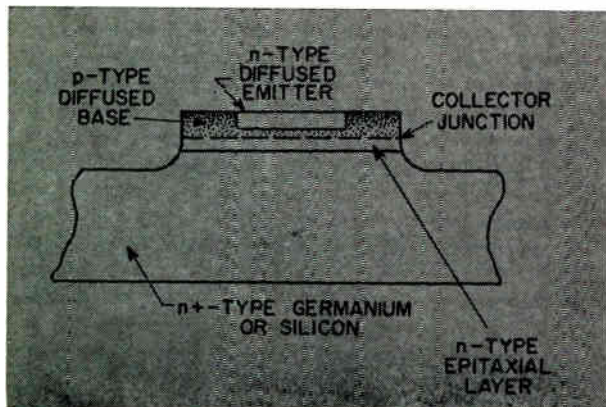
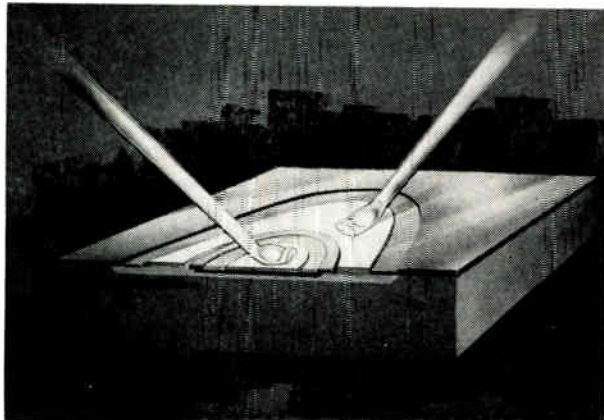


Fig. 7: The epitaxial approach to a mesa transistor is shown.

Fig. 8: Triple diffusion approach as applied to a planar structure.



emitters and base areas of about 2 mils dia. have been made. Performance in the GC range appears possible.

**The Planar Approach:** The approach which the entire industry is now adopting is the planar type. In this method, base diffusion as well as emitter diffusion is from a limited-area source. Main advantages are greater stability during life, a more constant beta with current, and a low  $I_{cbo}$ . Planar types have been found to have low noise at very low frequencies (1/f noise) consistent with low  $I_{cbo}$ . These features are probably inherent because of the oxide coating of all junctions—something not possible in mesa types. Another advantage of the planar construction is that the metallic coating from the emitter or base-contact area can be extended onto the oxide where connections can be made. This permits small active areas with larger areas for the wire contact—a useful feature for integrated devices.

The planar device, however, has two drawbacks. First, for a given base area, the collector capacitance is larger; this can be compensated for with a slightly reduced geometry. Second, although the low-voltage  $I_{cbo}$  is an order of magnitude or more lower with the planar structure, voltage breakdown figures have not been as good as those obtained with mesas having the same crystal resistivity. Processing refinements should dispel this problem.

**Silicon vs. Germanium:** Use of masking and photoetching has been carried further with  $S_i$  than  $G_e$ ; however, a great deal of work is being done to apply the same approaches to  $G_e$ . The planar approach appears to be applicable to both p-n-p and n-p-n germanium structures. Because of the greater mobility in  $G_e$ , it is thought that  $G_e$  would be used for the very highest frequencies. In VHF structures, however, the input and output capacitances are as important as the mobilities. This fact, along with the better temperature capability of  $S_i$ , may make  $S_i$  the logical choice.

Gains of 20 db at 200 mc are achieved with both  $S_i$  and  $G_e$ . The noise figure at 200 mc for  $G_e$  is as low as 2 or 3 db; for  $S_i$ , it has so far been slightly higher.  $G_e$  has been pushed faster than  $S_i$  into the GC ranges, but  $S_i$  may overtake  $G_e$ . In the next few years, transistors having gains of 20 db at 1 GC appear feasible in both  $G_e$  and  $S_i$ . The noise levels obtained may be the determining factor as to which material is used for VHF low-level amplifiers. For switching, this is not a consideration.

**Epitaxial Layers:** The second development which has improved the mesa (or planar) approach is the use of epitaxial material. This idea is an old one,

but its use in semiconductors is recent. Epitaxial construction permits the growth of a thin layer of semiconductor material of the desired resistivity. The epitaxial layer need only be thick enough for the needed design parameters of the transistor. The layer thickness is usually in the range of 0.1 to 0.5 mil. The carrier material, which serves only as a holder, is of such low resistivity that the voltage drop across it and the charge storage in it are negligible. Improvement in the performance of mesa or planar devices with the epitaxial approach makes them completely competitive with the MADT.

**Triple Diffusion:** Another approach is to use triple diffusion instead of the epitaxial method. The collector side of the wafer is diffused to provide a low resistivity. The triple-diffused method has one drawback; in diffusing into the collector, it is difficult to control the top-layer thickness of original resistivity. However, triple diffusion has the advantage of producing a top layer with any desired value of resistivity; the epitaxial approach is at present limited to a few ohm-centimeters. The triple diffused structure, therefore, is applicable for high-voltage transistors, especially for nonsaturated use.

**Planar Types in the Future:** Except for certain areas where  $G_e$  alloy and drift types and  $G_e$  mesas will continue to be widely used, it appears that epitaxial or triple-diffused  $S_i$  planar types will become the low-power type of the future. This field is just beginning to settle down because much of the use in the past has been in prototype equipment. There has been a race to obtain faster and faster transistors in order to show a continued improvement, especially in computer speed. However, the older slower types are now being used in production equipments and there is some sign of stabilization of types. The n-p-n structure has been the favored type because of the higher mobility of electrons in  $S_i$ ; however, the p-n-p type is now finding wider use. The p-n-p type can be used in complement with an n-p-n type where low power consumption is useful (such as for satellite use); it is also easier to use as a replacement for a p-n-p germanium type. Because of the effects of the oxide of  $S_i$  on the  $S_i$  surface, it has proven to be much more difficult to obtain stability in a p-n-p type. However, increasing knowledge of surface effects (which can be controlled more readily in  $S_i$  than in  $G_e$ ) promises high reliability for both p-n-p and n-p-n  $S_i$  planar types. The reliability level is becoming so high that it is hard to measure.

**Field-Effect Transistors:** An outgrowth of improved  $S_i$  technology is the development of useful  $S_i$  field-effect transistors. A bipolar transistor has

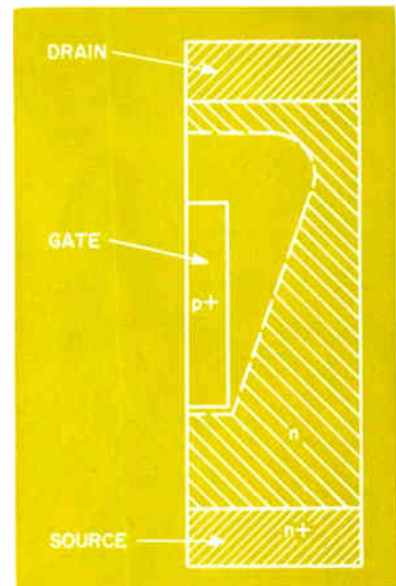
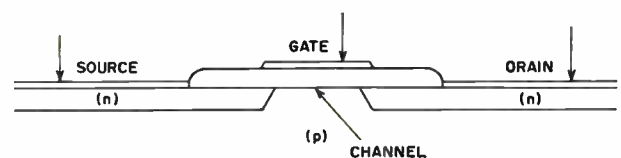


Fig. 9: One of two forms that field-effect types have taken is that of a back-biased junction to control the channel current.

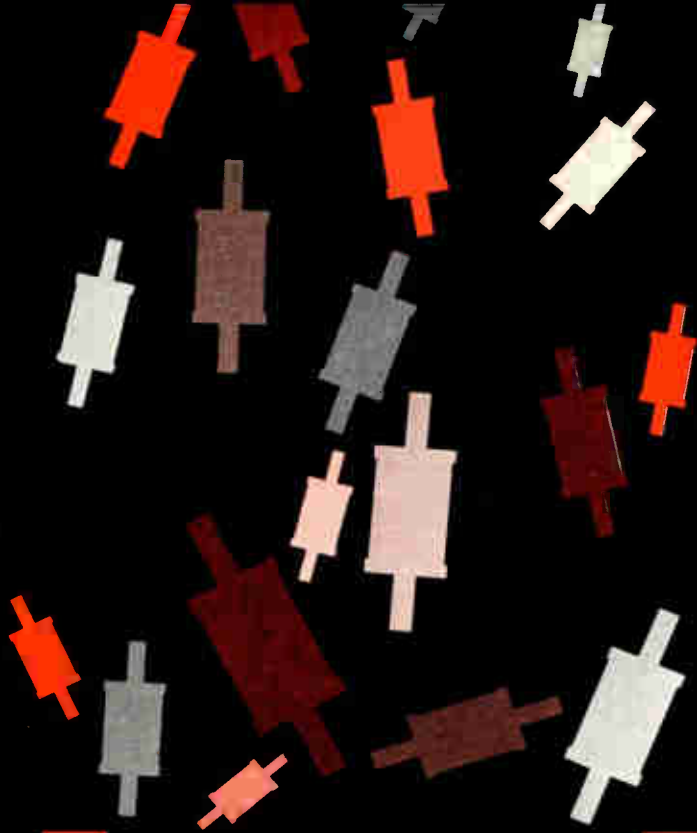
many advantages, but it has suffered from three major disadvantages: (1) a low and variable input impedance which has made matching to high-impedance sources difficult (this also makes design of high-gain tuned stages difficult); (2) an exponential dependence of the collector current on input voltage which can result in severe cross-talk and has limited the use of transistors in high-performance communication receivers; (3) difficulty of automatic gain control (AGC). The field-effect transistor has none of these disadvantages because of its high input impedance and its square-law dependence of output current on input voltage. Field-effect types have taken two forms: (a) that of a back-biased junction to control the channel current; and (b) the metal-oxide semiconductor (MOS), in which the channel current is controlled by the voltage on a metal gate which is separated from the channel by an oxide. Both have

Fig. 10: Another form that field-effect types have taken is the MOS, in which channel current is controlled by the voltage on a metal gate which is separated from the channel by an oxide.



the advantages discussed above, but the MOS has further improved characteristics: (1) Input impedance is entirely capacitive, with the resistive component greater than  $10^{12}$  ohms (in general limited by the enclosure used). This feature makes the MOS useful as an electrometer. (2) Because the gate is insulated from the channel by an oxide it can be made negative or positive. This permits many circuit in-

(Continued on page C11)



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## SEMICONDUCTOR DEVICES (Concluded)

novations not even possible with vacuum tubes. (3) Frequency responses will probably always be higher for an MOS. (4) Small change of its characteristics with temperature.

Insulation of the gate has another advantage. Instead of having conductivity in the channel which can be cut off by making the gate negative, the MOS can be designed to conduct current only when the gate is positive. At low positive voltages (2 to 4 v) the current can be made small, while large currents flow with gate voltages of 8 to 10 v. Such a transistor permits direct-coupled switching circuits, in fact, the circuits can be the same as for DCTL with bipolar

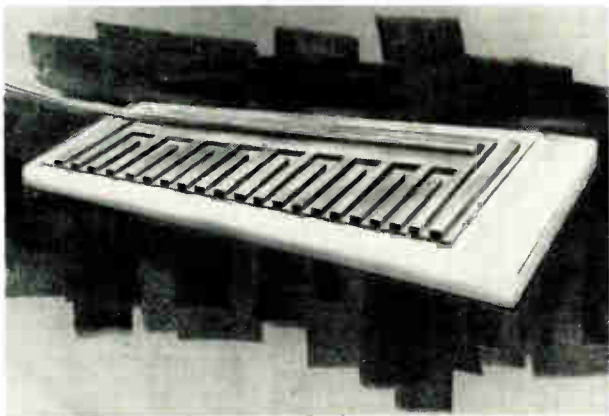


Fig. 11: An interdigitated emitter design is depicted here.

types. MOS circuits have the advantages of no "base hogging" and better s/n ratios. By combining n-channel MOS transistors with p-channel types, switching circuits can be built which use no stand-by power (current flows only during switching). Such circuits are attractive where low power is essential, e.g., in satellites.

It appears that the next breakthrough in transistors will be in the field-effect types. Such transistors have all the advantages of tubes, plus most of the advantages of bipolar types. Frequency response up to the GC region and switching speeds which provide stage delays of 50 to 100 nsecs should be possible.

### High-Power Transistors

It is not clear whether  $S_i$  or  $G_e$  will dominate the small-signal and low-power switching fields. However, in most areas of the high-power transistor field,  $S_i$  is becoming the preferred material. Audio-output-amplifier and power-supply-regulator transistors are an exception because of the low cost of  $G_e$  audio power types. The initial problem with  $S_i$  power tran-

sistors was the poor saturation voltage, which made the usual mesa approach unattractive. This problem was solved by designs in which the collector and emitter are simultaneously diffused from opposite sides and part of the emitter is etched off to obtain a base contact.

**Triple-Diffusion and Epitaxial:** The single-diffused approach has given good  $S_i$  power transistors with low saturation resistances and good reliability. Because of the low saturation resistance, this approach will be used for a long time. Diffusion from both sides, however, makes control of the base width difficult. The frequency response, therefore, is limited to the single-diffused device. With the advent of triple diffusion and epitaxial layers, it is now possible to make power devices using the mesa or planar approach, and to obtain low saturation resistance and higher frequency response. Transistors having power outputs of nearly 100 w. at 50 mc have been designed using triple diffusion. There will be a place both for these and for the older single-diffused designs.

**Geometry Considerations:** Another factor in the design of h-f, high-power devices is the tendency for the emitter to emit only at its edges at high currents, especially in  $S_i$  types. Best h-f results are obtained with the largest emitter perimeter for the smallest emitter area. Shape of the base with respect to the emitter must also be considered in order to keep the base area, and consequently, the base collector capacitance small, and at the same time keep  $r_{bb}$  low. Good results can be obtained with a variety of geometries, including a ring emitter, a star emitter, and interdigitated emitters and base contacts.

**The Future:** The field of high-power, h-f devices is only beginning to open up. Today, devices are available that will provide 3 w. at 200 mc, 10 w. at 100 mc, 50 to 100 w. at 50 mc, and several hundred watts at 5 mc. In the next few years, devices capable of several watts at 1 gc, 50 to 100 w. at 100 to 200 mc, and several kw at a few mc appear to be possible. This area is one of the most exciting in transistor design. In general, planar technology is used unless the high collector voltages obtained at present only with mesas are needed. With further study of surfaces, the voltage limitations of planars will be removed. Also, a serious problem in power types, that of "second breakdown," must either be solved or designed around.

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# TRENDS IN SEMICONDUCTOR RESEARCH

Semiconductor research has progressed at a rapid pace over the past fifteen years. This progress is reviewed and areas of active research interest are indicated in this article.

IN SEMICONDUCTOR RESEARCH, there has been a close connection between basic science and applications. Scientific discoveries have often been translated rapidly into practical devices. Applied research due to interest in applications has often led to advances in understanding. Probably in no other field has invention followed so closely after scientific discovery. Every year or two a new breakthrough seems to come along to give new impetus to the field. Latest is the junction laser. Certainly the results achieved during the past fifteen years have been tremendous, and we do not appear to be anywhere near the end of the road.

Progress in transistors can be characterized by increasing frequencies, power, and reliability; and smaller size and lower prices.

As transistors are designed to go to higher frequencies, dimensions become smaller and base layers thinner. Conductivity of the base layer material must be increased in order to get enough lateral conduction. In lab models, conductivity is getting into the metallic range. Many labs are in fact experimenting with metals for base layers as well as with other active thin film devices.

## Integrated Circuits

Transistors are usually put in a package larger than the working volume, to have something big enough to see and handle. To take advantage of the inherently small size, to simplify the problems of interconnections and to increase reliability, the trend is toward integrated circuits or functional blocks.

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### By Dr. JOHN BARDEEN

University of Illinois  
Urbana, Ill.

While it now appears that computers of the future will use integrated circuits, it is uncertain just how far the technology will go into other branches of electronics. It is certain, however, that a new technology with large potential remains to be exploited. Problems of design of these circuits and of the economics are quite different from those of normal circuits. Just how these will be worked out remains to be seen. There must be a compromise between a number of factors. The design engineer knows best what sort of compromise suits his purpose. Some semiconductor producers are using the master slice principle in which redundancy is built into the basic unit. This allows flexibility in circuit design, but has limitations. I do not know what the solution will be.

Present integrated circuits are assemblies of indi-

Dr. John Bardeen (left) shows a design of the junction laser to Paul Carroll, president of Semiconductor Specialists, Inc., Chicago.



vidual components built into a small package. In the future are truly integrated blocks in which a semiconductor or thin layer device will give a desired overall function. Shockley's 4-layer diode and its close cousin, the controlled rectifier, are examples. Another is the Esaki tunnel diode. We may expect further advances in such devices, but because of difficulties in fabrication as well as the ingenuity which must go into their design, progress probably will be slow.

With the increased packing density made possible by integrated circuits, heat dissipation becomes a problem. Partly for this reason, there is increasing interest in field effect devices which have a high impedance input and lower standby power.

Shockley suggested the field effect transistor prior to the invention of point contact and junction types; but, it took a long time for the state-of-the-art to advance to working models. It was not until 1952 that Shockley published his detailed theory and not until 1955 that Dacey and Ross published their classic paper on experimental devices. However, even after it was shown what could be done with field effect devices, they were neglected until quite recently.

The present state of the semiconductor art is the result of a large effort by many people. In 1948, the year the point-contact transistor was announced, I underestimated the time it would take to get transistors into commercial production and use, and did not appreciate the large scale effort needed to make useful and reliable devices. On the other hand, I did not foresee the success that has been gained in overcoming frequency, power and other limitations. This shows that patience is needed in a research program and that our sights should not be set too low.

### Major Steps

Some major steps have been the production of single crystals of germanium and silicon, starting in 1950 and 1951; zone refining, 1952; grown junction diodes and transistors, 1951; alloy junctions, 1952; surface barrier transistors, 1953; diffused base transistors, 1957; oxide masking a little later; and epitaxial growth and the planar design in 1961. Maximum frequency of transistors increased by more than a factor of a thousand between 1948 and 1962. Progress in diodes and rectifiers has also been impressive. Some of the important advances have been in power rectifiers, Zener reference diodes, Shockley's 4-layer diodes, tunnel diodes and junction lasers.

Largely through the efforts of Welker of Siemens-Schekert, an intensive study of the 3-5 compounds started in the mid-fifties. They appear to be quite

valuable for a number of purposes, including the junction laser.

Laser junctions of gallium arsenide convert dc power from a battery into light with high efficiency. By replacing some of the arsenic with phosphorus the wavelength of the light can be varied from about 8400Å to 6400Å. Perhaps with use of other compounds, the frequency can be pushed further into the visible. Possibilities here are great.

It has long been known that a junction laser is a theoretical possibility, but its practical realization came sooner than expected. As early as 1953, John von Neuman suggested it and made theoretical calculations of what might be needed.

There is now much (both basic and applied) research on luminescence, photo-conductivity, and

This article is based on a talk given in Chicago, Illinois at a seminar on semiconductor devices sponsored by Semiconductor Specialists, Inc.

other problems involving interaction of light and matter, including lasers. It seems that this is a broad area of great potential.

### Basic Research

Progress on basic research has paralleled that on device uses. Perhaps the most important step for both uses and basic science has been the development of methods for making nearly perfect single crystals. Measurements have given an understanding of what is going on in terms of the electronic structure and composition of the material. Composition control has allowed one to design devices on paper and then make them in the lab and expect them to perform as anticipated. There has been a change from empirical art to engineering design.

Basic research in semiconductors covers a broad front. Only two areas of current interest will be mentioned. One is on surface properties. It is now becoming possible to determine the atomic structure of the surface and to see what impurities or surface defects affect electrical properties. Another is the study of plasma effects in semiconductors. One can observe plasma pinch effects as well as magneto-hydrodynamical waves of various sorts.

### Innovation

Innovation or invention needs two factors: seeing a need and providing the technical means for fulfilling the need. In some cases one predominates, in some the other. Often elements of both are important. It is possible that the need can be met within

*(Continued on page C17)*





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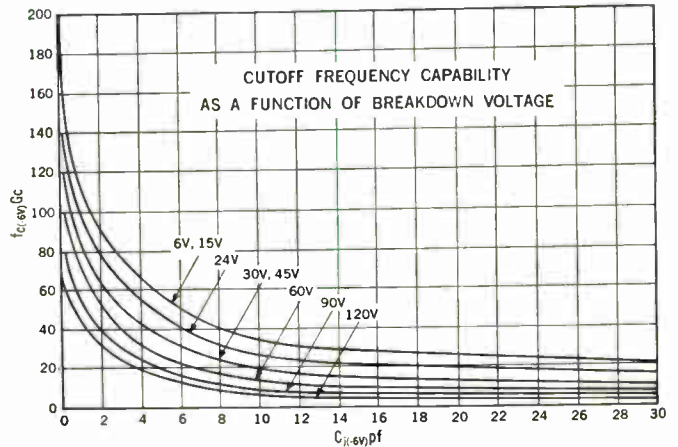
... 0.1 pf to 30 pf

## RELIABILITY

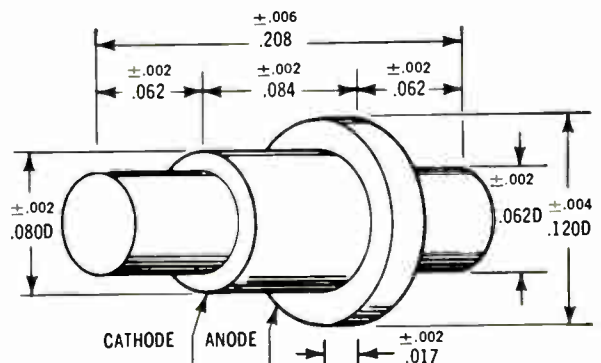
All varactor diodes are subjected to the MIL-S-19500 tests below according to standard military sampling procedures.

| Ref. Par. MIL-STD-750 | TEST                  | CONDITION   |
|-----------------------|-----------------------|---|
| 1052                  | Temperature Cycle     | -65°C to +200°C, 5 cycles   |
| 1056                  | Thermal Shock         | 100°C to 0°C  |
| 1021                  | Moisture Resistance   | 95% R.H. 10 cycles 10°C to 65°C   |
| 2016                  | Shock                 | 1500 G, 0.5 millisecond. 5 blows in each of 3 planes                      |
| 2056                  | Vibration             | 20 G from 100 to 2000 cps. Four 5-minute cycles in each of 3 orientations |
| 2006                  | Constant Acceleration | 20,000 G for one minute in each of 3 planes                               |
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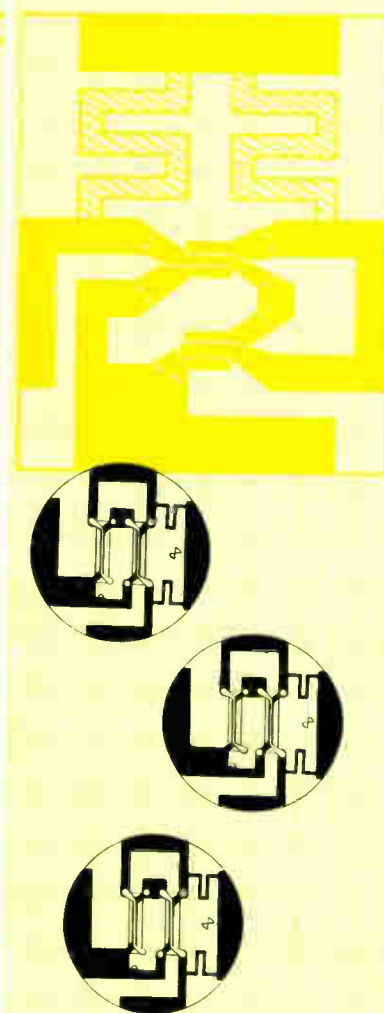
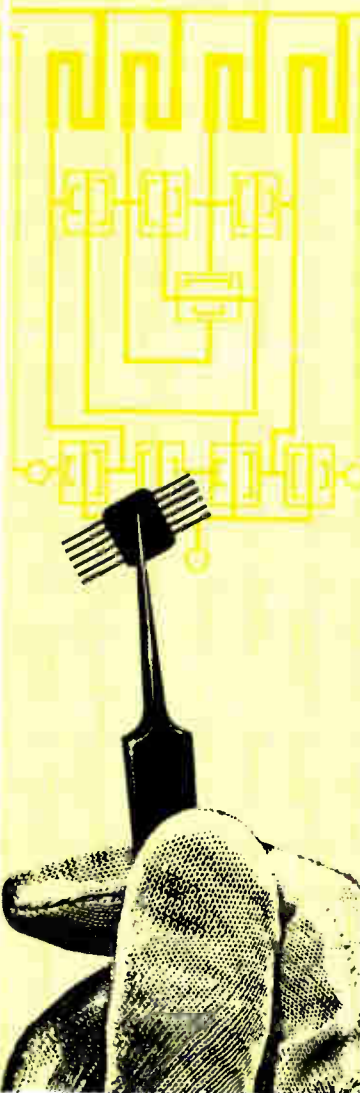
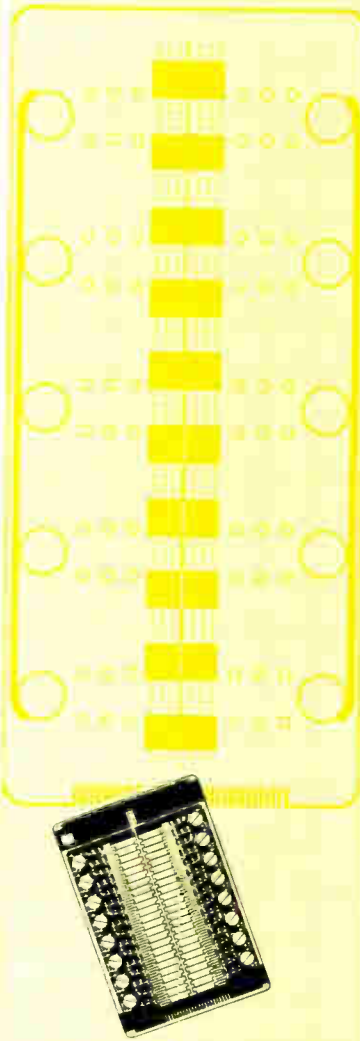
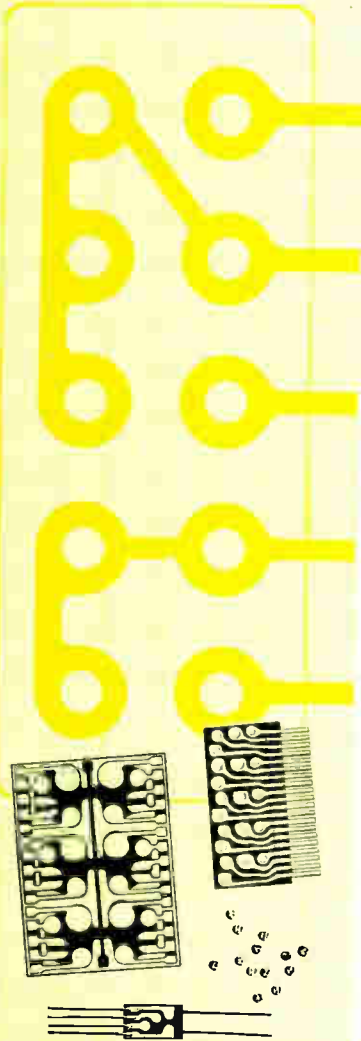
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## SEMICONDUCTOR RESEARCH (Concluded)

existing technology, even though much ingenuity may be involved. In most great inventions of the past century, the genius of the inventors was more in recognizing the need, and of seeing a better way of doing things, than in advances in technology. With the need in mind, they worked out ways to meet it. Edison advanced technology not by increasing basic scientific understanding, but by trying everything he could think of until he found something which satisfied his needs for a use he had in mind. This method is still valuable and is still widely used in areas where there is a gap between scientific understanding and technology.

In other cases the need may be seen, but no one knows how to fulfill it within existing technology. A breakthrough in science or technology then is needed. Invention of the transistor is an example of this. In this case, we knew that if we could make an amplifier which would operate without a heated filament, we would have something. We were ready to exploit anything which turned up in our basic research program which might help us achieve this goal.

Not long after Brattain and I invented the first point contact transistor, Shockley suggested the junction transistor and worked out the current-voltage characteristics to be expected. It took roughly three years for advances in technology to reach the stage where the first junction transistors could be made in the lab. These performed close to what had been predicted. In this case, the need was seen and there was basic understanding of what was needed but there had

to be marked advances in the art of processing semiconductor materials before the device could be made.

Sometimes innovation arises from a discovery in basic science. An example: development of atomic energy which came from the discovery of nuclear fission. When a new scientific discovery is made, one may ask: How can it be applied? What can it be used for? How can it be exploited?

The Government has been spending large amounts on basic research. Knowledge is accumulating at an increasing rate. Results of basic research are published freely throughout the world and are available to everyone. The most technologically advanced countries can take best advantage of this vast fund of knowledge. This country being the most advanced has the most to gain from basic research, wherever in the world it is done. A good example is the tunnel diode discovered by Esaki in Japan in 1958. Research on Esaki diodes was taken up rapidly by labs in this country not only for practical uses but also to obtain many results of great scientific interest. It was not long before Esaki diodes were an article of commerce.

What applies to different countries applies to different segments of our own economy. The bulk of semiconductor research is done in support of military and space efforts, with universities playing an important role in basic research. It has been difficult for electronics industries, which are largely civilian based, to support advanced research programs of their own and to attract our best scientists and engineers. There is a danger to the future of the industry if this trend is not reversed. If we are to compete with such advanced countries as West Germany and Japan, we need to get more of our best technical manpower thinking about problems of the civilian economy.

## GLOSSARY OF MICRO-CIRCUIT TERMS

Courtesy of Autonetics, A Division of North American Aviation, Inc.

**ACTIVE ELEMENT**—An element which displays transistance such as gain or control.

**ACTIVE SUBSTRATE**—A substrate for an integrated circuit in which a portion of the substrate displays transistance.

**ARRAY DEVICE**—A multitude of similar, basic, complex, or integrated devices without separate enclosures, each having at least one of its electrodes connected to a common conductor or all connected in series.

**ARTWORK**—Artwork is an accurately scaled configuration which is used to produce the master pattern.

**ASSEMBLY**—A number of parts or subassemblies or any combination thereof joined together to perform a specific function. (Examples: Audio frequency amplifier, vacuum tube, voltmeter, distance meter, analog-to-digital converter.)

**BASE**—An insulating support for the printed pattern. It may consist of a flexible or rigid material.

**BASIC DEVICE**—The simplest useful device exhibiting a basic solid-state phenomenon.

**BIONICS**—The art which treats of electronic simulation of biological phenomena.

**BOND STRENGTH**—A measure of the stress required to separate a layer of material from the base to which it is bonded. It is measured in pounds per inch of width (peel strength) obtained by peeling the layer, and in pounds per square inch (pull strength) obtained by a perpendicular pull applied to a surface of the layer.

**BOSS**—Use TERMINAL AREA.

**CERAMIC-BASED MICROMINIATURE CIRCUITRY**—Microminiature circuitry printed

on a ceramic substrate. Usually consists of combinations of resistive, capacitive, or conductive elements fired on a wafer-like piece of ceramic.

**CHARACTERISTICS**—Any dimensional, visual, functional, mechanical, electrical, chemical, physical, or material feature or property; and any process-control element which describes and establishes the design, fabrication, and operating requirements of an article.

**CHEMICALLY REDUCED PRINTED CIRCUIT**—A printed circuit formed by the chemical reduction of a metallic compound.

**CHEMICALLY DEPOSITED PRINTED CIRCUIT**—A printed circuit formed on a base by the reaction of chemicals.

**CHIP**—Use SUBSTRATE.

**CIRCUIT ELEMENT**—A basic constituent of a circuit, exclusive of interconnections.

**COLD WELD**—The joining together of two metals (without an intermediate material) by the application of pressure only, without an electrical current or elevated temperature.

(Continued on page C 32)

# THE STATUS OF MICROELECTRONICS

Microelectronics showed early promise of revolutionizing the industry. But despite the millions spent yearly by both government and industry on R&D, difficulties still hamper the production and widespread acceptance of these new components. These problems and others are frankly discussed.

FROM THE BREADTH OF WORK in techniques and applications of thin-film and single-crystal microelectronics, conservative estimates indicate more is to be discovered than has already been uncovered. The impact in future equipment will rank with the discovery of the transistor.

Semiconductor manufacturers, hopeful that present diffusion, passivation, photomasking and etching,

and epitaxial techniques will remain in use, are automating measurement, test, and assembly. Elimination of these areas as bottlenecks in an apparently predictable stable processing period ahead promises a hotly competitive circuit-pricing market in one to three years.

Standardization is expected rapidly only in test and measurement, with some acceptance of certain package configurations. Major emphasis may be applied to controlling and standardizing process steps, with less emphasis on circuit configurations and transfer function.

Integration of thin-film and semiconductor techniques is expected, but metallic thin-film active devices have not reached the development maturity necessary to assay a predictable future.

Military and aerospace equipment manufacturers are rapidly applying thin-film and single crystal microelectronic circuits to their products. Military contracts, expected to total \$100 million dollars in 1963, are aimed at developing the potential microelectronic advantages of improved cost, reliability, weight, lower power, quick reaction time and maintainability in selected applications. Although com-

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Fig. 1: Typical Characteristics of Microelectronic Techniques.

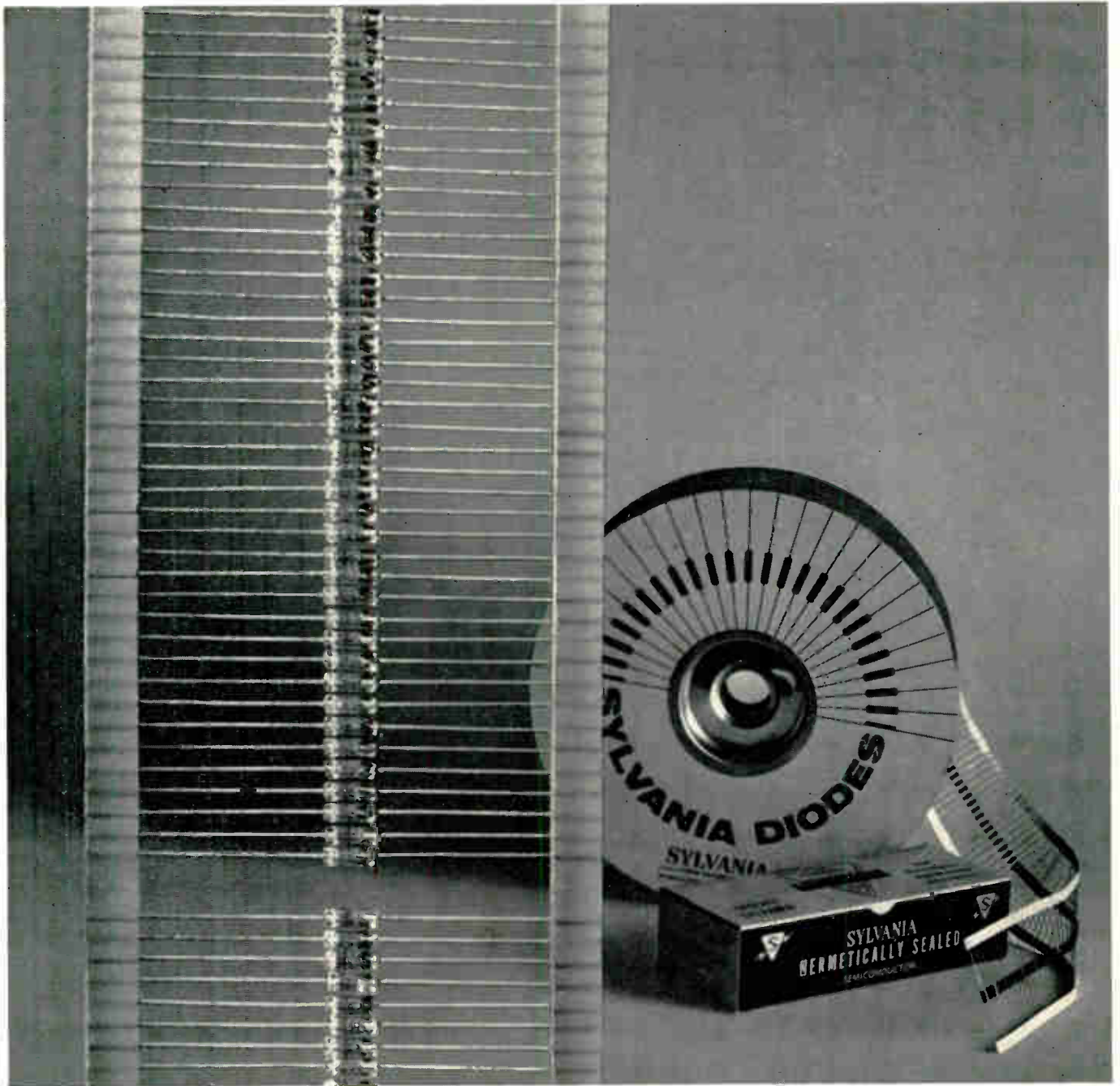
| THIN FILM CIRCUITS      | RESISTORS                         | CAPACITORS                               | ACTIVE DEVICES       |
|-------------------------|-----------------------------------|--|----------------------|
| Value                   | 200-400 ohm/sq                    | 30,000 Pf to 2 $\mu$ f/inch <sup>2</sup> | —                    |
| Tolerance               | $\pm 5\%$ , $\pm 1\%$             | $\pm 50\%$ , $\pm 10\%$ , $\pm 5\%$      | None (1962)          |
| Stability               | $\pm 0.1\%$                       | $\pm 1\%$                                | *                    |
| Ratio                   | $\pm 1\%$ , $\pm 0.1\%$           | $\pm 1\%$                                | —                    |
| Temperature Coefficient | $\pm 50$ PPM/ $^{\circ}$ C        | $\pm 1000$ PPM/ $^{\circ}$ C             | —                    |
| Voltage Stability       | Too low to measure                | —  | —                    |
| SINGLE CRYSTAL CIRCUITS |                                   |  |                      |
| Value                   | 200-400 ohm/sq                    | 20,000 to 50,000 Pf/in <sup>2</sup>      | Transistor Diodes    |
| Tolerance               | $\pm 30\%$ , $\pm 20\%$           | $\pm 30\%$                               | Field effect devices |
| Stability               | $\pm 0.1\%$                       | $\pm 1\%$                                | SCR'S                |
| Ratio                   | $\pm 0.1\%$                       | $\pm 0.1\%$                              | —                    |
| Temperature Coefficient | $\approx +1000$ PPM/ $^{\circ}$ C | Diode                                    | —                    |
| Voltage Stability       | —                                 | $\Delta 30\%$ (0.1 to 10 v)              | —                    |

\*Production feasibility of thin film active films not at present demonstrated.



By E. Q. CARR

Technical Director,  
Microelectronics Development Engineering,  
General Electric Co.,  
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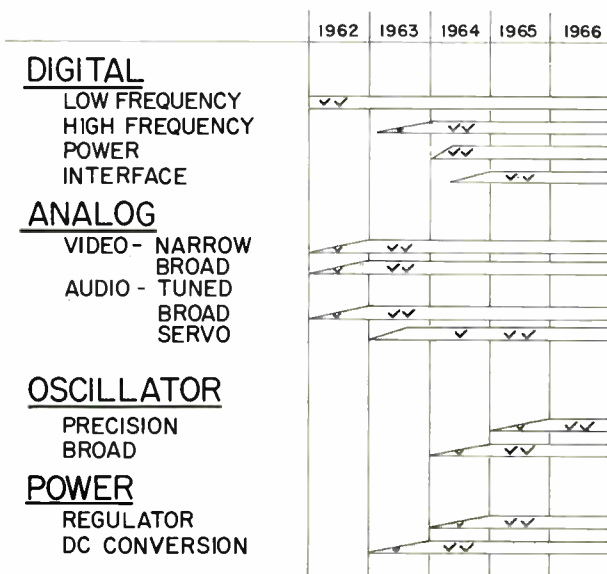
## MICROELECTRONICS (Continued)

mercial and industrial uses are expected at a slower rate, some appearances are expected in 1963. The major impact year for the military applications should be 1966; commercial applications should be 1968.

### Single-Crystal Circuits

Semiconductor component manufacturers are pressing vacuum tube and germanium transistor radio and TV markets with low-cost, high-performance, plastic-packaged, planar-passivated silicon transistors, which are produced by process techniques used to manufacture microelectronic single-crystal circuits. While the demise of germanium-alloy signal transistors is thus foreshadowed, equipment now capable of producing fifty thousand planar-epitaxial passivated transistors a day can be converted with little or no modification into a five thousand single-crystal circuit-a-day operation. A circuit can average ten components ranging through high-frequency transistors, fast diodes, zener diodes, tens-of-pico-farad capacitors and closely ratioed, high-toleranced resistors with large predictable negative temperature coefficients. Although only five or six semiconductor manufacturers reportedly have conquered both initial development and production yield problems, many have a one hundred to two hundred a week circuit pilot production-run stage. This quantity pilot run normally precedes a full thousands-a-week capability within six to nine months.

Fig. 2: Industry Circuit Availability.



Semiconductor manufacturers are relying on present processing techniques to carry them through the coming microelectronic era without revolutionary manufacturing changes. Present keys to low-cost manufacturing are:

- Precision control batch gaseous diffusion processing;
- Photo-resist etching;
- Fully or partially automated wafer/dice testing, die assembly, and packaging;
- In-process or post-passivation junction protection from moisture and other contaminants (permitting epoxy encasements for at least commercial environments);
- Epitaxial depositions; and
- In-house mask-making capability.

In the past, such measures obsoleted costly, automated, alloy type production lines before a profit was realized.

Established semiconductor and some equipment companies have programs involving from ten to one hundred professional contributors. Their goals range from in-house engineering development and application to several thousand circuits a month; but expansion plans call for production well into the tens of thousands of circuits a month if the demand warrants it. Last year a dozen or more military equipment firms have established in-house thin-film and/or semiconductor process engineering laboratories. Although they are not openly competing with semiconductor suppliers, equipment builders are seeking to establish a profitable future position in the single-crystal and thin-film circuits area, in addition to solving the problems of specifying, designing, and testing new circuit types. Consequently, semiconductor vendors are reacting with a barrage of services which include:

- Multiple device chip assemblies in a single package;
- Converting a circuit breadboard of conventional parts into a single-crystal circuit on a two-to-five week quick-reaction basis;
- Selling at any point in the semiconductor production line—from an epitaxial wafer to a fully diffused wafer without intraconnection and up to individual micropackaged device and circuit dice;
- Do-it-yourself kits which result in a hybrid assembly of flying-lead intraconnected device chips soldered in microelectronic packages; universal or custom matrices of limited range. The process-selectable standardized components are dif-

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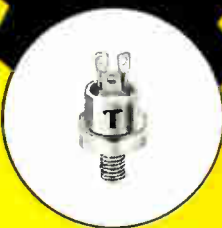
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|--------|--|---|--|---|---|
| 2N2866 | 20-60  | 0.4   | 80   | 15  | 20  |
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## MICROELECTRONICS (Continued)

fused in batches of stockpiled wafers convertible to fifty to two hundred circuits by two additional mask and process steps.

Competition between the component and equipment groups continues. With much significant growth still to be achieved in the technique areas, leading semiconductor firms continue to garner the high volume production runs.

Opinions vary but more widespread application, particularly in linear circuits, is hampered only by high initial mask cost. The industry, however, is plagued by a lack of definitive reliability criteria, reluctance of semiconductor vendors to discuss problems, and a tendency of these vendors to emphasize the merits of their individual approaches. Factors contributing to the situation are: only recent, lethargic, investigation into new associated circuit problems by equipment circuit designers; lack of detailed component-drift data and worst-case analyses; and definition of limits acceptable to reliability engineers long nurtured in component-oriented calculations. In addition, there are premature standardization conflicts caused by a plethora of different logic-block circuit types from each manufacturing source entering the field.

High-powered, hard oversells to upper management give rise to misconceptions on how much can be done—and how soon. In one instance, a request was made to micro and make redundant a wide-band multi-channel amplifier to achieve two-year unmaintained operation, thus solving a particular reliability problem in military field use. The findings of a cursory engineering investigation showed the present weighty thirty-two vacuum tube, small-quantity-use amplifier operated from a few hundred kc to the gc frequency range and, in field use, was lashed to a trembling sheetmetal support. Aside from requiring a costly and superb engineering achievement based on some blithe assumptions concerning an all-semiconductor problem solution, a low-budget cost-sharing arrangement was expected. Suggestions for non-redundant conventional alternative solutions to establish feasibility were ignored.

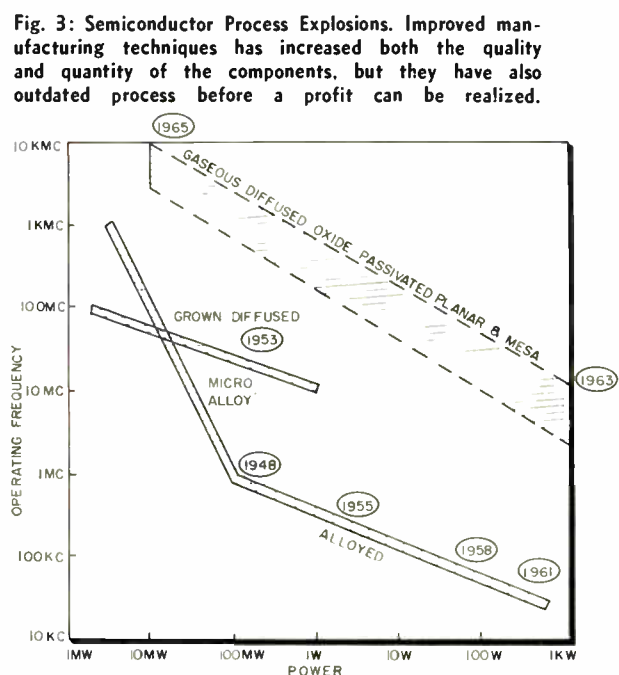
### Single-Crystal Circuit Applications

Considerable mixing of micro and conventional components, circuits, and techniques will prevail in the foreseeable future (Fig. 6). Digital computer designs and data processing with 90 to 100 per cent

fully integrated, single-crystal circuits in arithmetic and control sections is feasible. Remotely alterable memory, memory drive, and amplifiers are less amenable to micro techniques for reasons of per bit cost, low usage, high power, and large size. Techniques discussed later offer hopeful solutions in some areas, but progress lags in circuit availability by several years. The work of six firms engaged in military computers demonstrates size, power and weight advantages gained with micro techniques (Fig. 7).

Second-level interconnection of single-crystal circuits is accomplished in a wild, nearly chaotic, exploration of multilayer stacked, eyeletted, etched wireboards; multilevel electrodeposited epoxy-coated leveled board structures; cordwood stacking with welded risers; epoxy potted and unpotted, welded matrix interconnections with and without additional soldering, etc. So far all approaches are costly and, in some cases, still require significant amounts of handwork. A seven to eleven multiply stacked etched board in small quantities can cost a thousand dollars or more because of artwork and photomask tooling charges necessary even in small quantities. At least two military development contracts have been let to study and solve the problems, but the findings have not been generally accepted by industry. A number of techniques employing optical-laser welding at atmospheric pressure; programmed, kilowatt-power, precision-deflected, electron-beams welding at low pressure; small single-piece welding probes; and thin-film interconnection methods are being inves-

(Continued on page C26)



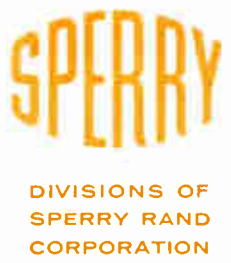




# close matching

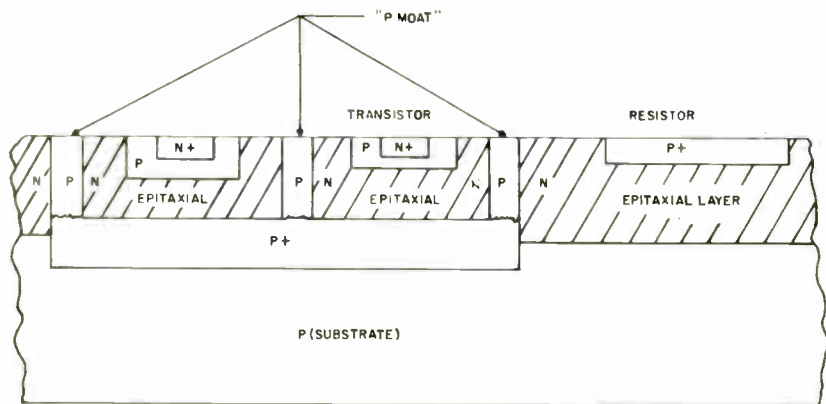


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Circle 3 on Inquiry Card

Fig. 5: Formation of thin-film, single-crystal layers on an insulating substrate could solve the parasitic problem with respect to junctions. However, this type of single-crystal film may not meet production process standards.

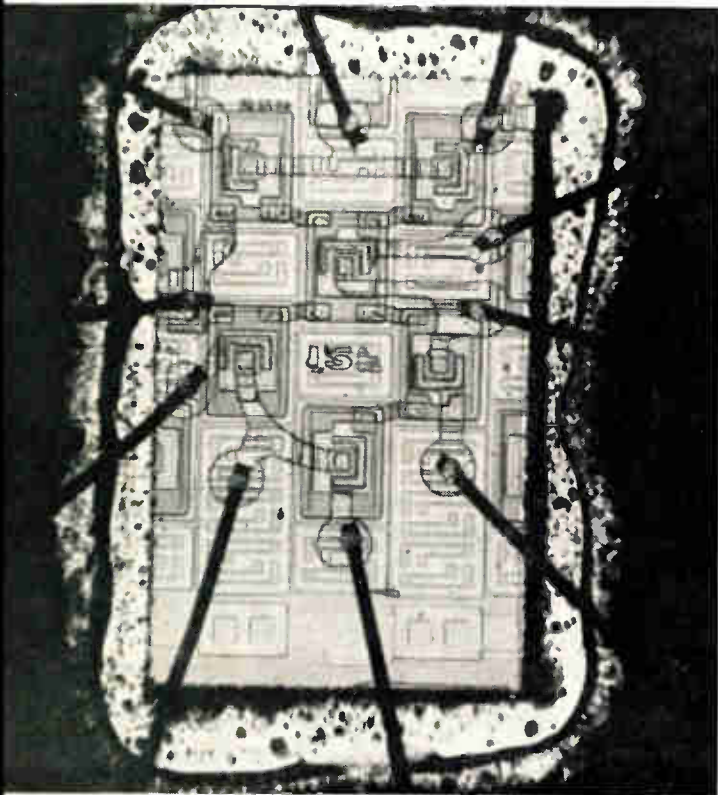


## MICROELECTRONICS (Continued)

tigated in an effort to improve reliability within reasonable cost.

Interconnection problems involving large inter-coupling capacity between cable-bundle leads, low-drive logic, small fanout, low clock speeds, plus uncertainty about power and ground bus noise at low power levels in semiconductor single-crystal circuits have caused computer manufacturers not to react rapidly to present microelectronic logic circuits. In a business in which 80 per cent is software and 20 per cent hardware there is little enthusiasm despite tantalizingly low-cost production proposals by semi-

Fig. 4: GE's 12F is an example of a current integrated circuit. It is a 5 gate NOR circuit consisting of transistors, 6-v zener diodes, fast signal diodes, and resistors.

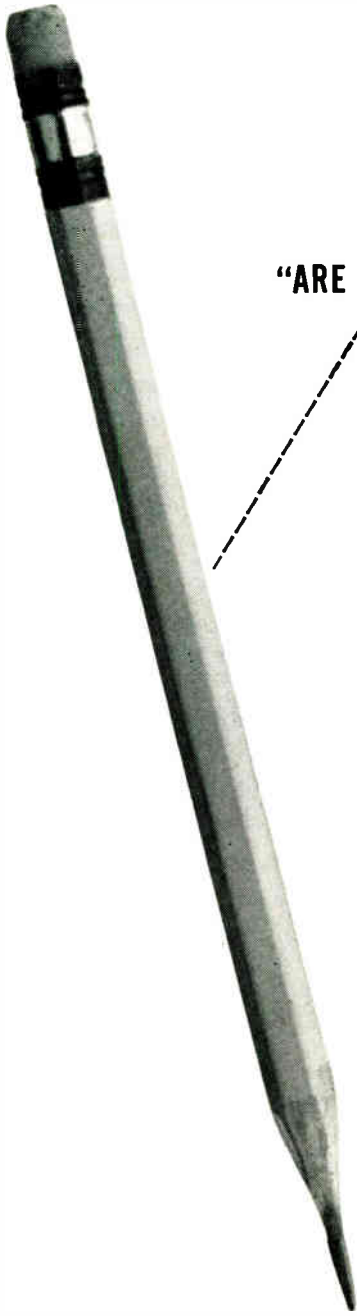


conductor vendors. Commercial computer firms that are hard pressed to expand or keep their share of computer markets have followed a pattern of increasing clock speeds and living on tumbling semiconductor prices, while increasing computer complexity to handle more and more difficult customer tasks.

Computer firms that have made developments in superconducting cryogenic microelectronics have aimed at an elusive target of low-cost, high-speed computation, and now are experiencing delays in converting laboratory work into production procedures. Production problems in yield, photoetching, intraconnection, precision mask alignment, and thermal shock are found when multiple-layer deposited thin films on large thinly-insulated metal substrates are being made.

Should delays in cryogenic production continue, manufacturers may take advantage of the cryogenic vacuum-evaporating, photomasking, and camera facilities to produce their own microcircuits. Additional equipment needed to perform this function would cost between \$300 to \$600 thousand dollars. This would be a successful venture because it would supply a wide second source of components for industry, and it would also open potential low-cost markets in small industry, machine tools, etc. The main stumbling blocks are a dearth of proven top-talent semiconductor personnel and necessary redesign in logic, interconnection and computer repackaging (and, whimsically, perhaps, "image unselling," if microelectronics shrinks the now commonplace showboat computer installations). The brilliant VonNeumann, who could not envision more than a few giant electronic computers in the late 1940's, might be startled at the number in use today—and perhaps shocked at future floods of computer-controlled micro-

*(Continued on page C28)*



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|--------|--|--|--|---|-----------------------|
| 2N1518 | 40 1.0   | 50 4   | 15/60 15                                 | 0.7 25  | 0.8° C/watt           |
| 2N1519 | 60 1.0   | 80 4   | 15/60 15                                 | 0.7 25  | 0.8° C/watt           |
| 2N1520 | 40 1.0   | 50 4   | 17/68 15                                 | 0.6 35  | 0.8° C/watt           |
| 2N1521 | 60 1.0   | 80 4   | 17/68 15                                 | 0.6 35  | 0.8° C/watt           |
| 2N1522 | 40 1.0   | 50 4   | 25/100 15                                | 0.5 50  | 0.8° C/watt           |
| 2N1523 | 60 1.0   | 80 4   | 25/100 15                                | 0.5 50  | 0.8° C/watt           |



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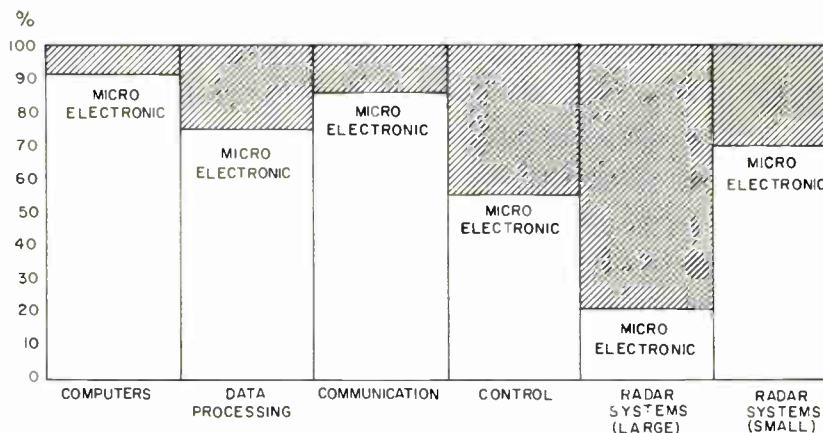
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Fig. 6: Estimated Conventional vs Microelectronic Circuits in Military Equipment by 1966.

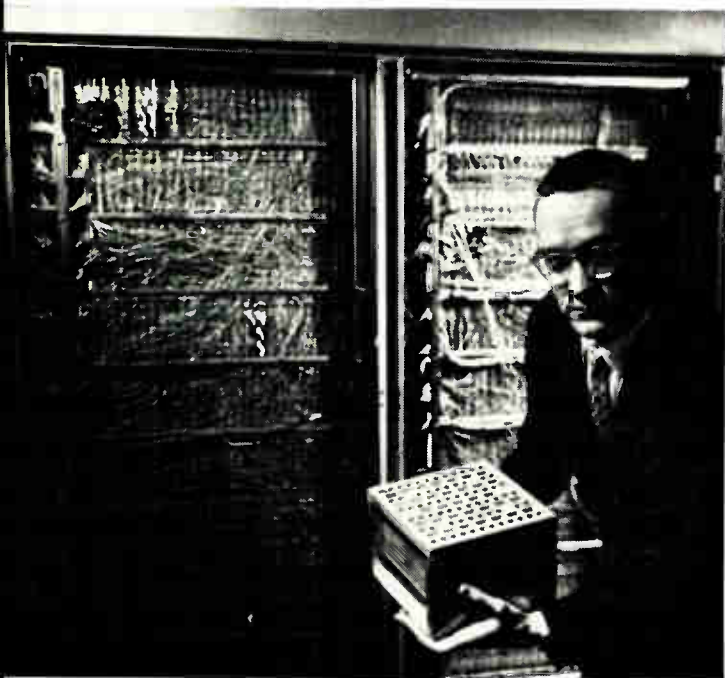


## MICROELECTRONICS (Continued)

electronic computers gleaming in the eyes of American marketing men.

The envisioned fifty-cent to a dollar circuit has caused cost-conscious, import-sore, radio manufacturers, already converted to germanium transistors in most home radios, to consider competitively-priced, higher-performance, low-collector capacitance individual silicon devices. Silicon-transistor breadboard receivers are operating already, and micro-techniques may soon be introduced. Production radio engineers design radios to operate on a bewildering variety of one, two, three or a dozen transistors for an r-f range of 200 kc to over a 108 mc. However, portable radio manufacturers exist on cheap transistors (those

Fig. 7: The A-236 is a microversion of the M-236 shown in background. The A-236 airborne central computer will be used in early warning and control systems, aircraft and weapon control systems, etc.



that do not meet specifications) from commercial computer quality transistor production lines. Challenging implications arise when a decreasing volume of the germanium transistors shrinks this transistor supply. Limited engineering staffs have caused many manufacturers to skimp on long-range development, thus causing a dependence on semiconductor vendors for advanced microelectronic innovations. This dependence may stay introduction of microelectronics for the years it takes to saturate the military market.

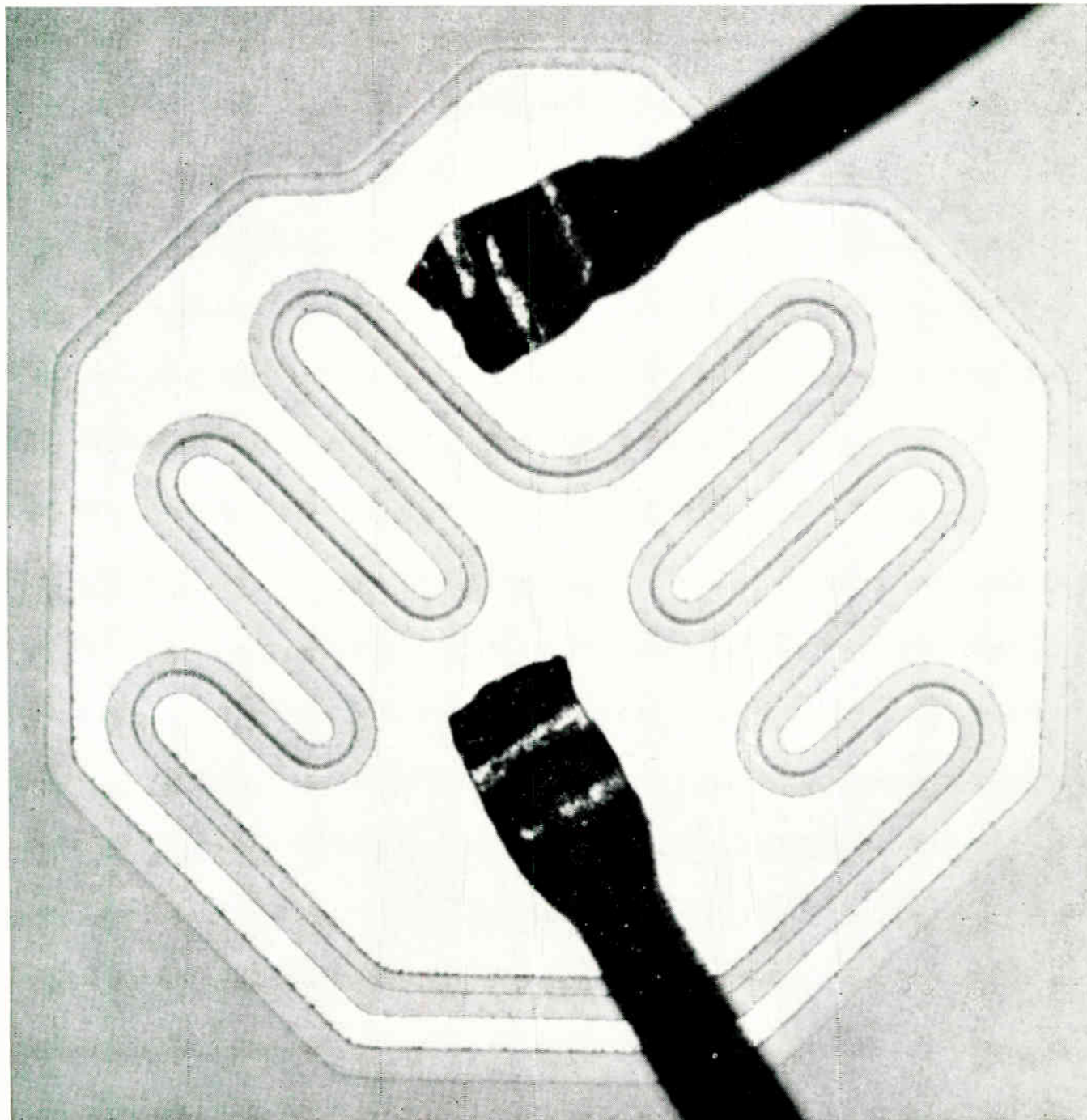
Raw materials for breakthroughs exist, and efforts may be directed towards low-collector capacity silicon transistors, characterized for linear class-A operation well below 1 ma collector current; that are below a fifty-cent transistor price; that have 3 to 10 kc bandwidth, low-insertion loss, 455 kc center-frequency filters to team with a three to five stage 50 to 65 db wideband video amplifier for i-f strips; potentiometer tuned oscillator/converter circuits; precision wide-capacity, swing-voltage variable PN junction tuning capacitors; R-C Q multipliers; combinations of field-effect devices and transistors; NPN and PNP transistors in one chip for high-efficiency audio stages; and, perhaps, cheap current regulators which permit half battery voltage operation in low-voltage portables. High-volume, auto radios, which have a greater margin in pricing, have more to gain by intrinsic silicon circuit advantages (easier wide temperature operation), and the opportunity to move some of the profit in-house now going outside to vendors will likely lead portables in the field.

### Thin-Film Microelectronics

Thin films are a paradox. Many equipment manufacturers enter microelectronics with thin films for the following reasons: lower initial investment; similarity of circuit design techniques to conventional components; less stringent photomasking, etching

*(Continued on page C30)*

# Bendix "Leaf"\* Silicon Transistor



\*Patent applied for.

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## MICROELECTRONICS (Continued)

and artwork; straightforward evolution from etched wireboard work; high-speed circuits with minimum parasitic problems; design flexibility; relatively low cost in small quantities; and the future potential of compatible process for thin-film active devices. But vacuum-evaporated metal thin films, recorded over a hundred years ago, have less than ten years experience in control of precision sheet resistance, temperature coefficient, substrate finish, source shapes, multiple element alloy compositions and effects of hydrocarbons, water vapor, oxide formations in the vacuum systems. Manufacturers find few experts in the composition of thin films below 1000Å thick. Cleaning procedures, materials specification and control, heater design, etc., as in semiconductor process, are presently more art than science.

Present processes use singly or in combination elements and oxides of aluminum, chrome, gold, copper, tantalum, niobium, silicon, nickel, titanium, barium, cadmium sulfide, tungsten, etc. Materials are evaporated by electron beams, metal ribbon and filament resistance heaters, r-f fields, and radiation heating. Laboratory uses include sputtering, glow discharge, ion transport, optical laser heating at

pressures of 10 to 100 microns in atmospheres of nitrogen, argon, and helium with controlled leak systems of oxygen, nitrogen, etc. Deposition areas are controlled with precision-registered metal, glass and ceramic masks, or by controlled etch-back techniques in "maskless" deposition systems. "Maskless" systems actually use photographic masks rather than etched metal masks to overcome tolerance and etching problems which, so far, limit minimum metal mask apertures to the 1 to 5 mil range.

Deposition substrate materials include fire-polished glass, chemically insulated oxidized or anodized metals, oxidized silicon, plastics and glazed ceramics of aluminum and beryllium oxide. Ceramics offer high thermal conductivity with present problems of controlling flatness, surface finish and thickness. Active devices are thermo-compression bonded, welded, soldered or ultrasonically bonded to the deposited substrates of passive components.

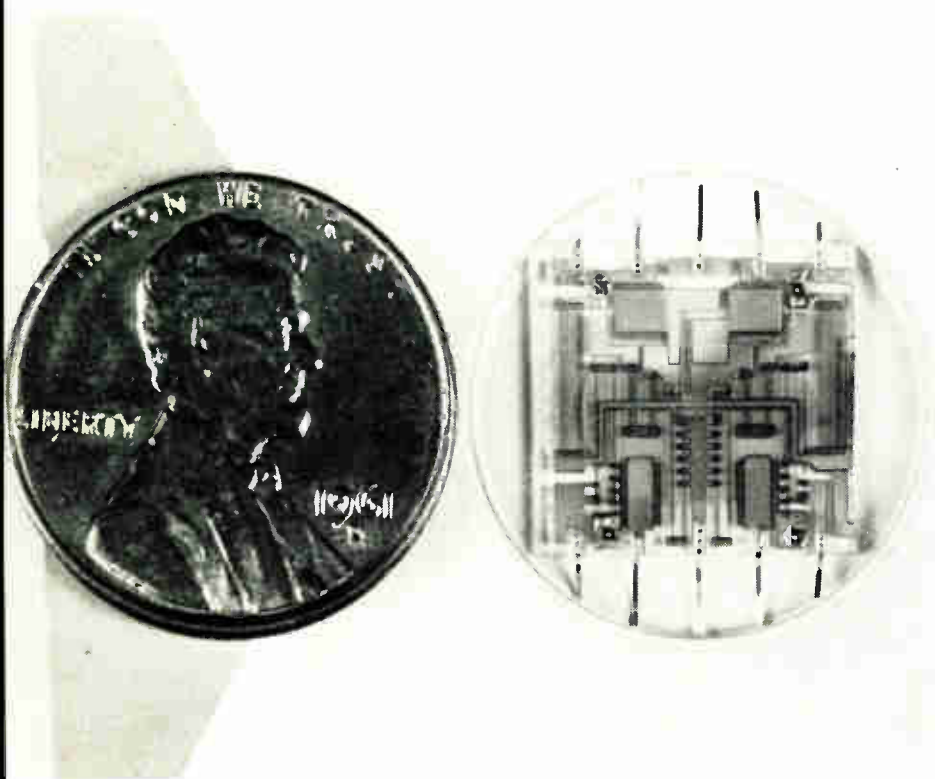
Circuit design procedures are similar to normal component approaches; the circuits have less severe resistor and capacitor tolerances than single-crystal circuits, but they lack adjustable resistor, capacitor or any usable inductance. The variety of methods being investigated indicate an open field but without a clearly defined path. As such, it is difficult to assess the future. However, thin-film approaches could well represent the ultimate in microelectronic techniques.

### Thin-Film Applications

Development applications already explored are digital and linear circuits in military radio receivers, missile instrumentation, auto pilots, test equipment, and high-powered, large-fanout, digital circuits. Four stage, R-C coupled, 50 to 60 db gain, wideband video amplifiers centered at 4.5, 30 and 120 mc are operating and under military test.

High cost of microsized semiconductors, improved quality of silicon-dioxide passivated device junctions, and improved chip-bonding techniques indicate the new paths of interconnection by thin films now in development. Fig. 8 shows the feasibility of direct-device dice bond-

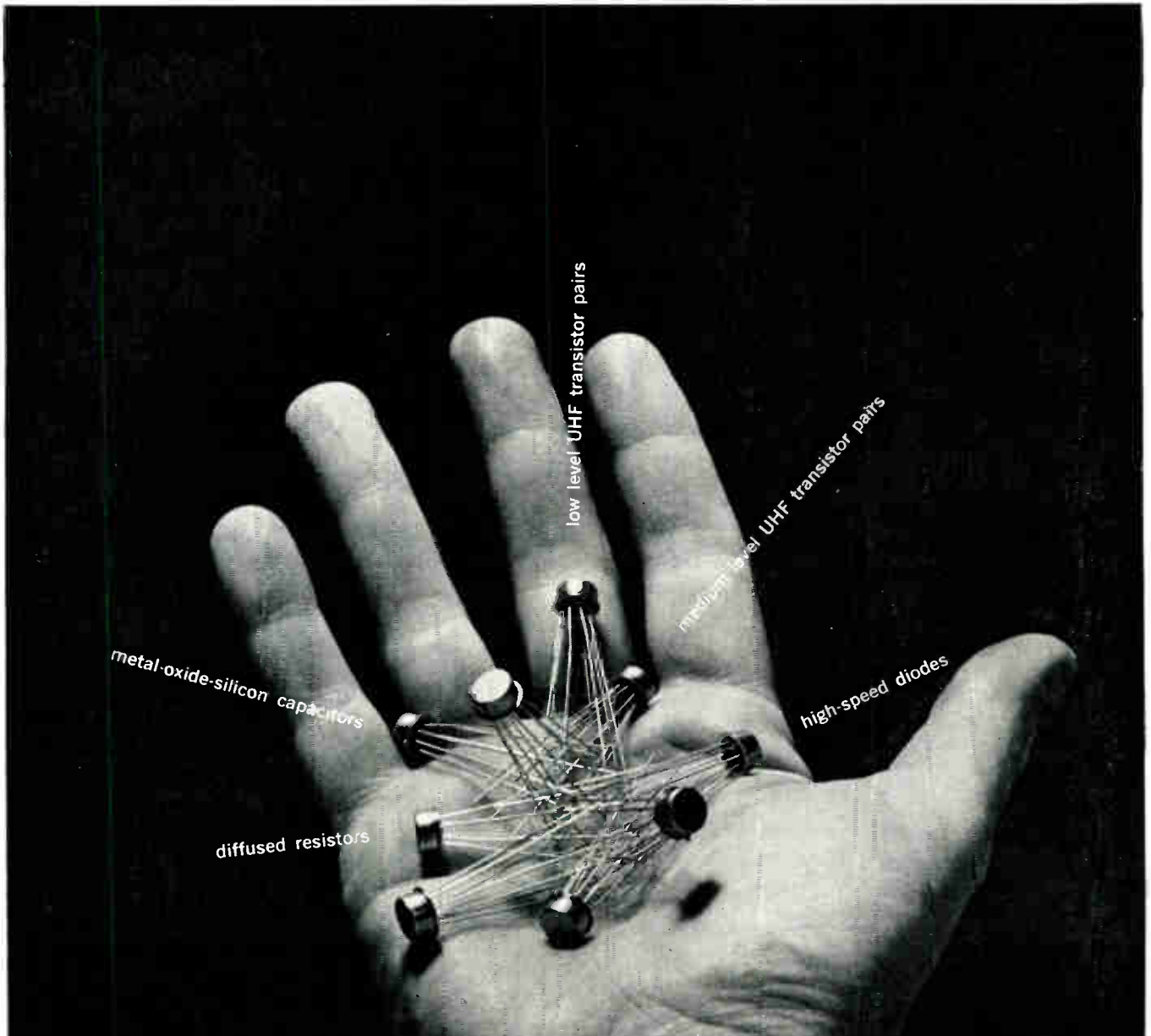
*(Continued on page C34)*



**Fig. 8: Device Chips Bonded to Thin-Film Substrate.** The individual device chips are thermo-compressed to a thin-film glass substrate.




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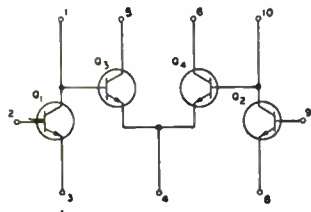
# ELECTRONICS

progress in semiconductors

## Who Put Those 21 Great Tobaccos

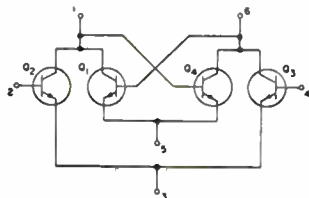
... in that itty-bitty can? The TV commercials say you know who. And who puts up to ten great planar passivated transistors in an itty-bitty TO-5 or TO-18 can? You know who! Or we can build in any combination of up to ten transistors, diodes and resistors. We have over thirty different kinds in stock, with many more variations available. We call them active discrete pellet functional devices (AFD's). They are compatible with conventional circuit board or thin film techniques because the complete active portion of a flip flop or gate circuit is contained in one can, and the resistors or capacitors are contained on the circuit or thin film substrate.

For example, take this two-stage differential amplifier in which Q1, Q2, Q3, and Q4 are very closely matched.



It's product type 12X015, in a TO-5 case, with ten leads. This single AFD can be used in a circuit in place of four planar transistors. You obviously save space, but also inherent in the packaging process are these very important advantages: (1) identical electrical characteristics (2) improved parameter ( $V_{BE}$ ,  $H_{FE}$ , etc.) tracking with temperature changes because the devices share the same environment and the thermal resistance between adjacent devices is minimized (3) reduced assembly cost, and (4) no initial charge for special fixtures or masks.

Take another example. This is the 12X007 Emitter Coupled Logic Half Shift Register, and it comes in a TO-5 or TO-18 case.



It has six leads, and is similar to transistor types 2N706, 2N708, and 2N914. Again you get identical electrical characteristics and improved parameter tracking with temperature change because the General Electric planar process yields oxide passivated pellets which may be electrically measured prior to mounting on the header and final packaging.

Practically all AFD pellets in completed housings are from the same transistor wafer. Manufacturing (pellet mount, lead bond, cap) and the test cycle have been streamlined to permit delivery on special products with two or more pellets in the same housing within three weeks after receipt of order. Write to Section 11E152 and ask for Bulletin 35.01. It lists circuit diagrams and applications for forty different AFD's, many of which are available off the shelf. Or you may want to specify your own special combination. Fine . . . they're built and delivered within three weeks. And just think of all those great transistors in those itty-bitty cans!

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# GENERAL ELECTRIC

## MICRO-CIRCUIT TERMS (Continued)

(Continued from page C 17)

**COMPONENT PARTS DENSITY**—Use PARTS DENSITY.

**CONDUCTIVE PATTERN**—A design formed from an electrically conductive material on an insulating base.

**CONDUCTOR**—A single conductive line forming an electrical connection between terminal areas.

**CONTROLLED PART**—An item which requires the application of specialized manufacturing and procurement techniques.

**CORDWOOD**—The technique of producing modules by bundling parts as closely as possible and interconnecting them into circuits by welding or soldering leads together.

**CRITICAL ITEM**—An item whose failure could result in hazardous or unsafe conditions or prevent performance of the tactical function of the end item.

**DEFINITION**—The fidelity of reproduction of pattern edges in the printed circuit relative to the original master pattern.

**DEGRADATION**—A gradual deterioration in performance. The synonym—DRIFT—is often used for electronic equipment.

**DEPOSITION**—The process of applying a material to a base by means of vacuum, electrical, chemical, screening, or vapor methods.

**DEVICE**—A combination of physical material to form a part comprised of one or more active elements. (Examples: Transistor, diode)

**ELECTRON BEAM MACHINING**—The process of using a controlled electron beam to weld or shape a piece of material.

**ELEMENT**—Increment of volume of a part that displays an electrical phenomenon. (Examples: Transistor fabrication within a silicon substrate using diffused structures, resistor formed by fusing metal oxide onto a glass base or conductor screened on a ceramic substrate.)

**EMISSIVITY**—The relative power (of a surface or a material composing a surface) to emit heat by radiation.

**ENVELOPE DIAMETER**—A dimension of an opening or hole, as in a tube or missile airframe, that describes the extent to which an object irregularly shaped can be accommodated as it rests in the opening or as it slides into the opening either at an angle or straight. The term is used especially in reference to accommodating electronic equipment within the airframe of a missile.

**ETCHANT**—A solution used, by chemical reaction, to remove the unwanted portion of a conductive material bonded to a base.

**ETCHED WIRING SUBSTRATE**—A printed conductive pattern formed by chemical, or chemical and electrolytic, removal of the unwanted portion of conductive material bonded to a base.

**FABRICATION TOLERANCE**—In the construction and assembly of an equipment or portion thereof, the maximum variation in the characteristics of a part which, when related to the defined variations of the other part comprising this equipment, will permit operation of the equipment within specified limits.

**FEEDTHROUGH**—Use INTERFACIAL CONNECTION.

**FINGER**—Use PRINTED CONTACT.

**GRID**—A two-dimensional network consisting of a set of equally spaced parallel lines superimposed upon another set of equally spaced parallel lines so that the lines of one set are perpendicular to the lines of the other, thereby forming square areas. The intersections of the lines provide the basis for an incremental location system.

**GUARD BAND**—The unused area which serves to isolate elements in a printed circuit. (Examples: Area between printed contacts, area between an element and the edge of the mounting base.)

**INTERFACE**—The junction point or surface between two different media.

**INTERFACIAL CONNECTION**—A conductor which connects conductive patterns on opposite sides of the base.

**LAND**—Use TERMINAL AREA.

**MASK**—An implement, usually a thin sheet of metal containing an open pattern, which shields selected portions of a base during a deposition process. Also, an implement used to shield selected portions of photosensitive material during photo processing.

**MASTER DRAWING**—A drawing showing the dimensional limits or grid location applicable to any or all parts of a printed circuit, including the base.

**MASTER PATTERN**—A 1-to-1 scale pattern which is used to produce the printed circuit within the accuracy specified in the master drawing.

**MATRIX**—Use GRID.

**MECHANIZED ASSEMBLY**—The joining together of parts and/or subassemblies with the aid of operators and semiautomatic equipment.

**MICROMINIATURIZATION**—The technique of packaging a microminiature part or assembly composed of elements radically different in shape and form factor. Electronic parts are replaced by active and passive elements, through use of fabrication processes such as screening, vapor deposition, diffusion, and photoetching.

**MINIATURIZATION**—The technique of packaging by reducing size and weight of electronic parts in step with the change from vacuum tubes to transistors and diodes.

**PAD**—Use TERMINAL AREA.

**PARTS DENSITY**—The number of parts per unit volume.

**PASSIVE SUBSTRATE**—A substrate which exhibits no effects of transistance. (Examples: Glass, ceramic.)

**PEEL STRENGTH**—See definition for BOND STRENGTH.

**PRINTED CONTACT**—That portion of a printed circuit used to connect the circuit to a plug-in receptacle and to perform the function of a pin in a male plug.

**PRINTED ELEMENT**—An element in printed form, such as a printed inductor, resistor, capacitor, or transmission line.

**PRINTED-WIRING SUBSTRATE**—A conductor pattern printed on a substrate.

**PRINTING**—The act or art of reproducing a pattern on a surface by any of various processes, such as vapor deposition, photoetching, embossing, or diffusion.

**PULL STRENGTH**—See BOND STRENGTH.

**REDUNDANCY**—That design which makes additional electrical paths available to a function.

**REGISTER MARK**—A register mark is a mark used to establish the relative position of one or more printed-wiring patterns or portions thereof, with respect to their desired locations on one or both sides of a printed-wiring base.

**RESIST**—Resist is a material such as ink, paint, metallic plating, etc., used to protect the desired portions of the printed conductive pattern from the action of the etchant, solder, or plating.

**SEPARABLE PART**—A replaceable part, the body of which is not chemically bonded to the base, excluding the effects of protective coatings, solder, and potting materials.

**SUBMINIATURIZATION**—The technique of packaging miniaturized parts using unusual assembly techniques for increased volumetric efficiency. (Example: Cordwood.)

**SUBSTRATE**—A wafer-like piece of insulating material which may serve as a physical support or base and thermal sink for a printed pattern. (Examples: Ceramic, glass, silicon, quartz.)

**TAB**—Use PRINTED CONTACT.

**TERMINAL AREA**—A portion of a printed circuit used for making electrical connections to the conductive pattern, such as the enlarged portion of conductor material.

**TERMINAL PAD**—Use TERMINAL AREA.

**THERMOCOMPRESSION BONDING**—The joining together of two materials without an intermediate material by the application of pressure and heat in the absence of electrical current.

**THIN FILM CIRCUIT**—The combination on a single passive substrate, such as glass or ceramic, of a number of elements entirely in the form of deposited films of conducting, semiconducting, or insulating materials. The method and sequence of deposition, physical location, and shape of the film provide the interconnections on the common physical support. (Example: Vaporized tin oxide on glass.)

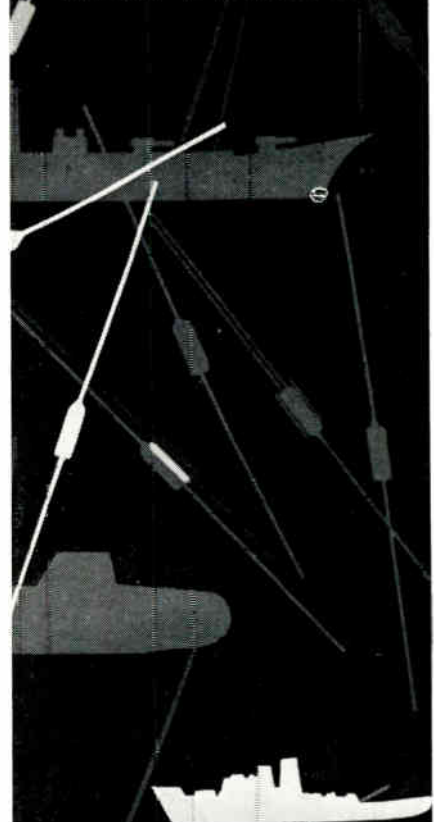
**TRANSISTANCE**—An electronic characteristic exhibited in the form of voltage or current gain or in the ability to control voltages or currents in a precise and nonlinear manner. (Examples of parts showing transistance: Transistors, diodes, vacuum tubes.)

**UNDERCUT**—The reduction of the cross section of a metal-foil conductor caused by the etchant's removal of metal from beneath the edge of the resist.

**WAFER**—Use SUBSTRATE.

**WIRING PATTERN**—Use CONDUCTIVE PATTERN.

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Dickson is the first to offer 9 volt, 500 mW, silicon diffused-junction temperature compensated zener reference diodes to meet the requirements of MIL-S-19500/156A (Navy). USN Types 1N935B, 1N937B, 1N938B, and 1N939B offer temperature coefficients of .01, .002, .001, and .0005% °C. Modest quantities are immediately available for your critical military applications.

Dickson also offers the industry's broadest line of standard temperature compensated zener reference diodes. The following types are presently available from stock, to JEDEC specifications:

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| 1N935-39B | 1N2163-71A | 1N3580-84B |
| 1N941-45B | 1N2620-24B | 1N4057-85A |

For complete information contact your authorized Dickson Representative, or write, wire or phone Mr. Jack Nancarrow, Dickson Electronics, P. O. Box 1387, Scottsdale, Arizona. Phone code 602, 946-5357.



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ELECTRONICS CORPORATION

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Circle 10 on Inquiry Card



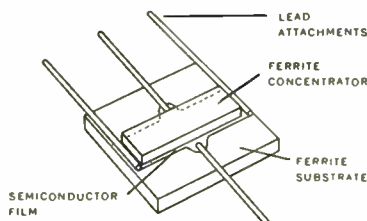


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We've complicated matters by giving our new-generation Hall Effect voltage generators two different substrates. For the best of reasons. There are two different areas of application - depending on the nature of the flux field being monitored. And there's a Beckman Hallefex\* Generator for each. It makes sense. Here are the hows and wheres.

### FERRITE SUBSTRATE

Using a special manufacturing process, we vacuum-deposit a microns-thin semiconductor film on the ferrite base. Then, to protect the film and improve flux density, we add a ferrite concentrator.



The ferrite unit is essential...

1 - where it's desirable to have low reluctance in the magnetic circuit. This is possible because we've reduced the effective air gap to 0.001". That's up to 15 times smaller than in other Hall generators.

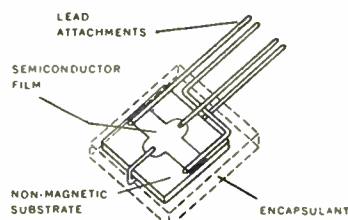
2 - where it's permissible to distort the magnetic field if the flux density can be increased. Because flux takes the path of least reluctance, this can improve field strength by several hundred times or more.

Check the Hallefex Model 335. It has an indium antimonide film that delivers input resistances of 100 to 600 ohms and output sensitivity of 2.0 volts/amp.-kilogauss, minimum. Or the Model 336 with an indium arsenide film for optimum tempo.

### NON-MAGNETIC SUBSTRATE

Employing the same basic manufacturing process, we here deposit the film on a non-magnetic

base. And encapsulate the whole works for protection.



A non-magnetic unit is essential...

1 - where there must be a minimum of disturbance to the mechanics of the system.

2 - where there must be a minimum of disturbance to the spatial flux distribution of magnetic paths. Distortion would be introduced by the presence of stray or induced poles in ferritic material.

3 - where a large dynamic range of flux densities is to be measured. Because they're subject to saturation, ferrite models have a built-in upper limit.

4 - where the coercive forces must be small compared to the applied MMF, or where the retentivity of the substrate must be small compared to the allowable error.

5 - where high frequencies are involved. Because hysteresis loss varies directly with frequency, a non-ferrite unit would be preferred.

Check two Hallefex models with non-magnetic substrates. The 350 has an indium antimonide film for maximum sensitivity. And the 351 has an indium arsenide film for optimum tempo.

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## MICROELECTRONICS (Concluded)

ing to metal films on glass substrates using a gold-silicon eutectic solder. This technique now includes complete single-crystal circuit dice assemblies used in shift - registers (Fig. 9).

Integrating thin - film techniques with single-crystal circuits should simplify interconnection, and allow the use of cheap glass substrates for large capacitors, precision, low-temperature coefficient resistors in certain linear circuits, and precision ladder - divider networks for A/D converters.

Thin-film passive circuits will be in low-quantity special circuits where high-speed or frequency operation and power levels greater than those obtainable from single-crystal circuit are needed. These circuits have larger substrate sizes, low parasitic values and favorable cost differential.

The paradox of thin films is that although it may be an advanced technique compared with the single-crystal diffusion process, continued integration of both technologies is already evident. Depositing isolated single-crystal platelets at scratches, pits and other surface anomalies in quartz, glass and semiconductors from gaseous reduction reactions has been observed for years. Large continuous single-crystal films proved difficult until recent work demonstrated that one - inch diameter patches of almost uniform silicon single-crystal film could be deposited on a molten layer of glassy oxides between the silicon and the final alumina substrate. Although laboratory work continues, transistor production-line quality films are not yet available. In the past six months,

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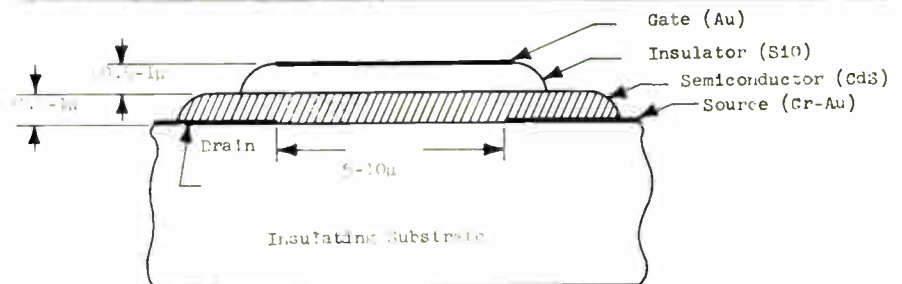
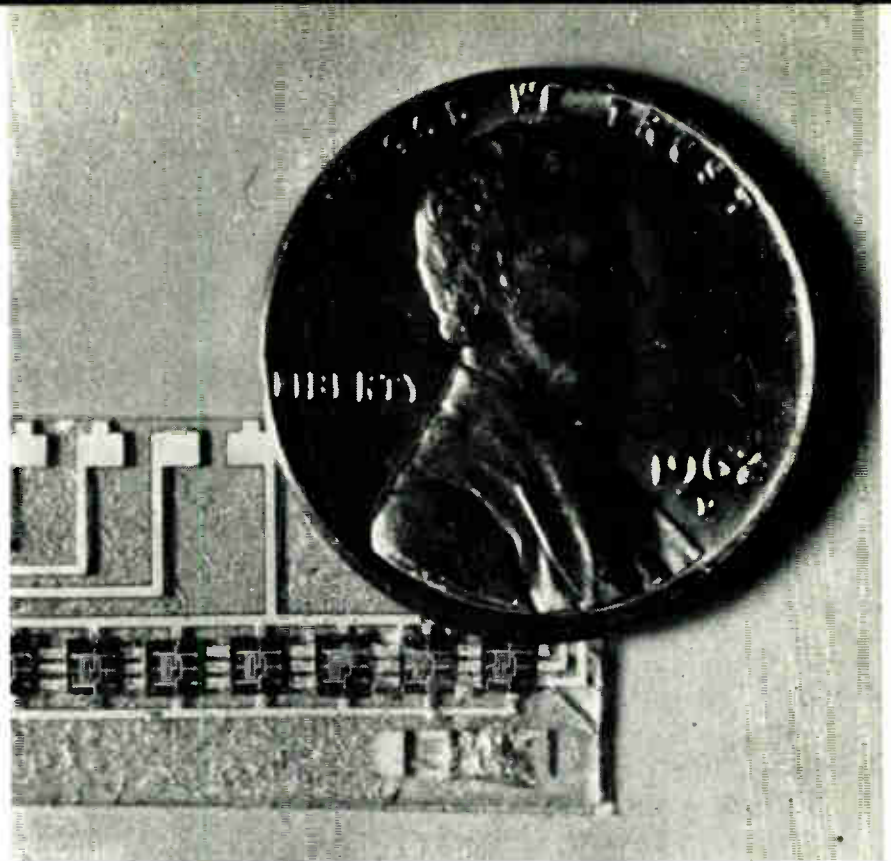
**Fig. 9:** The use of a cheap glass substrate instead of a more expensive silicon chip is demonstrated with this 4-bit shift register. Future progress in this field will reduce cost, size, and weight of the microcircuits.

military contracts for improvements have been awarded. The main technique attractions are large substrates (12 in. x 12 in. solar cells), continued utilization of present semiconductor device and circuit fabrication technology, almost complete elimination of parasitics by a passive substrate, and potential cost reductions. Every major research laboratory in the country has a thin-film single-crystal program in a technique which could prove a new industry departure point.

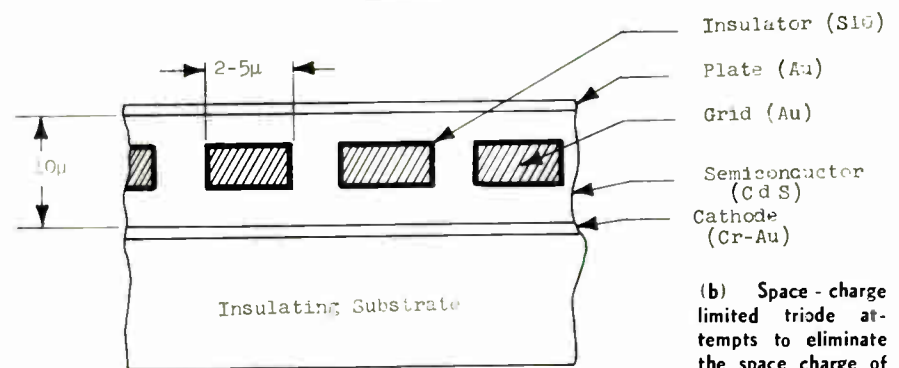
Thin-film active devices based on tunnelling phenomena, "hot" electron room temperature emission or field effects (Fig. 10) are intensively pursued in industry. Significant progress, short of the production line, however, has been made in field-effect devices employing polycrystalline cadmium sulfide and cadmium telluride. Production delays apparently stem from control and stability of semiconducting materials, film thicknesses, and fine line or gap and multilayer registration problems. As one researcher mumbled, "cadmium sulfide is a chemical mess!" But so were silicon and germanium in 1948.

Electron emission devices may be stymied in the only recently explored requirements of continuous, hole-free, high-dielectric constant insulators in the 50 to 100Å thickness range. The use of multiple metal and oxide film will eventually allow these devices to have higher nuclear radiation resistance than semiconductors.

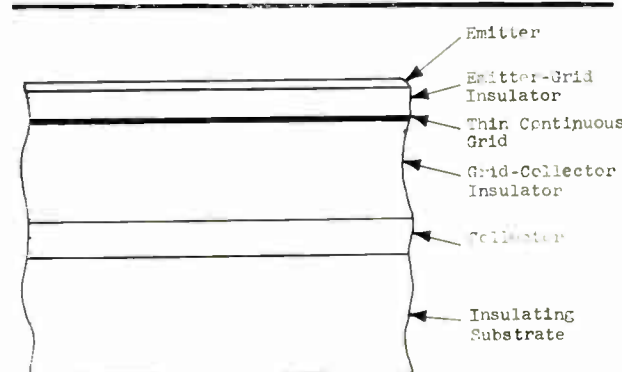
The continuing advantage of passive thin films in frequency response, plus the future discoveries which may be ahead in thin films, have led several semiconductor firms to maintain more than token programs in passive thin-film elements, looking to possible future merging of the major techniques.



**Fig. 10:** (a) Field-Effect Triode. The gate-electrode voltage modulates the carriers in the volume between source and drain electrodes.



(b) Space-charge limited triode attempts to eliminate the space charge of the conventional triode by allowing the electrons to move through a perfect crystal lattice.



(c) Nontunneling hot electron triode operates at ambient temperatures if there's spontaneous electron emission, ultra-thin insulation layers, and energy level differences in sandwich metals.

## New compact storage tube for airborne applications

Hughes has developed a 5" diameter direct view storage tube with an overall length of 8" (tube envelope length - 4"). The Hughes H-1076AP20 TONOTRON\* tube overcomes the severe size limitations inherent in airborne equipment.

Designed with weather radar and terrain avoidance radar in mind, the H-1076AP20 has both original design and retrofit applications. It is now feasible to realize the advantages of high light output direct view halftone storage tubes where before only standard cathode ray tubes could be used.

While much smaller in size, the average performance characteristics of the Hughes compact TONOTRON\* tube are equal to or better than many larger 5" diameter storage tubes:

**H-1076AP20** 5" TONOTRON\* direct view halftone storage tube with electrostatic focus and magnetic deflection. 4" minimum useful screen diameter. On-axis construction.

**STORED RESOLUTION** 50 lines/in (shrinking raster) for 5 $\mu$ a beam current and 80% of equilibrium brightness.

**BRIGHTNESS** 2000 ft. L equilibrium brightness at 10,000 volts.

**WRITING SPEED** 60,000 in/sec for 5 $\mu$ a beam currents, from 0% to 80% of equilibrium brightness.

**ERASE TIME** 200 milliseconds (length of single pulse to reduce brightness from 100% to 20%).

**VIEWING TIME\*\*** 30secs.—0% to 20% of equilibrium brightness.

For additional information and answers for your specific display problems,

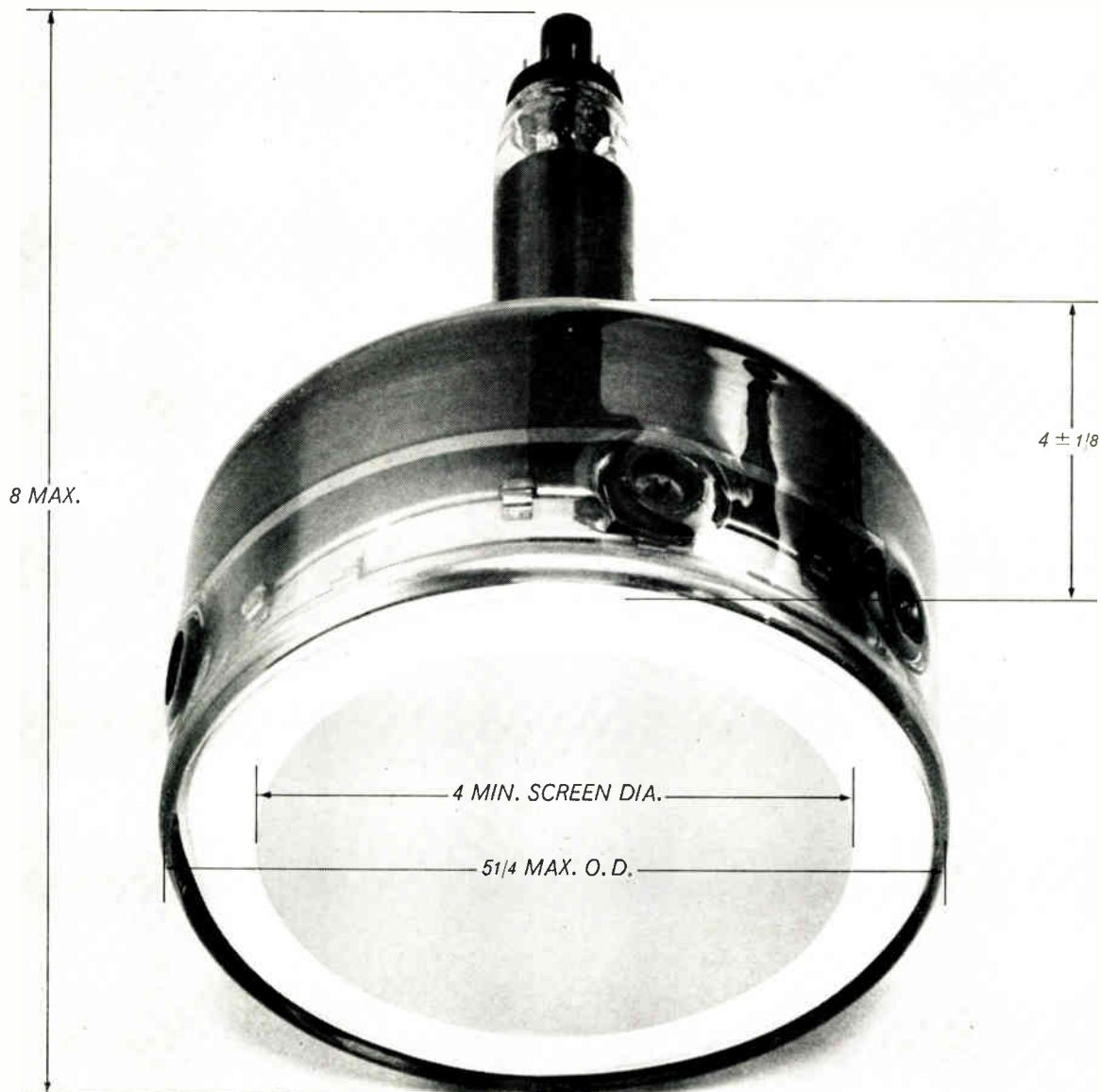
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\*Trademark Hughes Aircraft Company \*\*By means of pulsing techniques, unneeded light output can be traded for extended viewing time.





# SECTION **C**

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## **SEMICONDUCTORS & TUBES**

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### **Part Two—Tubes**

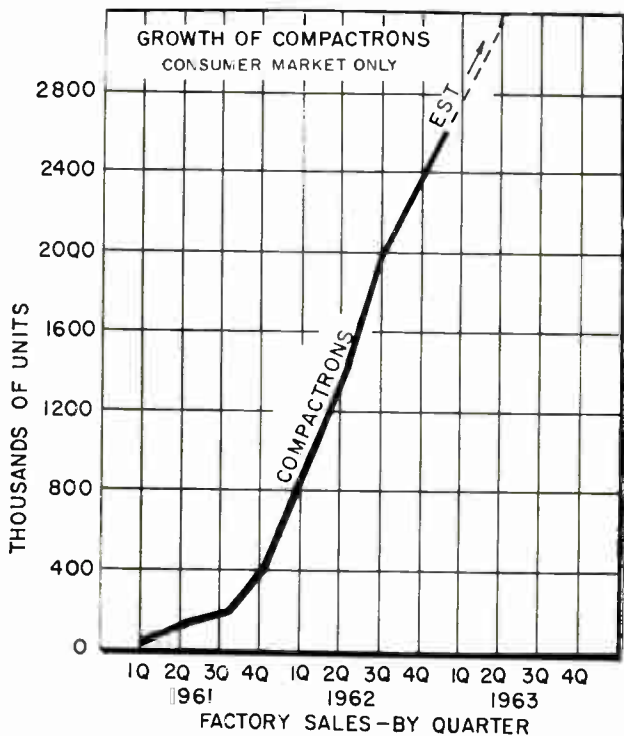
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| Tubes—Today and Tomorrow | C38 |
| Industrial Tubes Today   | C44 |

# TUBES— TODAY AND TOMORROW

In spite of the gloomy prediction of a few years ago, vacuum tubes are very much "alive" today. The dollar volume remains high, better than \$300 million. Many improvements have been made that are obvious only to tube designers.



Fig. 1: The novar, compactron, and frame-grid constructions represent some of the newest types of tubes used today.



LIKE MARK TWAIN, the electron tube industry can say: "Reports of my death are highly exaggerated."

For despite the oft-repeated dire predictions of the past decade, this industry today remains a healthy and vigorous supplier of electron control devices in all four major areas of application—entertainment, industrial, military and space.

Behind the scenes, screened by successive flurries of popular interest in scores of other developments, tube makers and users have quietly continued to place hundreds of millions of these devices in the bread-and-butter circuitry that has been the backbone of the

Fig. 2: Compactron sales have been increasing at a fast rate.

By **ROBERT E. MOE**

Manager of Engineering  
Receiving Tube Dept.  
General Electric Company  
Owensboro, Kentucky

electronics industry. In addition, tubes play an important role in the more glamorous Space Age electronics.

Recently the continuing progress in tube design and usage has brought this work to public view sufficiently to cause some comment that tubes are "coming back." One knowledgeable tube man, when confronted with this comment, quietly smiled: "Well, really you know, they never went away."

Significant technical advances, particularly in materials usage, have been spurred by competition within the tube industry and from other devices—both in the United States and throughout the world. Research and development in basic techniques, as well as materials, will continue to provide advances in tube structures, efficiency and characteristics.

Recent progress, in the face of both new electronic circuit needs and competition, has been pointed toward the circuit functions and areas where the electrical advantages of electron tubes, their established predictable operation, and their economy outweigh those of other devices.

As a whole, the tube industry remains large both in dollars (more than \$300 million in domestic receiving tube manufacturers' sales alone last year) and in unit-functions. Though actual sales of tube *units* have decreased somewhat in recent years, tube *functions* have, in effect, increased because of multi-function units like compactrons, because of more sophisticated circuitry which needs fewer units, and in a sense also because increased tube reliability has necessitated fewer replacements. All this adds up to added value in the present-day products of the tube industry.

Here are some of the high points of present and future developments in the major areas of tube use:

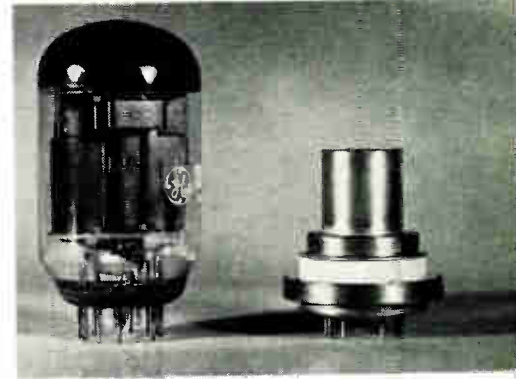
### Entertainment

The most significant development in the entertainment area is the mushrooming usage of the 12-pin compactron in television receivers (Fig. 1). A glance at the current service manuals shows that compactrons are used now in the majority of TV chassis—and it is safe to say that their usage will become even more general. There are 60 types of compactrons registered which serve any and all present TV purposes. Some, the hard-working power types remain single-function units; but the majority are two, three, and four-function types.

Incidentally, there has been some rather shallow criticism, particularly in the consumer press, to the effect that compactronized circuits make maintenance more costly. This argument is built on the seemingly

logical assumption that if one section of a multi-function tube fails, the whole unit must be replaced. However, those who voice such criticism are not aware of two facts: First, tests and field experience have proved that, with less points of possible breakdown, a compactron can and does rack up a better reliability record than the 2 or 3 tubes it replaces. Secondly, years of experience have proven that the

Fig. 3: The compactron (left) and the metal-ceramic power tetrodes provide high power at 175 mc and 450 mc respectively for mobile communications.



only significant concentration of tube failures in sets lies in the small group of usually-over-worked *single-function* tubes—the vertical and horizontal outputs, dampers, high-voltage rectifiers, and UHF oscillators.

In TV, tubes' ability to handle high power and high voltage continues to dictate their use in the deflection and picture tube circuits for a good many years to come. This is particularly true in color TV, still a growing infant, where the HV rectifier, shunt regulator, and damper tubes are the only devices which can handle the severe power needs in feeding a 90° deflection picture tube using 3 guns. In addition, the color matrix demodulation function in some circuits can be performed best by beam deflection tubes like the recent 6AR8 and 6JH8. For here the capability of generating a specific transfer function from input beam deflection plate to output collector current is unique to tube techniques.

The new frame grid tubes and, to a lesser extent volume-wise, the magnoval-based tubes and nuvistors of recent years are examples of the tube industry's ingenuity in tailoring products to fit the needs of equipment manufacturers and, in the end, consumers.

The second-largest entertainment market, AM broadcast receivers, still largely uses tubes in clock and table radios where extremely small size, portability and power consumption are not major considerations. Tubes continue to excel in this area because of quality of operation, lower price, and simpler and



## RECEIVING TUBES (Continued)

less costly maintenance. The most influential of these factors is, of course, price—a pressure to which styling and various other factors have knuckled under.

One might wonder why no manufacturer has come out with a one- or two-compactron table radio. The answer lies in a peculiar combination of psychology and economics. Manufacturers firmly believe the public is deeply rooted in the philosophy that the more components a radio has, the better it is. So, none is willing to risk a “one-tube” or “two-tube” radio manufacturing schedule. Complementing this factor, and perhaps even more over-riding, is the fact that the standard four- and five-tube AM “kits”—long tried, trusted and proven—can be turned out by tube manufacturers just about as cheaply as the comparable compactrons.

The ability of tubes to handle high radio frequencies efficiently—both from the viewpoint of economics and electrical operation—assures their continued large volume use in FM radio and stereo multiplex. In the foreseeable future, only a small portion of this market will turn from tubes to meet the demands of the relatively few consumers who demand the latest in “gadgetry”—a factor which also is affecting, in a small degree, the continuing use of tubes in hi-fi equipment.

A heretofore “hidden” advantage of using tubes in circuits connected to household and commercial ac power lines recently has come to light. Seeking to solve a problem plaguing modern tubeless entertainment and industrial circuitry, application engineers have found that transients as high as several thousand volts, lasting several microseconds apparently are quite prevalent on 60 cycle power lines

—both from atmospheric and man-made electrical disturbances. Tubes apparently have taken such pulses in their stride for many years.

Among the recent developments in tube materials and construction are the use of welded top caps (instead of soldered), rhenium tungsten heaters, 3- and 5-ply plate materials, and many detailed structural improvements which have passed unnoticed by all but the working tube designers. These have yielded significant improvements in performance, reliability, life and cost. Progress has been so steady and sound there can be no doubt that it will continue at the same or even a faster rate. This progress is rooted deeply in materials and techniques studies, most of which are clothed in proprietary interests and remain unheralded for obvious reasons.

### Industrial

Although solid-state devices have been adopted in the large-volume applications of the computer industry, tubes still serve the specialty functions in the industrial field, such as industrial TV systems and high-voltage thyatron applications. This is particularly true where some of the newer devices have caused sharp current rises, producing line transients and severe radio noise which must be shielded and filtered—situations more easily and economically solved by using tubes.

In the growing radio communications equipment field, receiving functions are shared with solid-state devices in mobile equipment as higher performance and more predictable transistors become available. Yet even in these low power functions the most economical installations employ tubes where a high degree of miniaturization is not demanded. The output stages of transmitters, even relatively low power, will continue to use tubes for the foreseeable future.

Fig. 4: Starting on left are nuvistor, TIMM and ceramic triode.

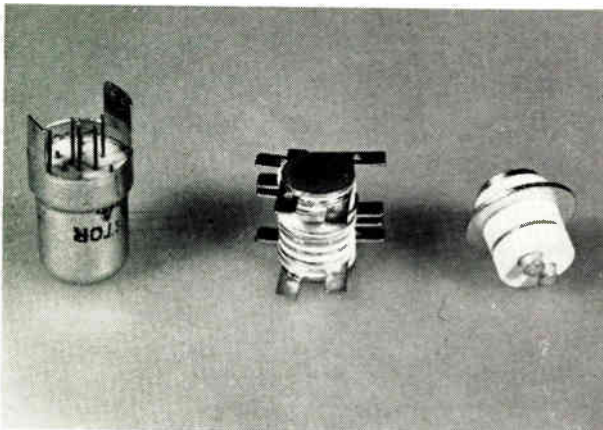
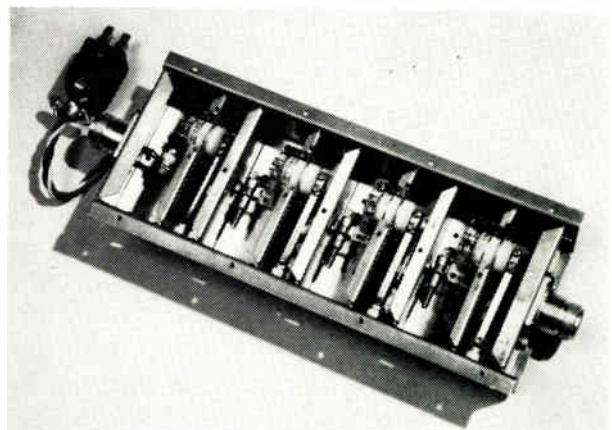


Fig. 5: Ceramic tubes provide 40db gain in an i-f at 1300mc.



This includes the new power tetrodes at 175 mc. and metal-ceramic triodes and tetrodes at 450 mc. (Fig. 3). Except for additional emphasis on the use of transistors, which can competently serve the more critical size and power factors, airborne communications and navigation equipment will follow this same pattern.

Another large field, the instrument market, provides a healthy and growing body of applications for tubes in such items as oscilloscopes, spectrum analyzers, gas-tube counters, RFI detectors, vacuum tube voltmeters and many others.

### Military

While it appears at this point that both transistors and tubes will be succeeded in the large volume military uses by integrated circuitry—either semiconductor or thin-film—such devices still are severely limited by intolerance to both high temperature and nuclear radiation, and by application techniques. Design choice may be severely limited.

The presently-available devices which most easily tolerate these difficult environments are the new, small metal-ceramic tubes (Fig. 4). Their tolerance is inherent in the characteristics of the ceramic and metal materials used—which have been carefully developed with this purpose in mind.

Such tubes can, and are, providing top electrical performance in military equipment where low cost, reliability and performance are the key factors. No other devices of comparable size and weight can attain the combination of power, high frequency, low noise and bandwidth possible with small ceramic-metal receiving tubes. (Fig. 5)

Small transmitting tubes, too, will continue to supply those applications where a few kilowatts of peak pulse output are needed for radar, beacon

transponders, altimeters, and telemetry equipment. (Fig. 6) The same is true of receiver local oscillators in these applications, where ceramic triodes will save weight and space.

In phased-array radar, where linearity and freedom from phase-shift are vital, tubes will see use in the output stages and in beam-deflection phase comparison circuits.

Even in battery-pack field transceivers, where the low-level stages are transistorized, filamentary tubes are used in the power output stages for better uniformity, gain and power at high frequencies.

Present miniature and subminiature tubes in the "reliable" series will continue in use for many years, as equipment still is being designed around them, and they enjoy a good replacement market.

### Space

Recent work on high-current ceramic triodes has shown their feasibility for C- or X-band work where these frequencies must be used to transmit through the plasma sheath formed around a space vehicle during re-entry. Useful power from triodes has been obtained at 10,000 mc. and upwards—a significant "raising-of-the-sights" on the part of the tube industry. (Fig. 7)

This work has shown the feasibility of using triodes for such super-high frequency operation in both pulsed transmitters or receiver local oscillators. Performance-to-weight and cost is far more favorable with triodes, as compared to present microwave klystrons, magnetrons, or TWTs. These new triodes are no larger than the eraser on the head of a pencil.

As shown by the Telstar experience, radiation damage can pose a serious threat in space electronics. These metal-ceramic tubes have a tolerance 10,000

Fig. 6: Triodes generate high peak pulse power up to 3.5gc.

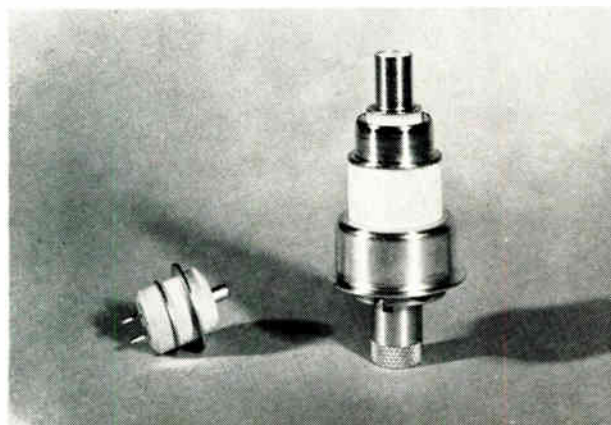
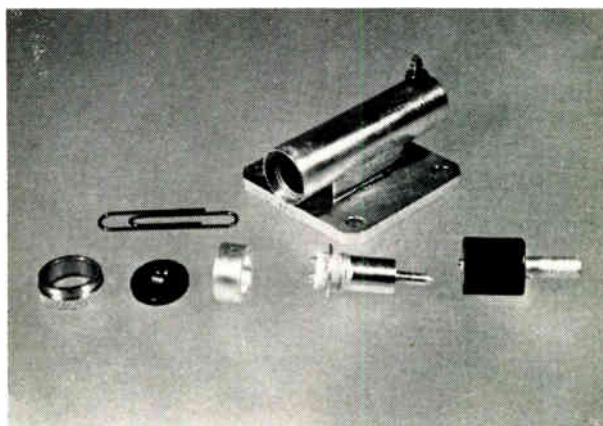


Fig. 7: A special metal-ceramic tube provides 20mw at 10gc.



## RECEIVING TUBES (Concluded)

times higher than the active components in most presently-designed space electronics. Although perhaps more costly from the viewpoint of space and power consumption, it may be that ceramic tubes will provide the necessary reliability in facing radiation in space.

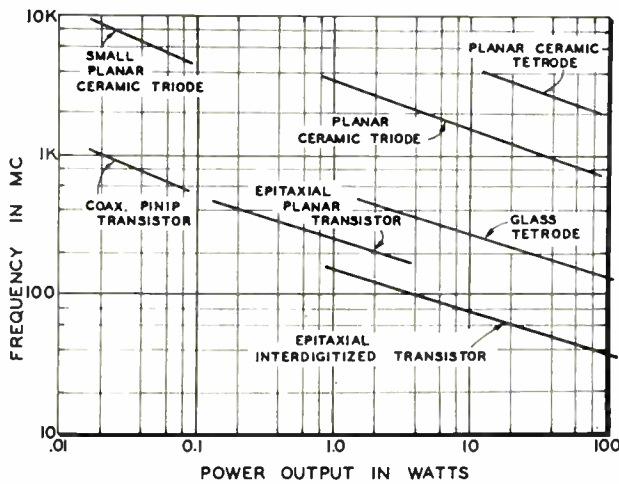
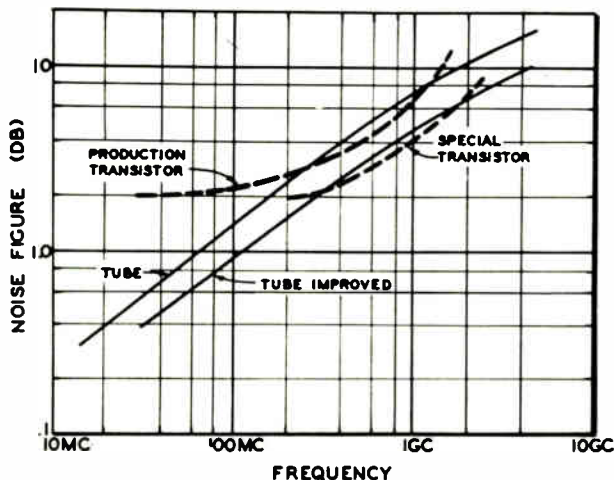


Fig. 8: CW power output vs. frequency for available devices.

Fig. 9: Noise figure versus frequency for current state-of-the-art (devices not used as parametric amplifiers).



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In fact, both ceramic tubes and heaterless ceramic diodes and triodes combined in the integrated circuitry known as Thermionic Integrated Micro Modules (TIMM circuits) have been tested in the core of a reactor. Results indicate that they could be used for control, navigation or communication purposes in a nuclear-powered missile or space ship without the need of radiation shielding, which adds weight. Needless to say, they also can withstand a much wider range of temperature than any other active electronic component. Ceramic tubes have operated while glowing red-hot; and TIMM circuits operate normally at 580° C.

Using tube-derived technology, TIMM circuits have been successfully produced in a wide variety of circuit modules which have scores of resistors and capacitors—passive components—as well as diodes and triode control elements. These modules now are being evaluated for use in advanced air-borne and space electronics systems. They are competitive in size and weight with all other modular approaches to miniaturization.

Although not a tube in the normal sense, the thermionic converter—either vacuum or gas-filled, will be a strong contender in space applications for converting nuclear heat to useful power. Most of these will be of metal and ceramic to withstand the temperatures involved. And here, again, tube technology can be put to profitable use.

### Special Devices

The broad subject of tubes covers things like multiplier phototubes, which will continue to have many applications because of their exceptionally high speed of response.

The extremely high input impedance of electrometer tubes at present continues to maintain the significance of these devices in specialized functions.

Cold-cathode thyratrons and trigger tubes also still hold special fields of application where low standby power and the ability to hold off high voltages is combined with high peak-current capability.

Feasibility studies are being conducted on the development of tunnel cathodes, which if successful, could advantageously apply thin-film technique to produce "heaterless" receiving tubes.

A specialized version of a cathode ray tube, the so-called "tuning-eye" tube, will continue to be both necessary and useful in tape recorders as level indicators, in FM sets for tuning accuracy, and in other visual control applications.



Photoconductive cells of high quality are now being born of tube-derived techniques. Now available as single units, they will, in the future, be made in many specialized multiple arrays, such as for reading data from punched cards.

### Trends

In general, tubes will continue to improve in cathode current density, higher efficiency, higher frequency capability, warm-up time, and cost-per-function. Size per unit of output will decrease slightly as more efficient cathode and plate materials are developed. With the advent of more automatic assembly techniques and the consequent reduction in the human error factor, reliability will improve by two or three to one in most fields—continuing the steady progress which necessarily is slow as the figure nears 100%.

In the high-frequency region—above 1 gc.—ceramic tubes will improve in power output, gain-bandwidth product, and noise figure, by significant amounts. This will be directly related to the improvements in cathode current density mentioned above. Figs. 8 and 9 show the current state-of-the-art.

### Conclusion

While no one can predict anything with certainty in this fast-moving industry (as witness the fate of the many predictions periodically expressed for a short life for the tube industry since 1950), it is quite safe to suggest there is a very strong possibility that electronic tubes will still be used in large volumes at the turn of the next century—the year 2000.

This thought appears conservative when one examines the record. Available figures for receiving tubes alone show that nearly two generations were needed to build this portion of the tube industry from its inception in the early 1920's to the peak dollar volume of domestic manufacturers' sales in 1957. Since then the curve has leveled, and there is no indication that it will drop faster than it rose in the first 33 years. In fact, the electron control device market still rises rapidly so that the net effect on domestic tubes appears to be a slight decline resulting from imports, increased reliability and other devices.

But even if the receiving tube volume were to drop at the same rate as it rose, an extension of the curve shows that this one section of the industry would continue until past 1990!

Finally, consider the so-called "battle" between tubes and transistors. Engineering-wise, no such

strife ever has existed. For facts are facts; and at any one point in time the respective states-of-the-arts have dictated that tubes serve best in certain functions and transistors in others. (Any overlap has been quickly settled by economics or technical reasons.)

The only "battle" has been one of human minds—battles waged with words, too often the wrong ones, derived from what knowledge (or lack of it) the person speaking at the moment enjoyed. Such battles have raged hottest in the market-place—a rutted no-man's land singularly unfertile for the growth of engineering sanity. And this situation may continue for some time.

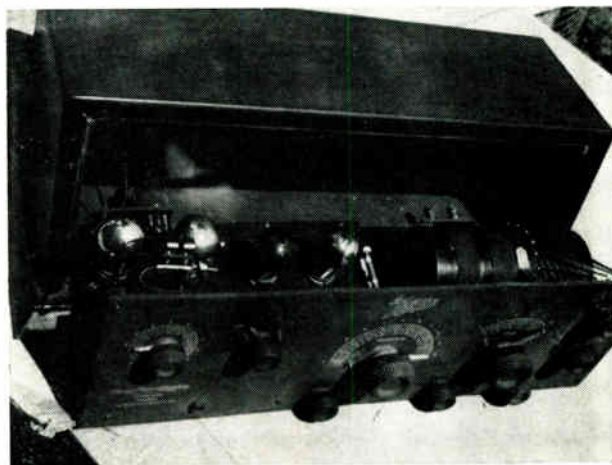
Periodically, however, the equalizing forces of economics and engineering will swing the scales into balance. And such a situation may well be approaching right now—which perhaps has led some observers into expressing the fallacy that tubes which never went away are "coming back."

Actually, the ideal sought by serious engineers in both fields is a reasonable situation in which the semiconductor and the tube each complement the other—each serving where its characteristics (including cost) are superior. But inasmuch as human endeavors and desires move more on the order of the oscillating pendulum, it may be unrealistic to hope that such a steady, logical and scientific balance ever will be maintained for any length of time. One can only hope that competent equipment designers will enjoy the freedom, knowledge and components necessary to accomplish their objectives within the limits of the state-of-the-arts at the time.

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### AN OLD SOLDIER

Anyone remember this one? A 1925 Model 3R Zenith radio receiver that was to the Charleston as color-TV is to the twist.



The industrial segment of the electronic industry is among the most fertile at the present time.

Tubes are playing an important role in this growing area.

Latest developments, availability and new applications of major industrial tubes are covered in this article.

# INDUSTRIAL TUBES TODAY

**ELECTRON TUBES** are used for many manufacturing and industrial applications. A number of switching functions are done by gas-filled tubes such as ignitrons and thyratrons. Rectification of high voltage is usually done by vacuum rectifiers and low-voltage rectification by gas-filled rectifiers. Induction heating requires generation of higher frequencies than normal power frequencies and uses high-vacuum triodes.

Some of these functions can be performed by semiconductor diodes which promise greater life and reliability than tubes. Semiconductor equipment has, in some fields, displaced tubes; but in other fields tubes are superior in performance and reliability.

## Ignitrons

The ignitron is a mercury-pool cathode, single-anode tube. It is triggered every conduction pulse by a current of about 20a. flowing into the mercury pool through a resistance rod, one end of which is submerged in the mercury. This rod is called an ignitor.

The two ignitrons shown here are both rated at 56 amperes.



Most of the tubes are water cooled. Vacuum envelopes and water jackets are of stainless steel to minimize corrosion. Electrical insulating bushings are of glass-kovar design. Connection to the anode is by a flexible cable and to the cathode by a strap projecting from the cathode of the tube for bolting to a buss-bar connection.

Recent design changes are a new cathode mounting at the top of the metal envelope that simplifies connection to the circuit. This reduces the cost of the massive conductors involved and provides a reduction of the magnetic field interacting with the mercury arc, reducing the tendency of the arc to contact the tube walls.

Now we will look at some of the current uses of ignitrons.

**Power Conversion:** For power rectification, several sizes of ignitrons are available. Many of the lower voltage and power uses are now being filled by stacks of semi-conductor diodes. However, uses for variable-speed motor drives and others where the phase shift control of output voltage is convenient are being filled by ignitron rectifiers.

**Capacitor Discharging:** In recent years, ignitrons have become of interest in connection with fast discharging of capacitor banks to obtain large currents. A new use is metal forming by hydraulic or magnetic impact. Several sizes of ignitrons are available for this work. Table 3.

**Resistance Welding Control:** Most ignitrons are used in the resistance-welding field. Two ignitrons connected in reverse parallel in series with a single-phase welding transformer is the common type used.

---

By **D. MARSHALL**

Engr. Supervisor of Special Purpose Tubes

and **JAMES A. HALL**

Advisory Engineer

Image Tube Dept.

Westinghouse Electric Corp.

Elmra, N.Y.

The ignitron acts in a switching capacity. Current to the welding transformer can be started and stopped. It can be controlled in magnitude and synchronized with the frequency of the power supply, reducing unwanted transients, or can be non-synchronized where transients can be ignored.

The three-phase welder circuits have additional features of reduced frequency output at the welding electrodes. This results in reduced secondary reactance and, therefore, improved primary power factor, and the primary current is distributed over the three phases, resulting in reduced phase unbalance.

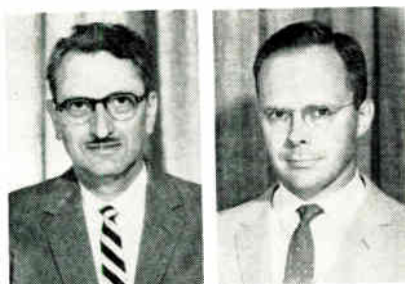
Ratings and outline drawings have been registered by the EIA (Electronic Industries Association) for a series of six sizes of resistance-welding-service ignitrons. Data on these ratings are enough to show capabilities of the tubes for single-phase welding control, Table 1.

### Thyratrons

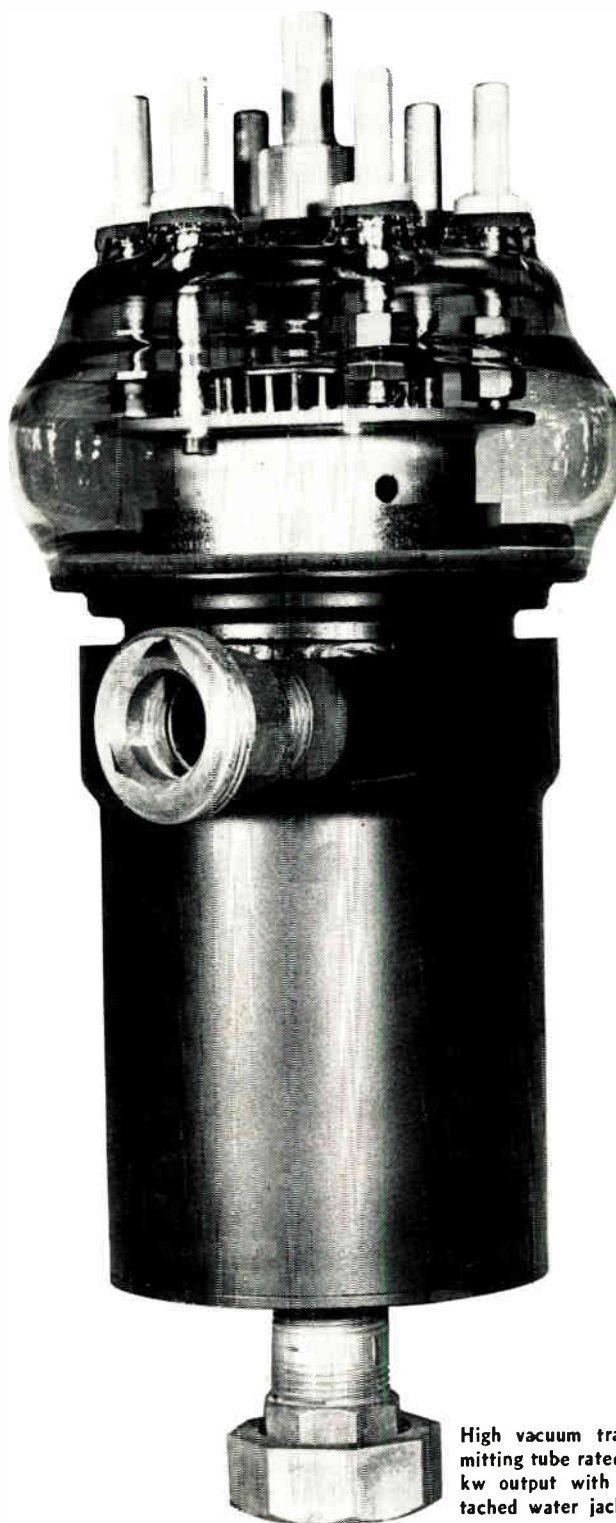
Thyratrons are grid-controlled, hot-cathode, gas-filled rectifiers. The gas filling may be mercury vapor or inert gases such as argon, neon, hydrogen, or xenon. Most thyratrons are made in glass envelopes. Method of mounting in the circuit may be by a pin base and socket, flexible leads, or lug bases. The latter two methods usually provide more reliable connections to the cathode heaters. This is important since the heater voltage may be 2.5v. and the heater current near 20a. A small resistance in the socket-to-base pin connection may be the cause of reduced cathode temperature. This results in reduced electron emission and thus reduced life.

They are used for voltage-controlled rectifiers, and for controlling the speed of dc motors, either by controlling the field currents or the armature current. There are many control situations where they are used as fast-acting relays and many small thyratrons are used in relaxation inverter timing circuits.

Thyratrons are used in large quantities in the ignitor circuits of ignitrons. Control of the ignitron is through the grid of the thyratron. Combining the two provides the needed control of the thyratron and the high current capability of the ignitron.



Authors:  
D. Marshall (l.)  
and J. A. Hall  
(right)



High vacuum transmitting tube rated 75 kw output with attached water jacket.

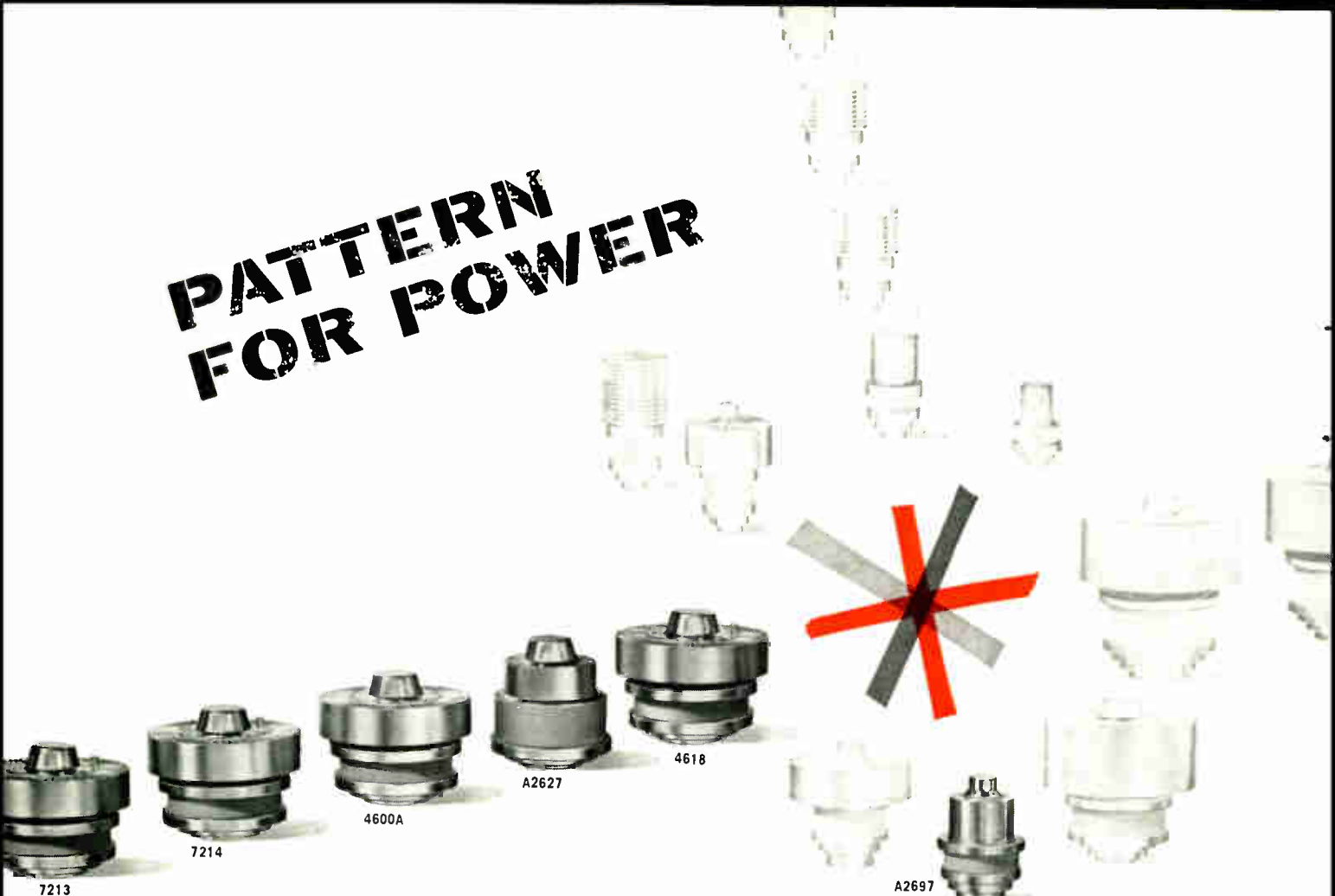
### High-Vacuum Tubes

**Radio-Frequency Heating:** Heating of metal parts by induction at kc and mc frequencies provides a method of annealing, hardening, melting, brazing, cleaning materials, parts and assemblies.

Source of the high-frequency power is often an oscillator circuit containing one or more high-vac-



# PATTERN FOR POWER



# RCA CERMOLOX FAMILY

Just five years ago RCA introduced the first members of the CERMOLOX "family," a new concept in power tubes incorporating precision-aligned grids, and ceramic-metal construction. Today, "second generation" types are emerging and forming individual "type-families." Highlighted here are just two of these "type-families:" RCA-7650 and RCA-7213. These rugged beam power designs provide the power required for virtually every type of electronic application. They are easily tailored to a variety of air-cooled or conduction-cooled techniques for communications, control, radar, UHF-TV, phased array, and distributed amplifier applications. CERMOLOX design is adaptable in power and size from watts to megawatts, and in frequency from kilocycles to gigacycles.

For technical information and assistance, consult your RCA Industrial Tube Representative or for technical data on specific tube types write: Section: F - 50 - Q. Commercial Engineering, RCA Electron Tube Division, Harrison, N. J.

| Tube Type | Capabilities  | Applications        | Cooling    |
|-----------|---|---------------------|------------|
| 7650      | 800 watts power output  | CW Amplifier        | Forced-Air |
| 7651      | 39,000 watts peak power output                                      | RF-Pulse Amplifier  | Forced-Air |
| 4614      | 2,500 max. plate volts<br>0.5 max. plate amperes                    | Voltage Regulator   | Forced-Air |
| A2697     | 3,000 max. plate volts<br>1.25 min. peak plate amperes at zero bias | Hard-Tube Modulator | Conduction |
| 7213      | 1,350 watts power output  | CW Amplifier        | Forced-Air |
| 7214      | 65,000 watts peak power output                                      | RF-Pulse Amplifier  | Forced-Air |
| 4600A     | 3,500 max. plate volts<br>1.0 max. plate amperes                    | Voltage Regulator   | Forced-Air |
| A2627     | 15,000 max. plate volts<br>20 max. peak plate amperes               | Hard-Tube Modulator | Conduction |
| 4618      | 1,350 watts power output  | CW Amplifier        | Forced-Air |



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## INDUSTRIAL TUBES (Continued)

uum triodes. These tubes are adapted from designs originally used in radio communications.

Basic principles are much the same as in earlier days. However, many improvements in materials, design and processing have resulted in improved efficiency and life.

Design improvements consist of shorter and lower inductance connections, giving better performance at the higher frequencies; stronger vacuum-envelope design; coated grid wires to reduce secondary grid emission; placement of cathode and grid to reduce the electron current to the grid on positive grid drive, thus reducing grid heating and permitting higher power outputs per tube.

Thoriated-tungsten cathodes are being used in many of the tubes. This gives greater cathode electron-emission, resulting in less heating energy needed for the cathode.

For tubes handling large power, cooling becomes important. As a result of analysis, efficient water jackets and air-cooled radiators have been developed.

A recent development has been cooling by evaporation. In the past, the cooling water had to be held to temperatures below boiling because of the insulating effect of the vapor bubbles which formed on the cooling surfaces. The new method uses carefully designed roughness of the cooling surface. This promotes release of the bubbles and increases the surface area. Evaporative cooling reduces water consumption and is important when cost of water is a factor.

Tubes are available in nearly uniform steps from 10 to 300kw power-output with operating frequency at full rating up to 22mc. These larger sizes are cooled by water flow or water evaporation. In sizes below 50kw, radiator-cooled tubes for use with fan-driven, forced-air cooling are available.

### High-Vacuum Rectifiers

High-vacuum rectifiers, up to 150kv. inverse-voltage rating and 2.5a. peak-current, are in general use. These are large glass-envelope tubes. They are used in smoke precipitators, capacitor charging and high-voltage testing equipment. Higher current and voltage ratings are available.

These tubes are designed for minimum X-ray output and minimum probability of cathode breakage. Their processing benefits from the recent improvement in high-vacuum methods.

Smaller vacuum rectifiers, in the 20kv. range with

250ma. rating, are also available for use with smaller equipment.

### Vacuum Gauges

As part of the improvement in high-vacuum methods, vacuum-measuring tubes of special design permit direct reading of pressure from  $10^{-1}$  to  $10^{-5}$ mm. of mercury in a "high-pressure" type, and  $10^{-3}$  to  $10^{-9}$ mm. in a "low-pressure" type. These are used in research, space environment simulation, electron tube factories, and industries engaged in high-vacuum work.

### Mercury Vapor Rectifier Tubes

The 857B hot-cathode, mercury vapor rectifier tube, rated at 20kv. inverse and 10a. average and the 869B, rated at 20 kv. inverse and 2.5a. average, are standard for medium voltage, fairly high-current uses. Many are used in the power-supply circuits of induction heaters. These tubes have shown ability to withstand voltage surges and short circuits. This is true even though used often with unreliable protective circuitry.

These are fairly large tubes. The 857B, for example, is 20 in. high and 7 in. in diameter.

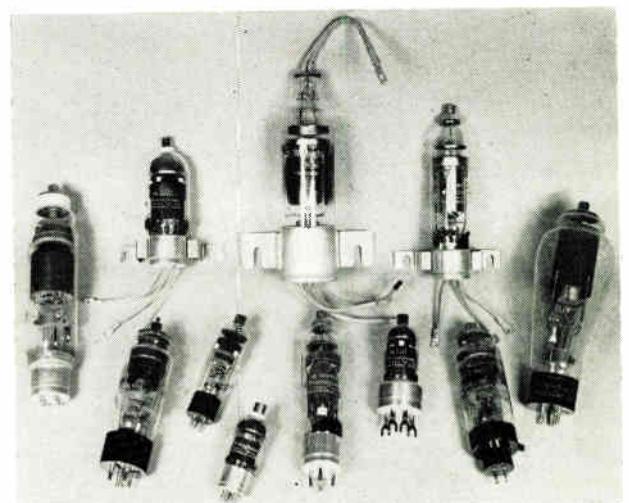
Smaller rectifier tubes for lower voltages are the 575 at 15kv. inverse, 2.5a. average and the 872A at 10kv. inverse, 1.25a. average. These tubes are about 10 in. high and 3 in. diameter.

### Imaging and Camera Tubes

Light sensitive tubes in industry are used mainly for inspection, measurement, and control, and more recently for surveillance or observation of areas which are remote, inconvenient or hazardous. Although the tubes themselves use little power, they are classed as power tubes. They are normally made by the power tube departments of the major tube manufacturers.

*(Continued on page 48)*

Assortment of thyratrons with various basing arrangements.



## INDUSTRIAL TUBES (Continued)



The Westinghouse WL-5997 X-ray image intensifier tube.

Three types of TV camera tubes are in industrial use today. Most widely used is the Vidicon, a one inch diameter tube which operates in compact equipment. It is designed to use camera lenses manufactured for 16mm. motion picture cameras. These tubes produce high quality pictures with 10 to 100 foot-candles illumination on the objects being viewed (normal factory or office area illumination levels). They have operating lives of 3000 to 8000 hrs. Present uses include remote viewing in connection with servo controlled manipulators for handling radioactive materials. TV cameras using vidicons are being used in many monitoring and surveillance applications.

Vidicons designed for operation under either standard broadcast or slow-scan conditions are also available to permit scanning pictures, diagrams, or orders and sending this information to another plant location over telephone lines.

A special purpose TV tube, the Permachon camera storage tube, operates in a standard vidicon camera and can take flash exposure pictures and display them on a standard TV monitor, for times up to several minutes. This device is useful for detailed studies of rapidly moving parts in a high speed production process.

Another TV camera tube in industrial use is the image dissector which needs much light but is simple and long lived. It is used by some electric power companies for functions like the remote monitoring of boiler water levels. The image orthicon, a very sensitive tube used in entertainment broadcasting, is also used. Although expensive, \$1000 to \$3000 for the tube alone, and needing camera circuitry costing from \$4000 to \$20,000, and despite its short life of 500 to 2000 hrs., it will come closest to seeing in the dark of any tube in production today. They are good where illumination is critically low, including TV

microscopy in the ultra-violet, inspection of photo-sensitive materials by low level and infrared radiation, and remote viewing uses. Most startling of these image orthicon uses is the installing of a water cooled TV camera within a blast furnace in a German steel mill to observe the ore reduction process as it happens.

### X-Ray Sensitive Tubes

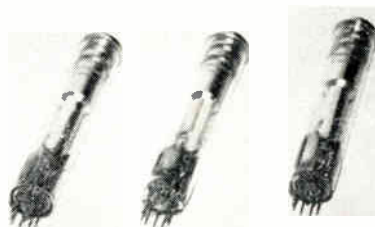
A second major use for photo-sensitive tubes is in the X-ray examination of industrial products. The tire industry is using automated high speed X-ray inspection as a quality control measure. To cut ex-

Image orthicon camera tubes—WL 7611, WL 22722 and WL 22724.



penses for photographic supplies, they use an X-ray image converter like the WL5997 to visually inspect for defects in the tire carcass. The X-ray image intensifier tube is used rather than direct viewing of a fluorescent screen to present a bright, readily visible image to the operator and because the X-ray tube voltage and current can then be set for high resolution, high contrast, and longer tube life.

A similar arrangement has been used for inspection of welds and castings, which, because of their X-ray opacity, need both high intensity and intensi-

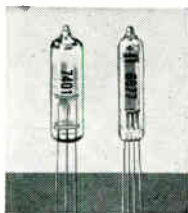


Vidicon-like devices used in industrial applications are (l to r), the WL 7290, WX 4887 and WL 7383.

fication of the output image to give a directly visible picture of flaws. For small items like transistors and complete solid state microcircuits, high resolution X-ray sources and X-ray sensitive vidicon type camera tubes are used to give a magnified TV picture of connections or of desired density variations within the device.

The method is important for a small number of high reliability items in which control cannot be assured by destructively testing samples from a large production run. (See Rating tables on page C50)





INDICATOR TUBES

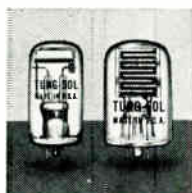
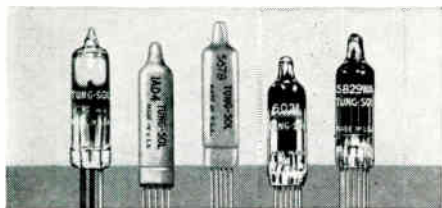
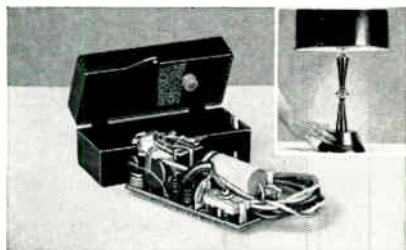


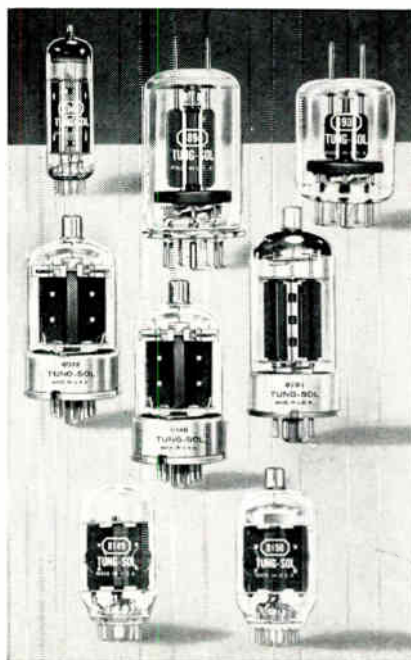
PHOTO TUBES



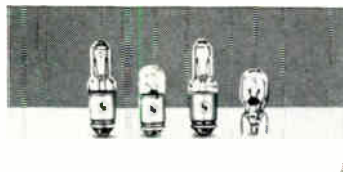
SUBMINIATURE TUBES



DYNAQUAD I: TOUCH CONTROL MODULES



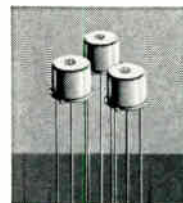
TRANSMITTING TUBES, INCLUDING COMPACTRON TYPES



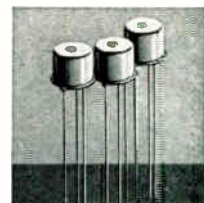
SUBMINIATURE LAMPS



GERMANIUM POWER TRANSISTORS



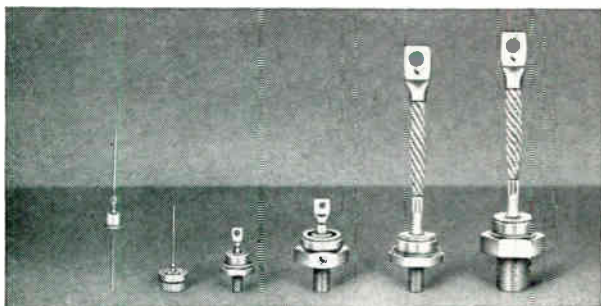
DYNAQUADS



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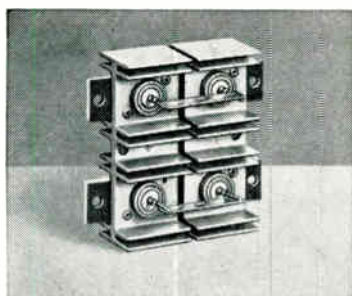
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**INDUSTRIAL TUBES (Concluded)**

Table 1  
 EIA REGISTERED IGNITRON RATINGS\*

| Type Number | Max. Ave. Current Per Tube (amp.) | Max. Pk. Current (amp.) | Max. Averaging Time (sec.) | Tube Dimensions Diameter (in.) | Height (in.) |
|-------------|-----------------------------------|-------------------------|----------------------------|--------------------------------|--------------|
| 5550        | 22.4                              | 850                     | 11                         | 2 1/8                          | 9 7/8        |
| 5551        | 56.0                              | 1,700                   | 9                          | 2 3/4                          | 13           |
| 5552        | 140.0                             | 3,400                   | 7.1                        | 4 1/4                          | 14           |
| 7681        | 210.0                             | 5,100                   | 7.1                        | 4 1/4                          | 17 1/2       |
| 5553        | 355.0                             | 6,800                   | 5.6                        | 5 5/8                          | 19 1/2       |
| 7151        | 900.00                            | 13,600                  | 4.5                        | 9                              | 22 3/8       |

\*Data listed are for 400 to 500 volt RMS, 25 to 60 CPS supply.

Table 2  
 RECTIFIER IGNITRON REGISTERED RATINGS

| Type Number | Max. Ave. Amps/Tube (amp.) | Max. Inverse Voltage (v.) | Tube Dimensions Diameter (in.) | Height (in.) |
|-------------|----------------------------|---------------------------|--------------------------------|--------------|
| 5554        | 100                        | 2,000                     | 4                              | 16           |
| 5555        | 200                        | 2,000                     | 5 3/4                          | 19 1/4       |
| 5630        | 50                         | 20,000                    | 5 3/4                          | 22           |
| 6228        | 150                        | 20,000                    | 9                              | 41 1/2       |

Table 3  
 CAPACITOR DISCHARGE IGNITRONS

| Type Number | Peak Current (amp.) | Max. Ave. Current (amp.) | Peak Voltage (v.) | Tube Dimensions Diameter (in.) | Height (in.) |
|-------------|---------------------|--------------------------|-------------------|--------------------------------|--------------|
| 7703        | 100,000             | 0.6                      | 20,000            | 2 1/8                          | 7 1/4        |
| 8306        | 35,000              | 0.6                      | 15,000            | 2 1/8                          | 7 1/4        |

Table 4  
 TYPICAL THYRATRON RATINGS\*

| Ave. Current (amp.) | Peak Current (amp.) | Peak Voltage (v.) | Max. Averaging Time (sec.) |
|---------------------|---------------------|-------------------|----------------------------|
| 0.1                 | 1                   | 1300              | 30                         |
| 1.0                 | 8                   | 1300              | —                          |
| 1.6                 | 20                  | 1500              | 15                         |
| 3.2                 | 40                  | 2500              | 15                         |
| 6.4                 | 80                  | 2500              | 15                         |
| 16.0                | 160                 | 1250              | —                          |

\*Formal standardization of thyratrons is not effective. Type numbers, therefore, are not universal and are not given.

**NEW TECH DATA**

**Corona Stabilizer**

Type SC5 is a new double-ended tube. Its double top cap facilitates easy fitting and greatly improves reliability by reducing the possibility of internal flashing or accidental mechanical damage to the glass envelope. It is available at output voltages of 5,000, 6,000 and 6,800v. operating over a current range of 25µa to 1ma. The M-O Valve Co. Ltd., Brook Green Works, London W.6, England.

Circle 563 on Inquiry Card

**Silicon Rectifiers**

Eight hermetically-sealed silicon rectifiers covering the current range from 25 to 250a. are available. Each is available in a choice of 6 voltages: 100 to 600 PIV and 70 to 420 max. RMS input volts. All units feature hard solder at every junction interface and oversized junctions that hold a max. forward voltage drop to 1.2v. Semiconductor Div., Sarnes Tarzian, Inc., 415 N. College, Bloomington, Ind.

Circle 564 on Inquiry Card



## NEW TECH DATA

### Tube Brochure

More than 600 different tubes are cross-indexed by type number, function, and operating characteristics in this 16-page brochure. Tubes include diodes, twin diodes, triodes, dual triodes, multi-section types, thyratrons, decade counters, radiation counters, etc. Industrial Components Div., Raytheon Co., 55 Chapel St., Newton 58, Mass.

Circle 328 on Inquiry Card

### Magnetron Design Aid

"Magnetron Application Notes," 21 pages, is an 8 section report to aid in designing circuits that use magnetrons. Included are sections on magnetron test specs., effect of system on tube, measurements of system and tubes as a unit, and application notes for testing. Graph, tables, and equations are also included. Sylvania Electronic Tube Div., Seneca Falls, N. Y.

Circle 329 on Inquiry Card

### Cooling-Water Repurifying

Bulletin #149-B describes cooling-water repurifying system which adds to life of UHF transmitting tubes. System consists of mixed-bed and oxygen-removal cartridge holders, Submicron® filter and purity meter. It comes completely assembled, ready for operation. Bulletin tells why pure water is needed to safeguard life of transmitting tubes. Barnstead Still & Sterilizer Co., 201 Lanesville Terrace, Boston 31, Mass.

Circle 330 on Inquiry Card

### Backward-Wave Oscillator

SYB-4403 features packaging which makes external cooling unnecessary. The tube is tunable over the 2.0Gc to 4.0Gc range, with a power output of 100mw. and a power variation of less than 2db. from a straight line. The Microwave Device Div., Sylvania Electric Products Inc., 730 Third Ave., New York 17, N. Y.

Circle 331 on Inquiry Card

### Phototubes

Three low-noise multiplier phototubes, differing basically in their photo-cathode spectral responses, are available from ITT Industrial Laboratories, Div. of International Telephone and Telegraph Corp., Ft. Wayne, Ind. All are 16-stage units; they withstand 25g's of vibration and 50g's of shock. Uses include star tracking, guidance, field uses in laser receivers, and unambiguous photon counting.

Circle 332 on Inquiry Card

### Orthicon Selector

This quick selector publication gives sensitivity and spectral response for Westinghouse tubes. Included in the operating characteristics are the min. illumination ratings for 200 and 400 TV lines. Westinghouse Electronic Tube Div., Elmira, N. Y.

Circle 333 on Inquiry Card

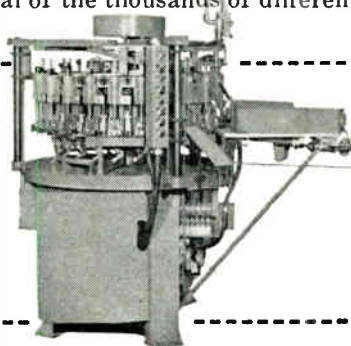
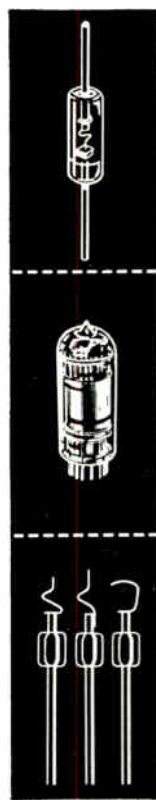
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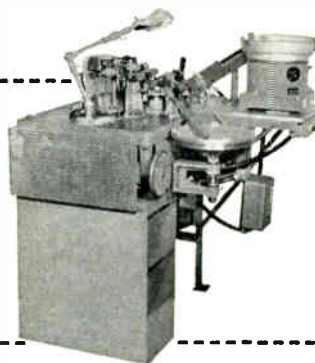
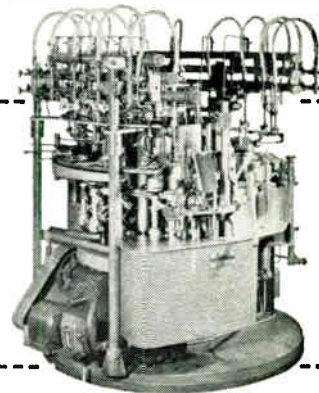
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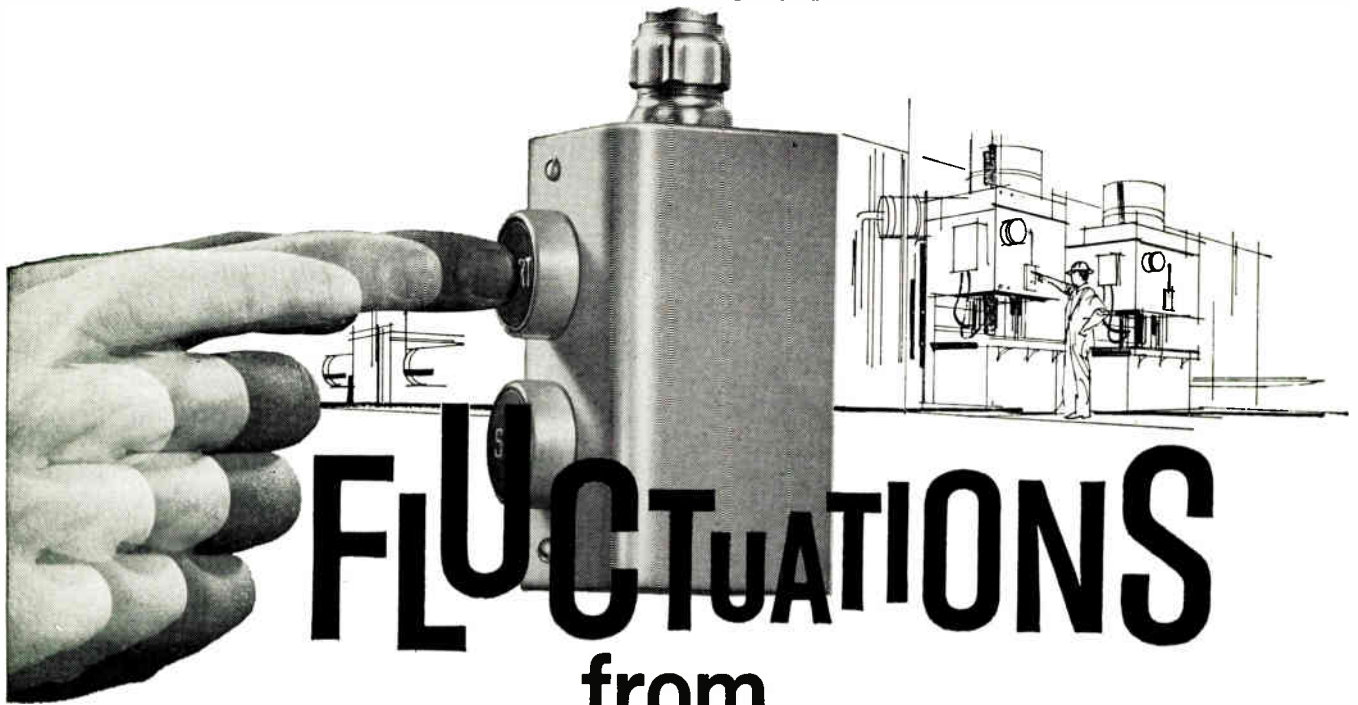
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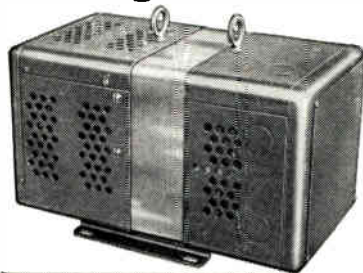
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# SECTION **D**

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## **CIRCUIT COMPONENTS**

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## RESISTORS: THEN AND NOW

In 80 years since carbon film resistors first made their appearance the construction and materials of these devices have changed radically to meet new demands. The most challenging demands are being made today. Here are comments on the evolution of resistors and on changes expected in the next few years.

THE USE OF A CARBON COMPOSITION FOR RESISTORS dates back to about 1885. In this first era, scientists and investigators working in electromagnetic wave propagation and electrical power utilization often had to devise their own methods of inserting resistances, such as carbon blocks or pieces of wire, in their experimental circuitry. Then World War I provided the impetus to use radio communications on a large scale. This led to both commercial and military demand for resistors.

In the second major era of component history, continuing through the 1920's, the first commercial radio transmitters went on the air. Thousands of experimenters demanded that the industry produce devices for home-built receivers. Fig. 1 shows some of the resistive components of this era; the acknowledgement contains names of these antique components. With this development came a new terminology for dealing with these devices. For example, resistors began having uniformity of case sizes, wattage rat-

Fig. 1: The early resistors shown below were used in the 1920's. They are a far cry from the sophisticated units in use today.





ing, ambient temperature ratings and purchase tolerances. Many varieties of carbon composition and wirewound resistors became available.

### Carbon Film Resistors Appear

In the 1930's, the mass manufacture of radio receivers became a major industry. The importance of improving and standardizing resistors and other components was more evident. A new type of resistor, the carbon film, was marketed during this period. This invention was significant, because it completed the 3 families of discrete resistor components as we know them today: wirewound, composition and film types. Fig. 3 shows some samples and their cross sections.

Changes in construction, encapsulation and identification of these 3 basic groups provide a huge variety of choices today. For instance, insulation may be provided by molding, conformal coating or sleeving. Common lead terminations materials are copper, Dumet and nickel. Complete immunity to environmental conditions can be achieved by hermetically sealing the resistive element in an enclosure, such as shown in Fig. 4. Marking for part identification is done either with printed characters or color bands.

With development of the 3 basic types, the stage was set for the third era of components. World War II equipment, circuit designs and applications needed major strides in understanding and documenting resistor capability in such areas as temperature coefficient, temperature cycling, shock, vibration, load life, moisture resistance, voltage coefficient and high temperature endurance. Many methods of testing and performance levels for these parameters were evaluated during this period, and basic concepts for full scale industry and military standard specifications were set.

Another key factor was recognized and dealt with at this time: the use of statistical quality control concepts to resistor performance and test evaluation. Tables of sampling plans defining test lot sizes, degrees of statistical confidence levels, and associated risks were developed. These were to assure designers of the validity of performance claims and guarantees of component manufacturers.

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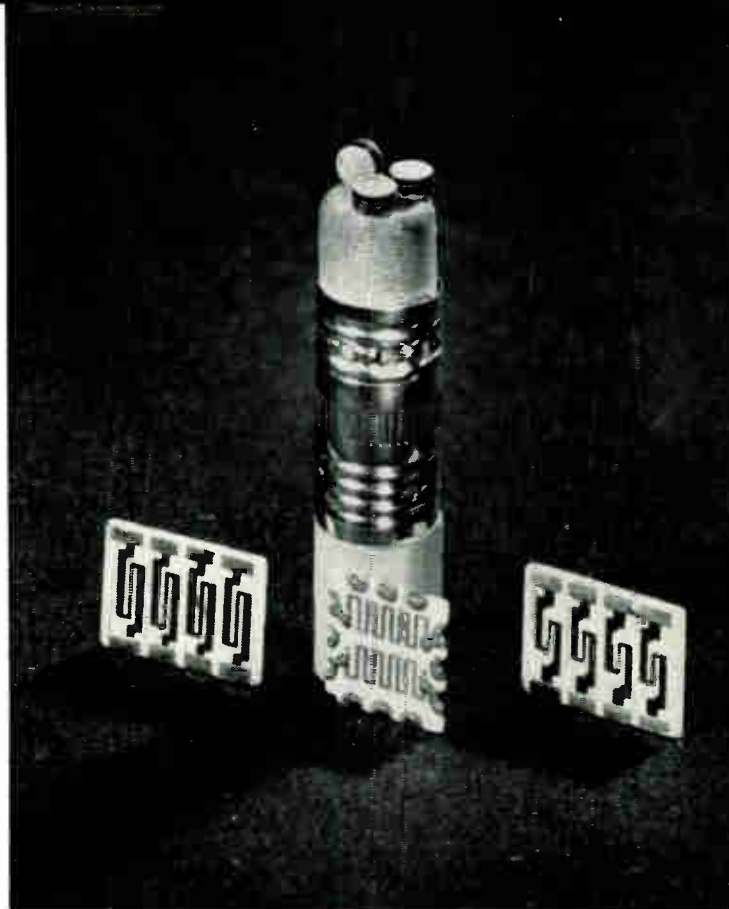


Fig. 2: The latest stage of resistor development is in the wafer and pellet film resistors for greater miniaturization.

### Generating Military Specifications

The desire for standardized resistor quality and performance continued through the 1940's and into the 1950's. Military and industrial groups worked closely together, generating a series of military specs for fixed resistive components. This was accompanied by the development of two significant and parallel specifications that were aimed as much at all components as they were at resistors. These are Mil-Std-105 (Sampling Procedures and Tables for Inspection by Attributes) and Mil-Std-202 (Test Methods for Electronic and Electrical Component Parts). The use of these documents, along with standard product descriptions, such as those found in specs listed in

TABLE 1  
Early Fixed Resistor Military Specifications

| Description of Resistor       | Component Designations | Specification       | Date of Basic Spec. |
|-------------------------------|------------------------|---------------------|---------------------|
| Fixed composition (insulated) | RC                     | Mil-R-11            | Feb. '53            |
| Fixed film (high stability)   | RN                     | Mil-R-10509         | Sept. '52           |
| Fixed wirewound (power type)  | RW                     | Mil-R-26            | Dec. '52            |
| Fixed film (power type)       | RD                     | Mil-R-11804         | Mar. '53            |
| Fixed film (insulated)        | RL                     | Mil-R-22684, (Navy) | Apr. '61            |
| Fixed wirewound (accurate)    | RB                     | Mil-R-93            | Mar. '52            |

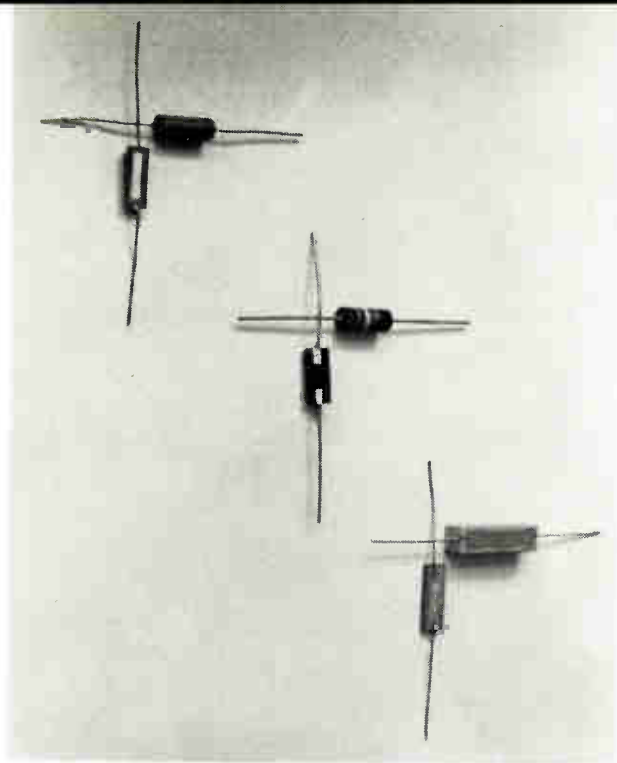


Fig. 3: Three general types of resistors and their cross sections are shown. They are the film, composition and wirewound.

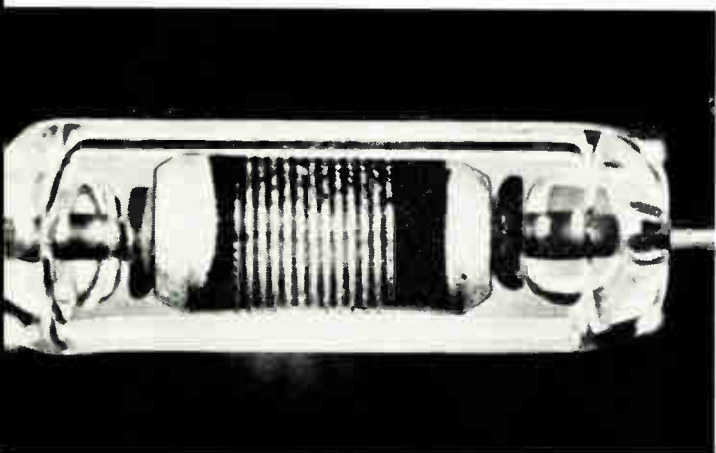
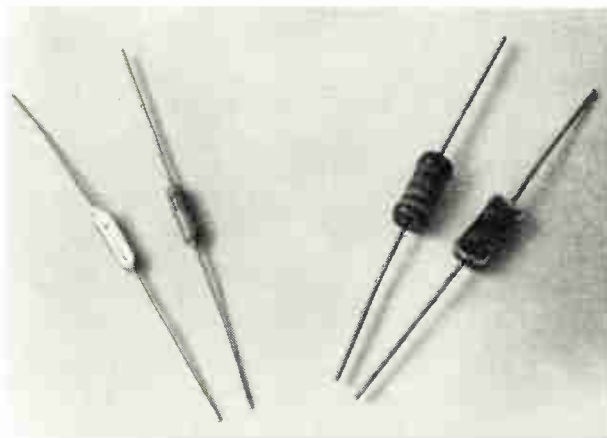


Fig. 4: Immunity to environmental conditions can be achieved by hermetically sealing the element in an enclosure.

Fig. 5: Samples and longitudinal sections of metal alloy and metal oxide types of resistors are shown in photo below.



## RESISTORS (Continued)

Table 1, helped assure quality resistors at a low cost. They also paved the way for improvements in size, materials and electrical performance.

Here it should be noted that not only resistors, but also other components were undergoing much the same general pattern of standardization and advancement during this period.

A classic example of advancement in the resistor industry is shown by the evolution of Mil-R-10509. The original issue of this spec. in September 1952 contained five wattage ratings from  $\frac{1}{4}$  watt through 2 watts. Each had two temperature coefficient characteristics. Since then, the spec. has been revised 3 times and is currently undergoing a fourth review. The original 10 resistor combinations have been obsoleted and replaced by 27 resistor combinations that include five temperature coefficient characteristics, one hermeticity characteristic, and wattage ratings from  $\frac{1}{10}$  watt through 2 watts.

During this period, the original carbon film resistors were modified and improved. Also, the metal alloy film resistor and the tin oxide film resistor were qualified to the basic standards in the specification. These, too, now are major factors in the film resistor market. Fig. 5 shows samples and longitudinal sections of metal alloy and metal oxide types.

### Establishing Reliability

Since the late 1950's, there has been a fourth major phase in the history of resistors. This phase results from industrial and military needs for components having established reliability. Modern systems made it necessary for circuit designers to have access to resistors and other components with proven minimum failure rates within specified performance limits. The first systems using this concept of established reliability achieved proof of reliability in many forms. Each resistor supplier and each equipment manufacturer had opinions and ways for both obtaining and proving component failure rates. However, in the case of standard components, it became apparent that standardization of these "reliability techniques" would be the only way to obtain the economies and availability of parts necessary to support system usage over the years.

Again, industry and military study groups worked together to find philosophies and techniques to guide this standardization. Many of the earlier concepts were applicable to established reliability needs, but it soon became evident that these concepts were much more complex when implemented in standard reli-

ability specifications. Basic materials and manufacturing processes needed detailed analysis to "build in" reliability. Previous "proof of quality" testing had to be upgraded in quantity by many orders of magnitude.

The culmination of this effort was reached in 1962 when the first coordinated military spec. Mil-R-55182 (Resistors, Fixed, Film, Established Reliability), was issued as a procurement document. Missile and space equipment designers now had a standard document specifying that parameter of reliability that had been so elusive. Since the issuance of the document, several other components types have achieved, or are in the process of achieving, this status. They include fixed capacitors, composition resistors, connectors and wirewound resistors.

As work in the established reliability phase continues, it is of interest to note the appearance of several technical concepts that simplify the understanding of reliability for resistors. Becoming accepted practices in the industry are tests such as power burn-in to eliminate early life failures, high voltage stresses to detect product or manufacturing deficiencies, and resistor current noise to evaluate degrees of individual product likeness. Much of the information obtained through studies can be applied to standard part manufacture and usage with resultant upgrading of the entire industry.

Accumulation of resistor performance data through established reliability testing has permitted acceptance of the validity of "worst-case design." Statistically proved performance parameters often reduces the circuit design effort significantly. Knowing accurate resistor design and tolerances permits engineers to optimize circuit performance and reduce cost of the overall system. Component reduction can be accomplished with this technique, resulting in decreased power consumption and heat dissipation, and increased reliability and overall economy.

The established reliability phase will continue at least through the foreseeable future of discrete resistor components. This phase is being complemented by major efforts toward reduction of size and weight. Also, improvements are expected in the areas of reliability, electrical performance, increases in usable ambient temperatures, determination of long-term performance under conditions of radiation and hard vacuum, adaptations of multiple performance ratings for single components, and modification of circuitry to take full advantage of presently unused resistor performance capability.

#### Future Aspects

A fifth and still embryonic phase for the resistor

is being created, along with other components, by changes in shapes. Resistive elements deposited in various patterns on flat substrates comprise one kind of modification. Small pelletized elements that can be inserted in a three-dimensional matrix have proved themselves an alternative. Fig. 2 shows both wafer and pellet film resistors. Combining passive elements with active transistor elements to create a functional electronic block, as in Fig. 6, is another approach. Many advantages of miniaturization are available through these new approaches.

Despite successes to date, major investigations will be needed to provide direction and balances for the inherent performance compromises that will face circuit and system designers as they adopt these new component forms. Such parameters as life stability, temperature coefficient, tolerance and reliability must follow the same rigorous path as that traveled by the discrete component. Also, industrial capability to supply vast quantities at low cost must be developed.

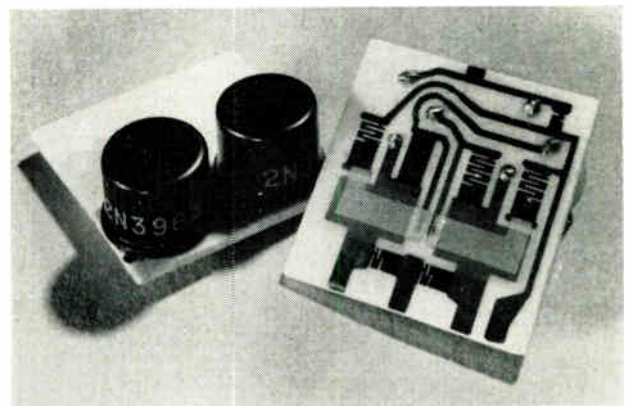


Fig. 6: Combining passive elements with active transistors is one approach being used to create a functional block.

The resistor today is a precise and sophisticated component. Its capabilities and limitations are known and documented to a very high degree. Though there are new and exotic resistor forms, the success of most circuit and system applications in the practical future will depend on the high performance and low cost of available products.

#### Acknowledgment

The author is grateful to Mr. C. H. Daykin of Geneva, N. Y., for supplying the components shown in Fig. 1. Names on these components are as follows: Dejur, Bosch, Radiall Company (Amperite), Arthur H. Lynch, Inc. (Lynch Equalizer), Pilotohm, Allen Bradley (Bradley-unit) International Resistance Co., and Daven Co. (Glastor and Resisto-Coupler).

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Thermoelectrics are introducing significant new trends in heating and cooling. These include infrared detection and cold-probe electronic measurements. Other devices in the field are shown and their effect on future products is predicted.

# THE OUTLOOK FOR THERMOELECTRIC DEVICES

RECENT ADVANCES IN THE AREAS of development and cost reduction are speeding the pace at which thermoelectric devices are reaching the point of commercial usage.

Currently, a number of manufacturers are making feasibility studies, checking prototype designs, or planning production of equipment for these classes of use:

|                                |                         |
|--------------------------------|-------------------------|
| Film Storage                   | Film Developing Tanks   |
| Parametric Amplifier           | Liquid Circulators      |
| Coolers                        | Drug Storage            |
| Incubators                     | Food Storage            |
| Dew Point Equipment            | Reference Chambers      |
| Gas Chromatography             | Cooling Electronic      |
| Guidance Control Systems       | Components              |
| Constant Temperature Baths     | Cooling Electronic      |
| Controlled Environment Chamber | Circuits                |
|                                | Melting Point Apparatus |
|                                | Microscope Stages       |
|                                | Electronic Measurement  |
|                                | Food Serving Equipment  |

## Heat Pumps

To stimulate application development activity, there are system-oriented thermoelectric units which appreciably reduce both the time and cost of developing prototype equipment. Introduced this year, these consist of assembled heat pumps of various ratings with matched power supplies, ready to be installed in many consumer products and commercial equipment.

The units are designed as a complete package with a cold plate to mount to the load, a thermoelectric module to do the heat pumping, and an integral fin-

fan combination to efficiently and conveniently dissipate heat to the ambient. (See photograph.) With them, engineering and fabrication time is reduced to a minimum. The application problem is reduced to the selection of the proper unit, mounting the electrically insulated cold plate to the load, and connecting the unit electrically.

Heating and cooling are done by varying the amount and direction of device current. With the right control system, the units can be used to cool loads over wide ambient ranges or to hold a desired temperature.

The integral fin-fan combination on the units allows ratings to be given in terms of specific cold-side temperature when the ambient temperature is known. The cold-side temperature is the actual information needed. The current necessary to produce the desired cold-side temperature can be found by reference to technical data.

As an application example, consider an infrared detector with preamplifier that is located in the roof trusses of a plant. The device is used to position large equipment, and in operation the ambient is 50° C (122° F). The detector has its maximum chassis, with its 5.5 w load, at this temperature.

The chassis is bolted to the cold plate of the module and a foam insulation placed about the chassis to reduce the ambient thermal loading. The total heat load from ambient is 2 w, so the total load is 7.5 w. Fig. 1 shows a plot of the characteristics of a Westinghouse W832G01 cooler in an ambient of 23.9°C. This plot give a cold-side temperature for various device currents and thermal loading. However, the present ambient is 50°C, so it becomes necessary to refer to Fig. 2, which is a plot of the algebraic cold-side correction temperature vs. ambient temperature. From these, a projected cold-side temperature can be found as follows:

$$T_{\text{projected}} = T_{\text{desired}} - T_{\text{correction}}$$

$$T_{\text{projected}} = 10^{\circ}\text{C} - (19^{\circ}\text{C}) = -9^{\circ}\text{C}$$

Referring again to the 23.9°C curve on Fig. 1, a -9°C cold side temperature with a 7.5 w load is obtained with a device current of 20 a.



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## Cascaded Units

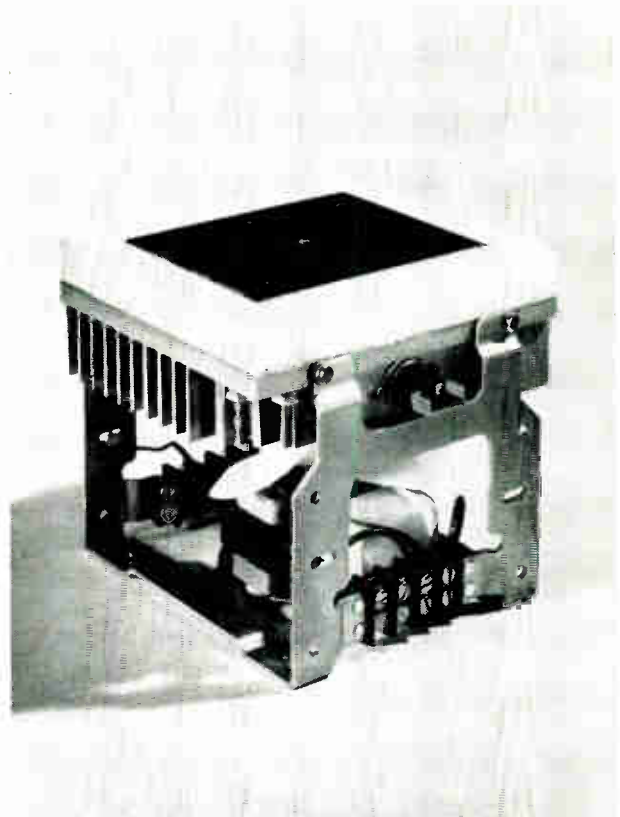
A cascade model provides a  $-50^{\circ}\text{C}$  ( $-58^{\circ}\text{F}$ ) cold-side temperature while cooling a 400 mw load. See photograph of this type unit. Designed to operate with 24 a. of dc current, the cascade effect is achieved by cooling the hot side of one thermoelectric module with the cold side of a larger one.

The cascade unit (type W832G03) can be used in the building of apparatus for freezing point measurements, dew point meters, freezing traps, photomultiplier tube coolers and many other low temperature uses.

Ratings of each of the units are based on an ambient temperature of  $23.9^{\circ}\text{C}$  ( $75^{\circ}\text{F}$ ). Cooling capacities are increased when operating under conditions wherein the temperature difference between ambient and cold side is lowered.

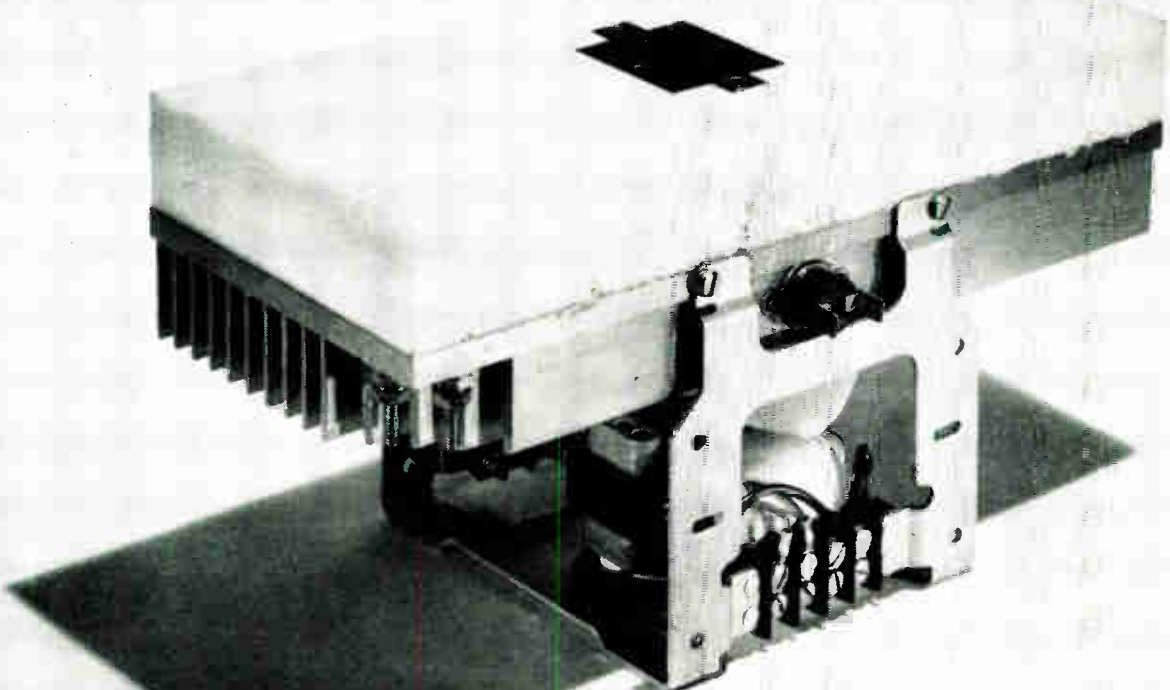
To speed mounting of the units, a set of tapped holes is provided in the cold plate. This helps to reduce the cold-side interface thermal drops, and hence increases pumping capacity. In those cases involving higher heat loads or difficult mounting geometry, several units can be applied to increase the heat pumping capabilities and use whatever mounting areas are available. The units also can be used to cool a chamber by placing one or more units into the chamber wall.

To enhance unit dependability, features such as



Thermoelectric heat pumps, like the assembly seen equipped with cold plate and integral fin-fan combination, facilitate application design. Matched power supplies are also available.

A cold side temperature of  $-50^{\circ}\text{C}$  is provided by this two-stage cooler. The cascade effect is achieved by cooling the hot side of one thermoelectric module with the cold side of a larger one.



## THERMOELECTRIC DEVICES (Continued)

"impedance-protected" fans rated for ambient temperatures to 125°F, a thermostatic cutout switch placed into the fin to prevent excessive temperature rises, and wide spaces between fins to prevent clogging from industrial atmospheres, have been made part of the standard design.

The units are completely wired and tested. Each

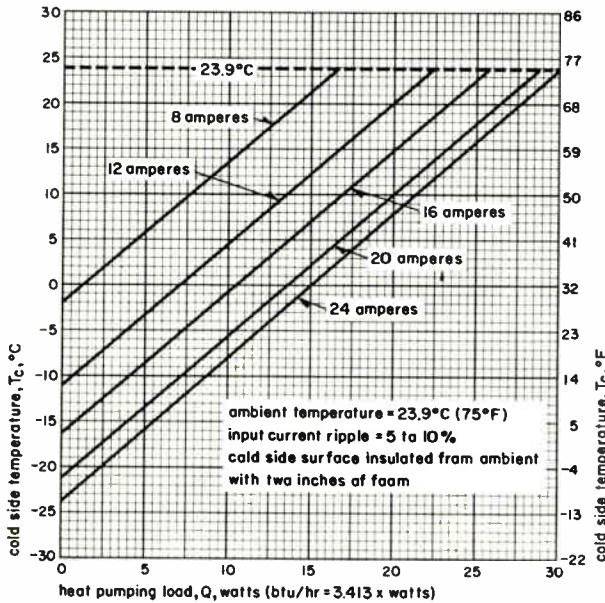
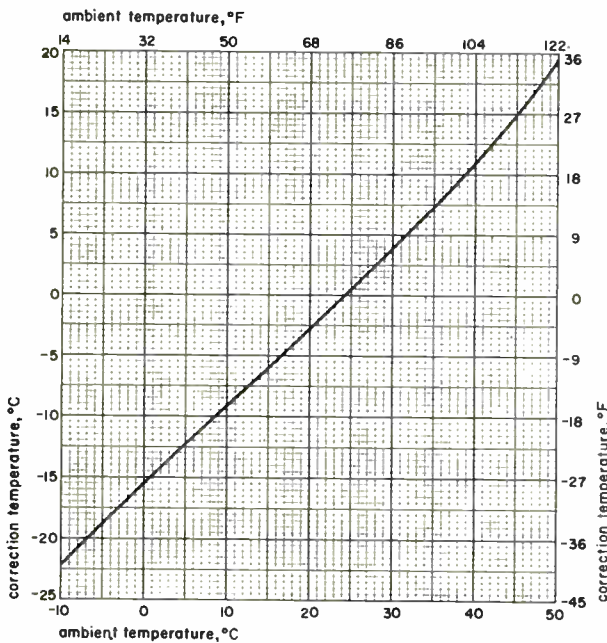


Fig. 1: Characteristics of W832G01 cooler showing temperature difference versus heat pumping load for constant currents.

Fig. 2: From this graph, correction is added algebraically to the cold-side temperature from Fig. 1, for other ambients.



has terminals for the 115 v ac 60 cps power for the fan, current terminals for the thermoelectric device, spare terminals for a temperature sensor or controller, and output terminals from two copper-constantan thermocouples imbedded in the hot and cold plates, which permits temperature monitoring for inspection or evaluation.

Optional designs are available in the event a standard unit will not meet a need. These are designed to give maximum flexibility so that many special design needs can be handled with minimum effort. Mil-type fans, units without fans, and other special changes are included in this classification.

Proper operation of thermoelectric heat pumps requires a low-voltage, high-current, low-ripple source of dc power. Various sizes of power supplies provide outputs matched to the assembled heat pumps with which they operate.

### Thermoelectric Devices for Lab Use

A number of thermoelectric devices for laboratory use have been placed on the market. Indicative of the current state of the art of thermoelectrics, they include a controlled temperature chamber, a controlled temperature bath, and a cold probe.

The controlled temperature chamber is designed for various "below ambient" uses, including temperature control of frequency reference quartz crystals, crystal oscillators, reference thermocouples, and reference diodes. The Westinghouse unit is equipped with control circuit, power supply and mercury thermostat, and controls temperature to  $\pm 1^\circ\text{C}$  at  $30^\circ\text{C}$  over an ambient range of  $-40^\circ\text{C}$  to  $+55^\circ\text{C}$ . The chamber, which has a diameter of  $2\frac{1}{2}$  in. and stands 6 in. high, is mounted on a  $4 \times 4\frac{1}{8} \times 1$  in. power package.

The controlled temperature bath is designed to permit determination of physical properties of materials as a function of temperature, chemical kinetics studies, and other laboratory uses. One model of the units made provides  $\pm 0.02^\circ\text{C}$  control of bath temperature at any point from  $-20^\circ\text{C}$  to  $+40^\circ\text{C}$ . It is equipped with mercury thermostat, electronic relay and Dewar flask. Although bath capacity is  $4\frac{1}{2}$  gal. of appropriate fluid, the unit is designed as a compact, table model measuring only 15 in. wide by 23 in. deep by 21 in. high.

The Westinghouse cold probe is designed to permit checking the conductivity type of very thin epitaxial layers, about 2 microns, and high resistivity layers on low resistivity substrates. The method of use is shown in picture. It is of value in uses where hot probes and/or room temperature probes are inade-



quate, since it eliminates the need for liquid refrigerants. The probe resembles a low-wattage soldering iron in appearance. A thermoelectric module, a cold-probe point, and heat-rejection fins are mounted on the head of a balanced handle. Two current leads and a potential lead are integral with the probe. A room-temperature probe which acts as the second potential lead of the unit is also furnished, along with a power supply that operates from 110 v ac.

Other laboratory uses for thermoelectric devices that could lead to specialized products within the next several years include:

|                              |                              |
|------------------------------|------------------------------|
| Blood sample coolers         | Microtome sample coolers     |
| Freezing traps               | coolers                      |
| Incubators                   | Distillation coolers         |
| Thermocouple reference baths | Controlled humidity chambers |

### Military Uses

Military uses for thermoelectrics will deal with problems raised by putting both equipment and men in ambient conditions beyond their endurance limit. Thermoelectric devices expressly will be used because of their ease of control, static operation and freedom from noise. While it is not possible to predict when various types of equipment might be procured by the military, there is little question of their current feasibility. Examples include:

Navigational equipment—Shipboard and aircraft use of temperature control chambers for sensitive reference components.

Infrared detectors—Sensors for missile guidance can often be cooled thermoelectrically to meet the needs, eliminating the complexity of cryogenic devices.

Air conditioned electronic equipment vehicles—Thermoelectric devices can provide noise and vibration-free temperature and humidity control for vehicles containing sensitive components and equipment.

Submarine air conditioning — Thermoelectrics makes possible silent and diversified air conditioning. It also minimizes maintenance needs, and needs no refrigerants which can pollute the air over extended submerged periods.

Air conditioned mobile field hospitals—Modular construction of thermoelectric units provides the portability and flexibility required of air conditioning systems for field hospitals which must function under widely-varying climatic conditions.

Dehumidification of enclosed personnel chambers—Bathyscaphs, space craft, test chambers, etc.

The thermoelectric cold probe eliminates liquid coolants in uses such as this checking of conductivity type of very thin epitaxial layers.



### Industrial Uses

Industrial uses feasible within the current state of the thermoelectric art are too numerous to mention. Refrigerated trucks, printing ink containers, fluorescent lamp coolers, and dehumidifiers show the broad range of industrial uses which will take advantage of the compactness and light weight of thermoelectric devices within the next 2 to 4 years.

The extensive effort placed on application development in 1962, and the reduction in the cost of materials ranging from 30 to 50% during the same period, have had their effect in stimulating new systems design. It is correspondingly true, however, that further cost reduction and application development is required before widespread introduction of products using thermoelectrics materializes.

For the immediate future, design engineers and product planners alike, should appraise the cost in terms of the entire system, rather than in the thermoelectric component alone. As an example, it should be realized that a complete 200 BTU/hr. refrigeration system with the necessary controls has less than 25% of the total cost tied up in the basic thermoelectric module.

In many heating/cooling systems, the cost of the modules is less than 20% of that of the entire system.

When complete original equipment utilizing thermoelectrics is considered as the base, the cost falls as low as 5 to 10%.

These figures suggest that widespread thermoelectric use depends on cost reductions in power supplies, control equipment, and system design, as well as on further cost reductions in thermoelectric materials and modules.

In this connection, it is also interesting to note that more substantial extension of the operating capabilities of thermoelectrics was achieved in 1962 via improved systems design and specific application effort than through improvements in thermoelectric materials. This may well prove to be a pattern which will govern the growth of the thermoelectric industry in the foreseeable future.

These light-dependent resistors provide circuits of increased simplicity and lower cost. They give non-arcing, "spike-free" switching for inductive loads. They provide the reliability of solid-state devices including high gain, plus the ability to handle power.

# PHOTOCONDUCTIVE DEVICES IN CONTROL CIRCUITS

ELECTRO-OPTICS AND OPTOELECTRONICS have drawn much attention lately, due to some extent to the laser. However, there is a part of the broad field of electro-optics that got relatively little notice until last year, but which has grown steadily—chiefly in breadth of applications. This is the area of those photosensitive devices which do not use photovoltaic or photoelectric properties in their operation.

A photosensitive device can be defined as one in which the number of available charge carriers changes due to incident light. The term photo implies visible light, but one usually includes infrared detectors in the definition.

Photosensitive devices are of 3 major types:\* photovoltaic (selenium barrier layers, silicon or germanium solar cells); photoelectric (the emission of electrons due to light striking a cathode, as with phototubes and photomultipliers); and photoconductive devices. Other than to compare with, we will discuss only the latter type from which we will leave out those devices whose properties do not vary much with light intensity (e.g., light-triggered silicon controlled rectifiers).

\*Misunderstanding in regard to the similarities and differences among these three types is great, even within the industry.

Fig. 1: Sketch shows make-up and is used to help explain the meaning of gain in a typical photoconductive device (see text).

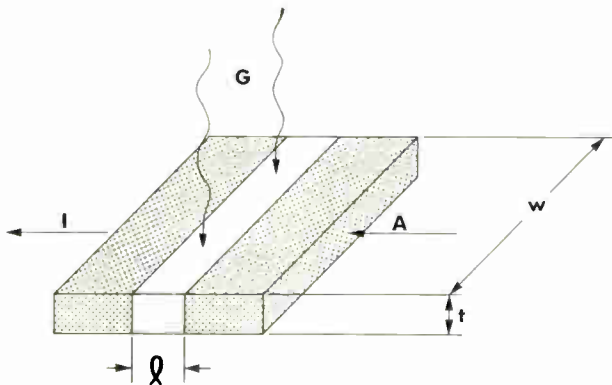


Table 1 lists several photosensitive devices with certain properties of each. Photoelectric devices are included for comparison since they are similar to the photoconductive devices in that their output is roughly linear with light intensity. A photomultiplier tube is really a "stack" of simple phototubes. Photoelectric devices are defined by the emission of electrons from a cathode and are described by their use of a vacuum and need of high voltages.

On the other hand, photoelectric devices have a higher speed of response than the photoconductive devices, although they are seldom used for other than as detectors. Photoconductive devices have the advantages of the glamour and reliability of solid-state devices plus the ability to handle power.

Only the CdS photocells can handle much power. This power capability is a new development for commercial use. Where applicable, these cells offer advantages in performance and cost.

## Basic Principles

The important properties of photoconductive devices and also photovoltaic devices depend upon generation of charge carriers in them due to light striking the material. In a normal conducting solid, such as copper or silver, there are many "free" electrons which can move under the stress of the applied voltage and thus, permit current to flow. In a nonconductor, either insulator or semiconductor under proper conditions, the electrons or charge carriers are bound to the ions or atoms which make up the crystal lattice.

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Fig. 2: Some available photoconductive devices: A is a single crystal cell; B is a small area sintered cell; C is a pressed-powder pellet; D, E, and F are all sintered powder on ceramic substrate with dissipation ratings of 0.5, 2, and 25 watts, respectively.

Free electrons, such as in conductors, are absent or sparse. Moderate applied voltages do not cause these bound charge carriers to move and so no current flows. Photoconductive materials fall into this category at least when not exposed to radiation. When radiation strikes the crystal, much of its energy is absorbed by the lattice. Apart from a totally reflecting surface, this is mostly true of all materials.

In photoconductors, an incident light photon (the basic energy particle of light having a specific energy for a given wavelength) will cause the production of one hole-electron pair. (The hole is defined as the absence of the bound electron and since this vacancy is free to move it too can carry current.) However, since the hole is immediately "trapped" (i.e., bound again) in either CdS or CdSe, conduction in these materials is purely by electrons.

### Fundamental Properties

Of importance in photoconductor devices are (a) gain, (b) gain-bandwidth product, (c) frequency response, (d) voltage capability and (e) power handling. For example, we would like to use available "line" voltages, avoid intermediate amplification, etc.: these are precisely the advantages of the CdS and CdSe cells.

To understand the meaning of gain in a photoconductive device refer to Fig. 1. The shaded areas are the electrodes or metallic contacts, the white area is the active photoconductor material.  $G$  is the number of light photons striking per  $\text{cm}^3$  per sec.,  $t$  is the thickness of the device,  $l$  is the distance between electrodes,  $w$  is the width of the device ( $tw = A$ , the cross-sectional area) and  $I$  is the current. Assuming that each photon generates 1 hole-electron pair or, since holes are immediately trapped, 1 charge carrier, the added number of carriers in the photoconductor

per  $\text{cm}^3$  will be,  $n = G\tau$ , where  $\tau$  is the effective lifetime of the electron or the average time an electron will live in the material before it is once again trapped by the lattice. Then if we assume there is no conductivity in the absence of light (in practice dark resistances are of the order of megohms), the conductivity is given by the usual expression,  $\sigma = n\mu q = G\tau\mu q$ , where  $\mu$  is the mobility of the charge carriers and  $q$  is the charge on the electron.

Then, since the current is given by,  $I = \sigma EA = (\sigma AV)/l$ , where  $E$  is the electric field equal to  $V/l$  and  $V$  is the applied voltage, we find the current to be  $I = (G\tau\mu qAV)/l$ .

Now we are more interested in the current for the number of light photons incident per sec. rather than per volume per sec. Thus, defining  $Q = GAL$ , we have,  $I = (\mu\tau VqQ)/l^2$  (1)

We see immediately that the current, instead of being  $qQ$ , the charge times the number of photons creating electrons per sec. is larger by a factor  $M = (\mu\tau V)/l^2 = \text{gain}$  (2)

This gain may be of the order of  $10^3$  or  $10^4$  in CdS or CdSe cells whereas it is near unity in other photoconductive devices. Thus, these cells have gains as much as 1000 times greater than the other devices.

Although the gain is "real," how is it possible for more electrons to leave the crystal than are released by the incident light? The simple fact is that there is nothing to stop free electrons entering from the negative electrode. This, in turn, may permit an electron liberated from the lattice to effectively pass around the circuit many times before it is recaptured by the lattice. Without radiation, free electrons are not generated within the crystal. Therefore, any appreciable number of electrons cannot enter the crystal from the electrode. Their entry is restrained by a space-charge effect.



## PHOTOCONDUCTIVE DEVICES (Continued)

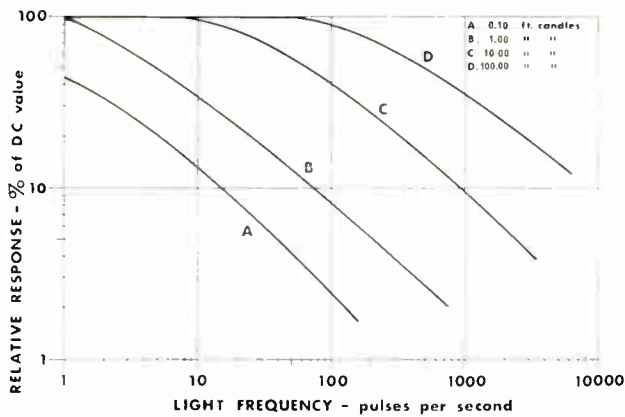


Fig. 3: The above graph shows how the speed of response of a typical photoconductor depends on the level of light intensity.

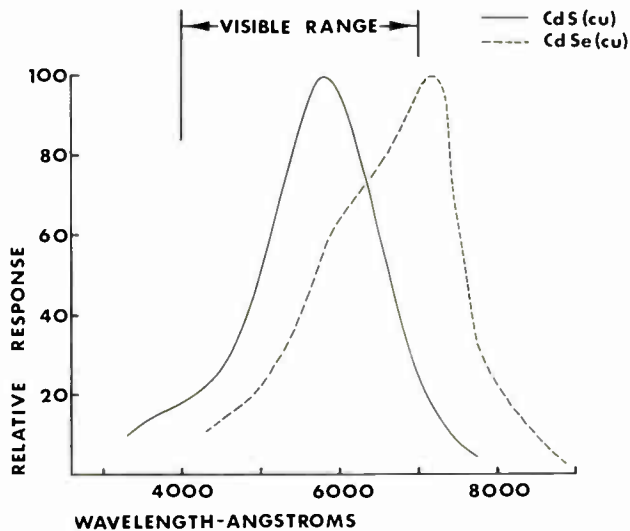
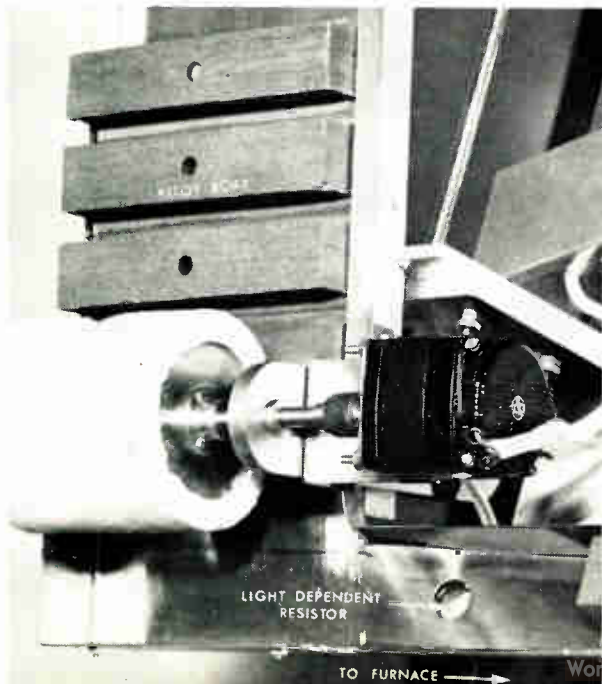


Fig. 4 (above): Graph shows typical spectral response of CdS and CdSe photocells. The Angstrom unit is equal to  $10^{-8}$  cm.

Fig. 5 (below): A process use of power photocells: the LDR controls motorized feeding and detects each boat for loading.



## Gain-Bandwidth

A purer definition of gain which leads to the same result but is somewhat more useful when talking about the gain-bandwidth product is

$$\text{gain} = M = \text{lifetime} / \text{transit time} = \tau / T \quad (3)$$

The gain bandwidth product  $R$  is the gain divided by the lifetime,  $R = M / \tau = 1 / T$ , (4)

or the reciprocal of the transit time, which is defined as the time for a charge carrier to traverse the distance between electrodes. In CdS cells  $T$  is of the order of 10  $\mu\text{sec}$ . so the gain-bandwidth product is of the order of 100 kc per sec. Since gain is of the order of 1000, the bandwidth which is roughly equal to the frequency at which the photoconductor can cycle from dark to light to dark resistance conditions, is of the order of 100 cps. Actually this is only at high light intensities as shown in Fig. 3; at low light intensities these cells are much slower.

Since the voltage appears directly in our gain expression (Eq. 2), the gain-bandwidth product should increase indefinitely as the voltage across the device increases, at least to the point of dielectric breakdown. However, in practice a saturation effect occurs, since the current is space-charge limited.

## Dielectric Strength

It is desirable to have a device which could "stand-off" high voltages. In CdS or CdSe cells, this property is a function of the dielectric breakdown strength and the spacing between electrodes. These materials have dielectric breakdowns high enough to enable relatively narrow regions to withstand fairly high electric fields,  $E (= V/l)$ . Typical electrode spacings of 0.010 in. will stand off 400 v. and easily 200 v. However, since the current (Eq. 1) varies inversely, or the resistance varies directly, as the square of the electrode spacing, it is preferred, at least in power devices, to keep this spacing small. In practice conservative voltage ratings above 400 v. are not practical to handle significant power.

Photoconductive devices have great advantage in switching inductive loads. Since their response is quite slow, they do not get voltage spikes from the usual inductive "kicks" and thus do not need protective circuitry. This freedom from spike trouble is aided by the normal thermal inertia of the average lamp used to activate them. We are inclined to regard slow response as a significant deficit in a device. However, the major use of these cells is the activation of power relays, motors or mechanical devices, all of which are very slow by modern speed standards.

(Continued on page D17)

# AMP PUTS AN END TO EVERY

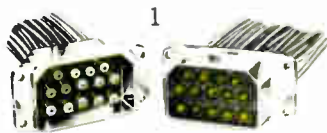
## CIRCUIT PROBLEM

A patented Compression-Crimp Technique . . . the finest research and testing facilities in the industry . . . an exclusive plating process . . . a sales and service organization that spans the world . . . all these are factors contributing to AMP's recognition as the undisputed leader in the field of Solderless Wire Termination. Shown here is a representative sampling of the more than 15,000

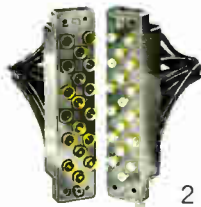
electrical/electronics products we design and manufacture. All are designed to provide you with more reliable circuitry. All are available for immediate delivery. From basic ring tongue terminals to intricate programming systems . . . from one-crimp coaxial connectors to compression-crimp fine wire splices . . . whenever a circuit needs completion, AMP delivers the best, fastest and most economical answer.

### COAXIAL CABLE AND SHIELDED WIRE PRODUCTS

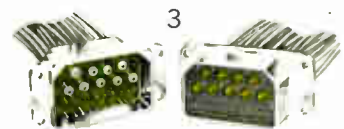
**COAXICON® CONNECTORS**—Quick connect/disconnect for coaxial wire with one crimp termination of inner conductor, outer braid and cable support . . . an exclusive AMP feature. Multiple and single-in-line types, in standard, miniature and subminiature models. RG/U sizes .075 to .250". Gold over nickel contact plating . . . standard with AMP.



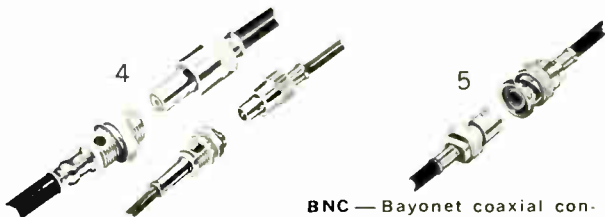
**MINIATURE—(TYPE IV CONTACT)**  
—12 and 20 positions.



**STANDARD—18, 24 and 34 positions.** Special configurations available on request.



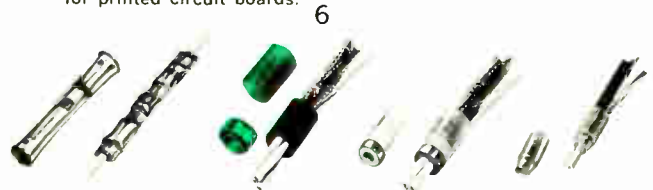
**COAXICON Connectors and Pin and Socket mix.**



**TNC**—Standard and miniature sizes. Plus hardware version of COAXICON Contacts for through panel installations.

**BNC**—Bayonet coaxial connector for a quick connect/disconnect of maximum reliability. Noise free because of exclusive A-MP® crimp. Meets requirements of MIL-C-3608.

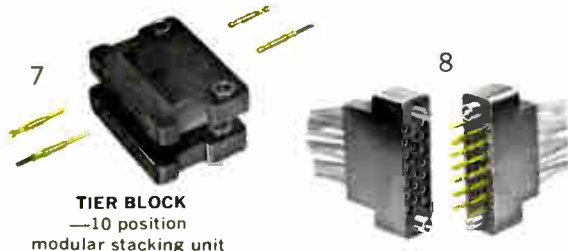
**TERMASHIELD® SPLICES AND FERRULES** — both pre- and post insulated, for single and multiple conductors with nylon or TEFLON insulation. Line includes special heat-resistant ferrules and a new pre-insulated ferrule for printed circuit boards.



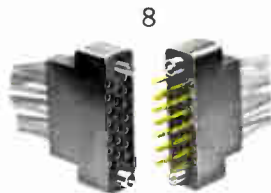
## PIN AND SOCKET MULTIPLE CONNECTORS

AMPin-cert® Pin and Socket connectors satisfy and exceed applicable Military and commercial requirements. Complete range of sizes and configurations. Feature crimp, snap-in contacts. Available in stamped and formed and screw-machine processed types, in single-piece or strip form for application with A-MP® hand, semi-automatic or fully automatic crimping tools. Gold over nickel contact plating . . . standard with AMP!

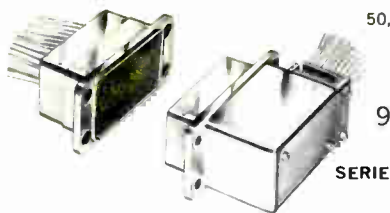
### Connectors conforming to MIL-C-8384



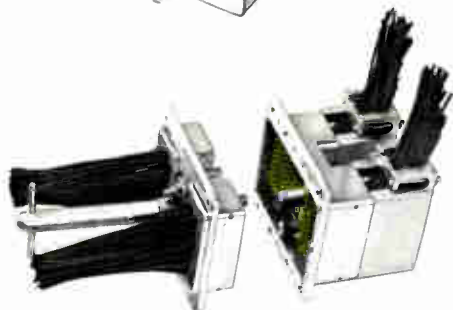
**7**  
**TIER BLOCK**  
—10 position  
modular stacking unit



**8**  
**SERIES "M"**—14, 20,  
21, 26, 34, 41,  
50, 75 and 104 position.



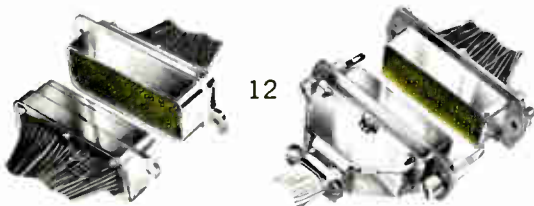
**9**  
**SERIES "D"**—78 position



**10** **SERIES "DD"**—156 position



**11**  
**SERIES "W"**  
26 and 40 position



**12**  
**SERIES "A"**  
Meets electrical and environmental requirements of MIL-C-26518. Metallic shell . . . sealed or unsealed . . . 50 and 100 positions. Rack and panel or bulk-head mounting. Screw-machine contacts exclusively. Center to center spacing of .150".

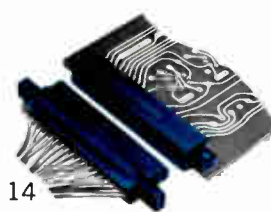
**SUBMINIATURE**  
High density, 50 position connector. Center contact spacing of .060". Wire range 26-32. Insulation support.



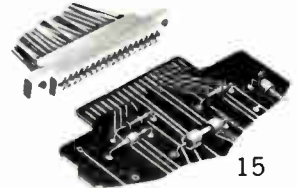
**13**

## PRINTED CIRCUIT CONNECTORS

AMPin-cert one and two piece printed circuit connectors, available in a wide variety of sizes and configurations. Utilize crimp, snap-in contacts. Unique design insures controlled contact pressures for reduced surface wear. Exceed requirements of all applicable MIL specifications. Connectors are alpha-numerically coded, not pre-loaded and feature gold over nickel contact plating . . . standard with AMP! Complete range of hand, semi-automatic and fully automatic application tooling.



**14**  
**RIGHT ANGLE CONNECTOR**  
Pin and Socket contacts  
. . . 19 positions  
sealed and/or unsealed.



**15**  
**AMP-LEAF® CONNECTORS**  
8, 15, 18, 22 and 30 positions.  
Conforms to MIL-C-21097A.



**16**  
**AMP-BLADE® CONNECTORS**  
17, 23, 29, 35, 41 and 47 positions.  
Conforms to MIL-C-21097A.

**DUO-TYNE® FLAG CONNECTORS**  
One piece right angle connector.  
3 to 22 positions.



**17**

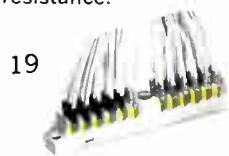


**18**

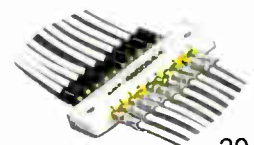
**CIRCUITIP® TERMINALS** — component tip for improved solder dip attachments. Can be applied at rates up to 7,200 tips per hour with A-MP Component Tipping Machine.

## TAPER TECHNIQUE

Miniaturized components for high density applications. Both pre-and-post insulated, stamped and formed and solid type taper pins to mate with a variety of one or two piece stackable nylon taper blocks. Pins are self-cleaning and self-locking and compression-crimped to the conductor for insured uniformity of connections. Newest addition to the line, TAYP-AIR® Pins, feature elongated pins which provide extreme vibration resistance.



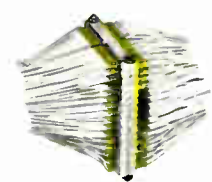
**19**  
**TAYP-AIR ASSEMBLY**



**20**  
**STANDARD ASSEMBLY**



**INSULATED and NON-INSULATED**

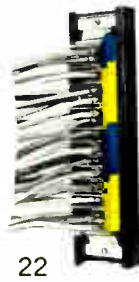


**STACKED TAPER BLOCKS**

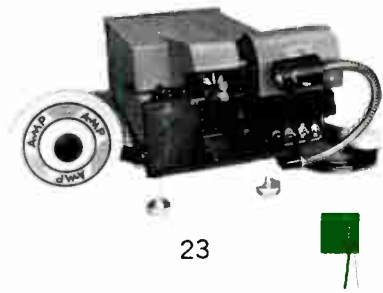




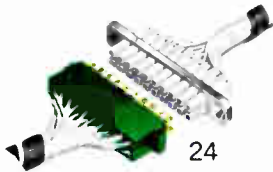
**TERMINALS AND SPLICES**  
Industry's most complete line of pre-and-post insulated compression-crimp terminals and splices. Accommodate solid, stranded and irregularly shaped conductors in all AWG wire sizes. Single-piece or strip form for application with AMP hand, semi-automatic or fully automatic crimping tools.



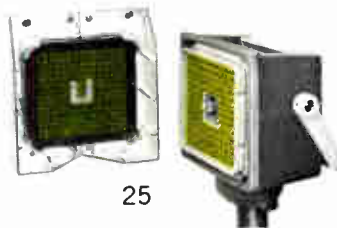
**TERMI-BLOK® CONNECTORS** — modular design terminal block connector for high density circuitry. Permits infinite variation in wiring logic and stack configurations. No need for insertion/extraction tools.



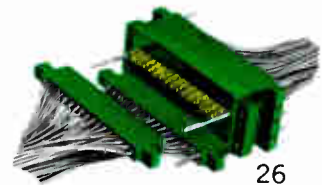
**AMP-FINE-Y-R® SPLICE TECHNIQUE**—compression-crimp method for joining 34 to 44 gage magnet wire to lead wires of 26 AWG or finer. Special air and electric crimping machine strips the wire and applies the splice. Takes just 12 seconds. Up to 300 finished splices per hour.



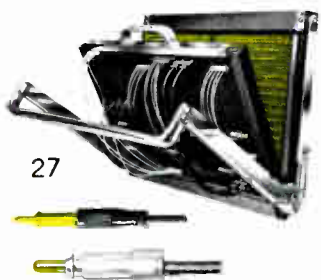
**DUO-TYNE® LEAF CONNECTOR**—new modular design connector with virtually unlimited application possibilities. Individually housed crimp contacts snaplock into aluminum mounting plates which can be designed to any size or configuration desired.



**200 CONTACT CABLE CONNECTOR** — crimp, snap-in contacts. Connector can be electrically disengaged without mechanical uncoupling. Cable outlet positioned at either 45° or 90°.

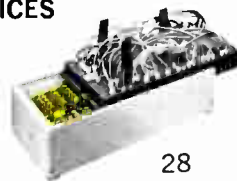


**AMP-BLADE® MULTI-CIRCUIT FEED-THRU CONNECTOR**—commoning block for rack-mounted systems. Density potential of 192 connections in a cubic area of 3.375". Crimp, snap-in contacts.

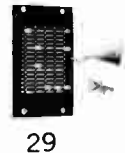


**PROGRAMMING DEVICES**

**PATCHCORD**—both universal and shielded construction. Standard rack mounted types and a new "space-saver" model which mounts into rather than onto the panel. Double-wiping action of crimped contacts. New double-detent patchcord. Spring retention member makes accidental dislodgement next to impossible.



**"240" PATCHCORD** — compact, lightweight programming system. Permits in-flight programming of electrical/electronic circuits in a matter of seconds.



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**STRATOTHERM®** — terminals and splices—for high temperature applications. Wire range 22-10. Conform to MIL-T-7928.



**TERMINYL®** — pre-insulated terminals and splices for large wire sizes (8-4/0). Conform to MIL-T-7928.



**SEALED HELICON® DISCONNECT** — pre-insulated and environmentally sealed disconnect for all high-reliability circuits. Wire range 22-10. Exceeds requirements of MIL-T-7928.



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GENTLEMEN: I would like additional information on:

|    |    |    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|----|----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 |    |

NAME \_\_\_\_\_ POSITION \_\_\_\_\_

COMPANY \_\_\_\_\_

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## TOOLING

A complete range of compression-crimp tooling to handle the most diverse wire application problems. Matching tool and terminal design insures reliable, uniform terminations of maximum tensile strength and electrical conductivity. Resistant to heat, vibration and corrosion.



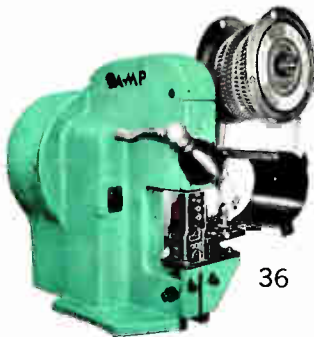
34

**"T"-HEAD® HAND TOOLS**—lightweight, compact, hand crimping tools designed to handle a wide range of AMP Products in wire sizes 26-14 AWG. Color and numerical assembly coding. Ratchet-in prevents opening of crimping dies until complete crimp has been made.



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**AMP-TAPEMATIC® TOOLS**—highly versatile, portable, semi-automatic crimping tools featuring tape-fed application of terminals and splices. Combine the speed and power of a bench-press with the compactness and light weight of a hand tool.

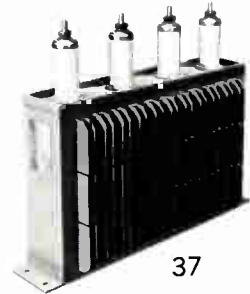


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**AMP-O-LECTRIC® AUTOMATIC MACHINE**—up to 4,000 uniform connections per hour are possible with this automatic, electrically powered crimping machine. Bench-mounted, easily moved. Handles a variety of AMP tape and strip mounted terminals, splices and connector contacts.

## CAPITRON\* PRODUCTS

Over 2,500 specially designed power supplies, pulse units, transformers, capacitors, etc. available as off-the-shelf items. Exceed requirements of all applicable military and commercial specifications.



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**PULSE NETWORKS** — designed to specifications covering all combinations of pulse widths, impedances and charging voltages with exact compliance to pulse shape, rise time and ripple tolerances.



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**RADAR PULSE NETWORKS**—quadrupled power in the same cube. Charging choke, pulse forming networks, supply, and pulse transformers combined in one balanced unit.



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**CAPACITORS**—a variety of special high voltage capacitors in oil-filled hermetically sealed cases, encapsulated in epoxy resin, of openframe construction and of other special types.

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For complete information  
on the products shown,  
circle keyed numbers  
on the reply card  
on page 3.

Fig. 6: Motor speed control circuits: "Standard" SCR type (A); LDR types are (B) simple, less feedback, and (C) with feedback.

### Types of CdS and CdSe Cells

Table 2 gives the main types of CdS and CdSe cells used, their general construction and their properties. Fig. 4 gives typical spectral responses of these materials and Fig. 2 shows some typical commercially available units.

Of the types shown in Table 2, the "powder" type is not seen on the market and this may be due to its low sensitivity and somewhat low power capability. However, it was able to withstand the highest voltages. Of the others, note that the sintered layer on ceramic has high sensitivity and by far the greatest power handling ability. (Continued on page K20)

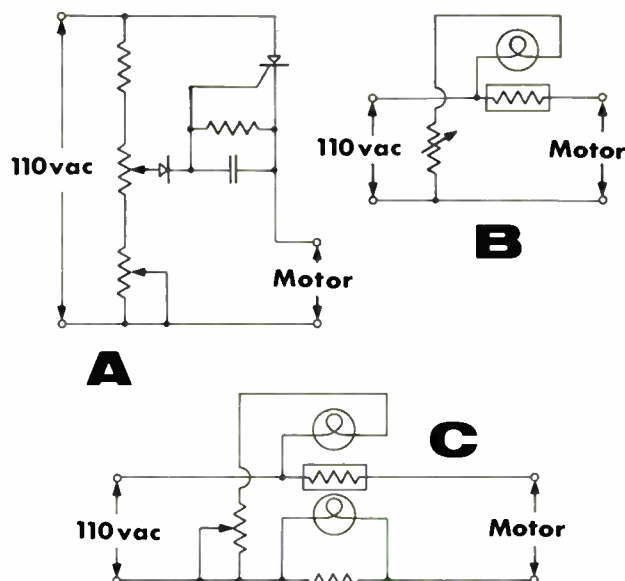


Table 1  
CLASSES OF PHOTOCONDUCTIVE DEVICES  
Two photoelectric devices, the phototube and photomultiplier, are included.

| Type                      | Sensitivity (per lumen) | Approx. Max. Frequency Response | Approximate Wavelength of Max. Sensitivity | Remarks  |
|---------------------------|-------------------------|---------------------------------|--|--|
| Vacuum phototube          | 100 $\mu$ a             | 100 mc                          | 4000 to 4500 Å                             | Requires approx. 100 volts.                      |
| Ge junction photojunction | 30 ma                   | 100 kc                          | 1.9 microns                                | Used mainly in computer equipment.               |
| Ge point-contact diode    | 100 ma                  | 200 kc                          | 1.9 microns                                | Detector and computer equipment                  |
| Si planar photodiode      | 200 ma                  | 100 kc                          | 1.1 microns                                | Same as Ge diode but better sensitivity.         |
| CdS and CdSe photocells   | Up to 50A               | 100 cps (CdS)                   | 5500 to 6500 Å (CdS)                       | Very slow at low light levels, can handle power. |
|                           |                         | 1000 cps (CdSe)                 | 7000 to 7500 Å (CdSe)                      |  |
| Photomultiplier tubes     | Up to 1000 A            | 100 mc                          | 4000 to 4500 Å                             | Requires up to 2500 volts.                       |

Table 2  
TYPES of CdS and CdSe PHOTOCELLS
















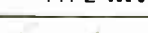
| Type and Method of Assembly                               | Comments   | Current, Voltage, Dissipation              | Distinguishing Feature  | Type of Encapsulation  | General Electrical Char.  |
|---|--|--|---|--|---|
| Single Crystal, small crystal with ohmic contacts.        | Earliest types difficult to fabricate and mount.   | Few ma.<br>200 v.<br>Few mw.               | Active area generally very small.   | All glass assembly.  | Ohmic with proper contacts—very low power dissipation.  |
| Powder, sintered powder in binder                         | Simple construction adapts to any size. Not marketed.  | > 10 ma/cm <sup>2</sup><br>To 1000 v.<br>? | Scant information but fairly high dissipation should be possible.           | Glass-metal or plastic-metal sandwich.                       | Current increases with up to 4th power of the voltage at low light levels due to particle boundary limit on conductivity. |
| Sintered, thin layer sintered on ceramic substrates       | Can be made rugged mechanically. About 10 times the sensitivity of powder version and 1/2 the sensitivity of pressed and sintered. | Up to 1 Amp.<br>To 400 v.<br>To 25w.       | Very high dissipation when substrate becomes part of package.               | Glass-ceramic, all glass or metal package with glass window. | Can be made quite ohmic. High power types not strictly ohmic because high conductivity metals yield poor ohmic contacts.  |
| Pressed and Sintered, sintered powder pressed into "pill" | Very high sensitivity though not as rugged or easy to fabricate. Dissipation limited by mounting scheme.                           | To 100 ma.<br>To 400 v.<br>To 500 mw.      | Relatively thick active body shifts spectral response to the near infrared. | All glass assembly.  | Can be made very ohmic.   |



**DALE***Better things in smaller packages*

Resistors, Trimmer Potentiometers, Precision Potentiometers – no matter how exacting your specifications – Dale can meet them. This ability stems from unmatched experience in winding the smallest diameter resistance wires as well as superiority in producing resistance devices with improved metallurgical and performance characteristics. If your needs are not listed here, contact Dale at once.

**WIREWOUND PRECISION RESISTORS** (Write for Catalog A)





| TYPE  | RANGE                | SIZES | WATTAGES                     | TOLERANCE   | FEATURES   |
|---|----------------------|-------|------------------------------|-------------|--|
| <br>TYPE ARS     | 0.1 ohm to 16K ohms  | 3     | 2, 5, 10                     | 1%          | Ultra-high reliability, failure rate less than .001% at 1000 hours of operation at 50% of rated power at 25° C. Ask for Bulletin R-66.   |
| <br>TYPE RS      | 1 ohm to 240K ohms   | 11    | ¼, ½, 1, 2, 2½, 3, 5, 7, 10  | 0.05% to 3% | Meets functional requirements of MIL-R-26C. Silicone coating. Weldable leads available.  |
| <br>TYPE RLS     | 10 ohms to 240K ohms | 9     | 1, 2, 2½, 3, 5, 7, 10        | 0.05% to 3% | Radial leads. Meets functional requirements MIL-R-26C. Silicone coating. Weldable leads available.   |
| <br>TYPE HS      | .1 ohm to 240K ohms  | 9     | 1¼, 3, 3¼, 3¾, 4¼, 6½, 9, 13 | 0.05% to 3% | Replaces vitreous enamel resistors in high temperature applications. Silicone coating. Meets functional requirements of MIL-R-26C. Characteristic V. Weldable leads available. |
| <br>TYPE NS, NLS | .1 ohm to 37K ohms   | 7     | 2, 2½, 3, 5, 7, 10           | 0.05% to 3% | Silicone coated, non-inductive winding. Type NLS has radial leads. Weldable leads available.   |
| <br>TYPE RSE     | .1 ohm to 240K ohms  | 7     | 2, 3, 5, 7, 10               | 0.05% to 3% | Resistance element suspended in metal tube meets toughest environmental conditions. Lead or clip mounted. Weldable leads available.  |
| <br>TYPE HL    | .1 ohm to 200K ohms  | 5     | 5, 6, 7, 11                  | 0.05% to 3% | Replaces vitreous enamel resistors in high temperature applications. Multi-layer silicone coating. Meets requirements of MIL-R-26C. Terminal or through-bolt mounted.          |
| <br>TYPE MRS   | 1 ohm to 4.6K ohms   | 2     | ¼, ½                         | 0.05% to 3% | Molded coating offers superior protection. Weldable leads available.   |
| <br>TYPE G     | .05 ohm to 175K ohms | 7     | 1, 1½, 2¼, 4, 6, 7, 15       | 0.05% to 3% | Decreased size with increased heat dissipation. Silicone coated. Exceeds functional requirements of MIL-R-26C. Weldable leads standard.  |
| <br>TYPE HG    | .1 ohm to 60K ohms   | 3     | 15, 20, 35                   | 0.5% to 3%  | Maximum heat dissipation at no increase in size. Meets or exceeds requirements of MIL-R-18546C. Chassis mounted molded radiator housing.                                       |
| <br>TYPE RH    | .1 ohm to 240K ohms  | 6     | 5, 10, 25, 50, 100, 250      | 0.05% to 3% | Resistance unit molded into radiator housing. Meets requirements of MIL-R-18546C. Mounts on chassis.   |
| <br>TYPE NH    | .1 ohm to 37K ohms   | 5     | 10, 25, 50, 100, 250         | 0.05% to 3% | Non-inductive winding. Silicone-sealed resistance unit in radiator housing. Mounts on chassis.   |
| <br>TYPE PH    | .1 ohm to 75K ohms   | 3     | 10, 25, 100                  | 0.05% to 3% | Silicone-sealed resistance unit in radiator housing. Mounts through hole in chassis.   |
| <br>TYPE WWA   | .1 ohm to 4 megohms  | 7     | .1, .15, .2, .25, .33, .5    | 0.05% to 1% | Bobbin type design with patented Dale features. Non-inductive winding, epoxy encapsulated. Meets requirements of MIL-R-93C, Char. C.   |
| <br>TYPE MWA   | 1 ohm to 160K ohms   | 2     | .100, .125                   | 0.05% to 1% | Sub-miniature bobbin type with molded coating for excellent environmental protection.  |
| <br>TYPE CWR   | 1 ohm to 12 megohms  | 7     | .15, ¼, ½, 1                 | 0.5% to 1%  | Ceramic bobbin type. Non-inductively wound. Radial tinned copperweld leads. Unencapsulated.  |

For detailed information on the resistors listed here, write for Catalog A. Complete data on Trimmer Potentiometers will be found in Catalog B. Catalog E contains specifications on Precision Potentiometers.


**DALE**

*Better things in smaller packages*

**DEPOSITED CARBON RESISTORS** (Write for Catalog A)

| TYPE   | RANGE                | SIZES | WATTAGES                     | TOLERANCE | FEATURES  |
|--|----------------------|-------|------------------------------|-----------|---|
| <br>TYPE <b>DC</b>  | 1 ohm to 200 megohms | 10    | 1/10, 1/8, 1/4, 1/2, 1, 2, 5 | 1%        | Miniature size. 3 layer silicone-base varnish coating protects against moisture and salt spray. Weldable leads available.           |
| <br>TYPE <b>DCF</b> | 1 ohm to 200 megohms | 10    | 1/10, 1/8, 1/4, 1/2, 1, 2, 5 | 1%        | Epoxy coating gives complete insulation and environmental protection in miniature size. Weldable leads available.                   |
| <br>TYPE <b>DCH</b> | 1 ohm to 200 megohms | 10    | 1/10, 1/8, 1/4, 1/2, 1, 2, 5 | 1%        | Hermetically sealed in non-hygroscopic envelope. Can endure severe mechanical shock. Can be clip mounted. Weldable leads available. |
| <br>TYPE <b>MC</b>  | 1 ohm to 50 megohms  | 5     | 1/8, 1/4, 1/2, 1, 2          | 1%        | Molded housing completely insulates and protects against environmental and mechanical damage. Weldable leads available.             |

**METAL FILM RESISTORS** (Write for Catalog A)

|   |                       |   |                     |            |   |
|---|-----------------------|---|---------------------|------------|---|
| <br>TYPE <b>MF</b> | 100 ohms to 4 megohms | 5 | 1/8, 1/4, 1/2, 1, 2 | .25% to 1% | Molded housing gives complete environmental and mechanical protection. Low temperature coefficient. Weldable leads available. |
|---|-----------------------|---|---------------------|------------|---|

**WIREWOUND TRIMMER POTENTIOMETERS**  
**HUMIDITY-PROOF - PRECISION** (Write for Catalog B)



**1200 SERIES**

Three different terminal configurations, standard or printed circuit mounting; 10 to 50K ohms; 5% tolerance; 1 watt up to 85° C, derating to 0 at 150° C.



**900 SERIES**

High temperature. Three different terminal configurations, standard or printed circuit mounting; 10 to 30K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 175° C.



**600 SERIES**

Eight different terminal configurations, standard, panel and printed circuit mounting; 10 to 30K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 175° C.



**1500 SERIES**

Nine terminal configurations, standard, panel and printed circuit mounting; 10 to 50K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 175° C.



**5000 SERIES**

New space saving square configuration; 100 to 50K ohms; 5% tolerance; 1 watt up to 70° C, derating to 0 at 150° C.

**WIREWOUND TRIMMER POTENTIOMETERS - LOW COST** (Write for Catalog B)



**100 SERIES**

Five terminal configurations; 10 to 50K ohms; 5% tolerance; .8 watt to 70° C, derating to 0 at 135° C.



**200 SERIES**

Five terminal configurations; 10 to 50K ohms; 10% tolerance; .5 watt to 70° C, derating to 0 at 105° C.



**300 SERIES**

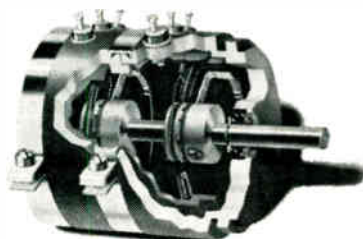
Two terminal configurations; 100 to 20K ohms; 15% tolerance; .25 watt to 70° C, derating to 0 at 85° C.



**1100 SERIES**

High temperature. Three terminal configurations; standard or printed circuit mounting; 10 to 50K ohms; 10% tolerance; 1 watt to 70° C, derating to 0 at 175° C.

**PRECISION POTENTIOMETERS - SINGLE TURN - WIREWOUND**  
(Write for Catalog E)



- Precision machined anodized aluminum cups
- Molded Diallyl Pthalate liners
- Welded Tap and terminal construction
- Precious metal wipers and slip rings
- Flush clamp bands
- Gold plated terminals
- Precision sleeve or ball bearings
- Centerless ground stainless steel shafts
- Single or ganged units

**SPECIFICATIONS:**

- Meet requirements of MIL-R-12934B and NAS-710
- Eight physical sizes, 7/8" to 3" diameter
- Electrical angles and functions to specification
- Special mechanical configurations available

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Series CC wire-wound resistors. 20 PPM/°C. 1, 2, 3, or 5% resistance tolerance. In 1, 2, 3, 5 or 10 watt sizes.

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Mounts above chassis for maximum heat dissipation. Application-required designs, including multiple taps, or separate resistance elements.

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Depend on famous Clarostat quality in wire-wound power resistors: Greenohm "V" vitreous enamel manufactured to MIL-R-26 specifications according to latest revisions; Greenohm cement-coated resistors for the toughest industrial and commercial assignments; Special purpose resistors for those beyond-the-usual application requirements.

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POWER RESISTOR DIVISION 

# CLAROSTAT

mfg. co., inc., Dover, New Hampshire





There is increasing demand for reliability in capacitors with more exact properties.

Mylar has been the best all-purpose, reliable plastic dielectric material for capacitor design.

But other and new plastics have challenging properties.

All of these are discussed in this article along with reasons for their importance.

Trends Toward Higher Reliability...

## PLASTIC DIELECTRICS IN CAPACITORS

TRENDS IN USING PLASTIC DIELECTRIC are toward higher reliability in smaller capacitors and better capacitors and better capacitor properties. After a good look at the plastic dielectric capacitor of today and of the near future, one may feel that plastics for capacitor dielectrics have "arrived." But new designs pop up more frequently. New ideas and techniques are put into use as our knowledge of plastics grows, and a great many films are "just around the corner" with new properties to use in supplying capacitors to meet the more exacting needs of today's sophisticated circuits.

### Plastics for Reliability in Capacitors

As electronic circuitry becomes more involved in the space age and its vehicles, polyethylene terephthalate (Dupont's Mylar), is being recognized as one of the most reliable dielectrics for capacitors. Mylar is received in the capacitor plant as a complete dielectric. It does not require impregnation to make it useful as all paper dielectrics must. It is well known that reliability increases with less handling because there are fewer chances of error.

Many of the steps that are needed to develop electrical properties of paper dielectric capacitors are excluded in production of dry Mylar units. Not having to impregnate a capacitor, helps to preclude chance of errors in temperature, vacuum, time cycles, and purity of the impregnant.

Mylar has excellent dielectric breakdown strength, good stability and long term life properties. It therefore requires minimum handling to be used in capacitors that become highly reliable components.

Great strides have been made in producing Mylar film over the years. Uniformity of thickness and electrical properties of the film are improved.

Experience in manufacturing capacitors from film and continuing tests of these capacitors have shown the extent to which controls of handling these dielec-

tics improves the quality and reliability of finished parts.

Mylar capacitors are recognized to be reliable for space applications. In part this is due to the outstanding performance of these capacitors in fields of intensive radiation. In several of the articles written about the testing of dielectrics in radiation, it has been pointed out that Mylar ranks among the highest in resistance to such exposure. (Good-All has an information booklet available which contains data and information from most of these articles.) For example, after similar radiation exposure, the following figures are shown in comparing temporary capacitance change on 3 different dielectrics:

Mica—changed from +7% to -11%

Paper—changed from 0% to -90%

Mylar—changed from +1% to -8%

With respect to transient capacitance change, one can see that Mylar is affected no more than mica and much less than paper by exposure to radiation. Space-age electronics requires reliability for obvious reasons besides the radiation problem. Plastic dielectrics certainly are playing a major role in capacitor design for reasons stated above.

### Control Process Is Important

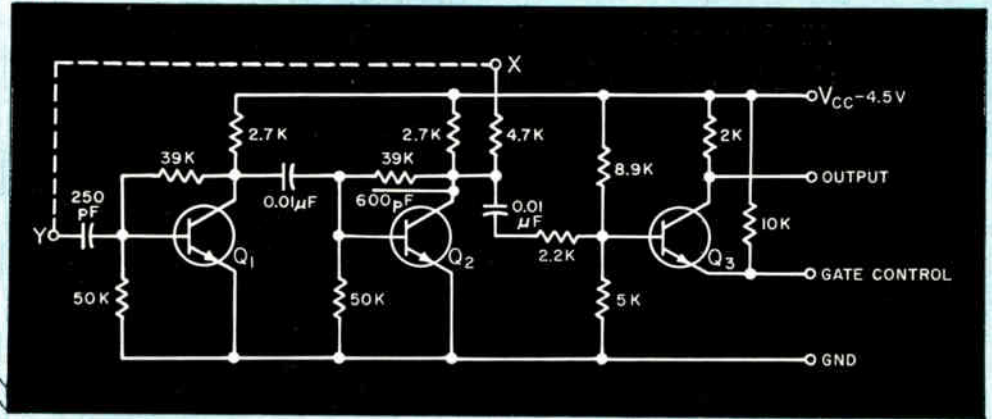
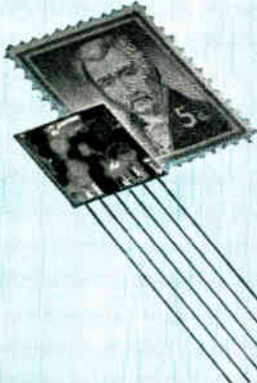
Good-All places emphasis on cleanliness of capacitor manufacturing areas. Their High Reliability  
*(Continued on page D23)*

### By TROY L. PESTEL

Chief Engineer  
Good-All Elec. Mfg. Co.  
Div. of TRW Electronics  
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Ogallala, Nebr.



# THIN-FILM MICROCIRCUITS NOW AVAILABLE FROM SPRAGUE!



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## PLASTIC DIELECTRIC (Continued)

manufacturing area has controlled atmosphere with electrostatic air filtering. Workers wear lint-free garments and their habits are being continually shaped in reliability-oriented channels. Extensive training is given to High Reliability capacitor workers in work habits as well as production techniques.

Detailed manufacturing specifications are a must to obtain highly reliable capacitors and adequate quality control personnel are needed to insure compliance with the specifications.

The High Reliability material screening process used is a unique system whereby a sample from a log roll of Mylar is used to wind capacitors. Extensive tests are then run to decide whether the material is "qualified" for production. Only after qualification is the entire log roll slit to necessary widths for use. This system has helped to achieve established failure rate of .001% per 1000 hours with dry Mylar constructed capacitors. This leads to the belief that greater reliability can be obtained as material manufacturers continue to improve the basic dielec-

tric and increased knowledge is gained about its qualities.

### Miniaturization a Reality

The pressure for smaller capacitors becomes greater with each day as circuit designers are cramped for space. Plastics again are filling this need.

Significant size reduction has been achieved in a plastic dielectric capacitor with Good-All's miniature capacitor called "Microlar" or type 608. This capacitor offers a 75% size reduction over conventional designs in small values and is fully capable of voltage rating over the temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  just as other Mylar units are.

The unique design of this capacitor features excellent lead-pull characteristics, even though it is very small (see photograph). A combination of small size and ruggedness are found in this discrete component. The "Microlar" line has only Mylar dielectric, but its design is readily adaptable to other plastics.

### Epoxy Dipped Units

Selections of physical shape and case style of capacitors are usually

dictated by space available, the need for humidity protection, and physical ruggedness required. Epoxy dipped units are popular since they fill the requirements on most of these points. Although as high a degree of miniaturization of the "Microlar" capacitor is not achieved with type 601PE dipped capacitors, they are small and provide the radial lead styles desired in printed circuit work. They can be made thin to take full advantage of board space and the case of tough epoxy is a very good humidity barrier.

### Other Plastics

Up to the present time, Mylar represents the best answer to an all-purpose, reliable plastic dielectric material for capacitor design.

Forward looking work by capacitor manufacturers is largely aimed at providing capacitors with improved properties in such areas as temperature range, temperature coefficient, dielectric absorption, and physical size. When one or possibly two characteristics must be optimized, the selection of a specialty dielectric is much easier today because of the variety of materials available.

The major portion of plastic dielectric capacitors today contain Mylar as the dielectric. Polystyrene is also a very important plastic used in capacitors.

Polystyrene capacitors offer the following advantages:

Extremely high insulation resistance.

Extremely low dissipation factor.

Low capacitance change with temperature change.

Very good stability.

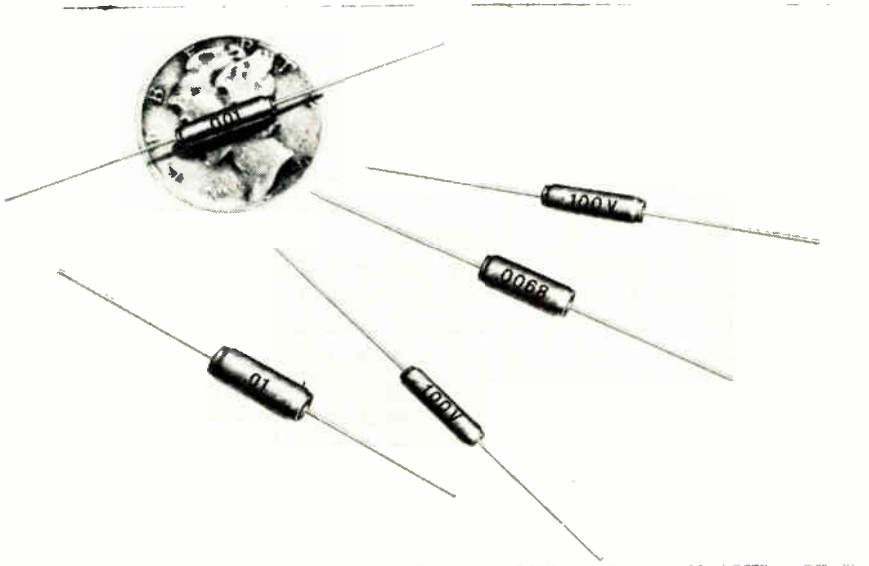
Low dielectric absorption factor.

But the chief drawback is its low melting point which limits its use to a maximum of  $85^{\circ}\text{C}$ .

Teflon overcomes the high temperature limitation of polystyrene

(Continued on page D24)

Good-All's "Microlar" Capacitors combine a 75% size reduction with unique lead-pull design.





## PLASTIC DIELECTRIC (Concluded)

while offering essentially the same characteristics. Although a few capacitor manufacturers offer lines of Teflon capacitors, it is very difficult to handle and has found only limited use as a capacitor dielectric due to the high costs involved in manufacturing.

There are a few other plastics used in capacitors today but these are of less importance and will not be discussed. New plastics which have been recently available or are expected to be available before long shall now be included.

### New Plastics

A relatively new plastic dielectric, polycarbonate, provides properties similar to those of polystyrene but up to at least 125°C operation. As mentioned, Teflon will do this, but has the drawback of being difficult to handle. Polycarbonate handles more easily and will probably find much broader use than Teflon has for capacitor use.

Comparison tests to date have shown polycarbonate imported from Germany to be superior to domestic films. This is unfortunate, but sizeable stocks of the foreign polycarbonate film are being built up in various places in the United States

and its use is expected to increase sharply.

Preliminary tests of Kodar (Eastman Kodak's new film) have been very encouraging. This film exhibits a significant improvement in temperature coefficient (capacitance change with temperature change) over DuPont Mylar above 85°C. Although Kodar is not now available in gauges thinner than 1/2 mil in production quantities, it shows promise to be a popular plastic dielectric of the future.

DuPont's H-Film is currently under study for high temperature use. This is another plastic which is available only in small sample quantities at present. It has good voltage breakdown strength, even above 150°C, and could be of significant value in this temperature range. Since its properties are good, it is fairly certain that this plastic will be an important capacitor dielectric.

Polypropylene may be staging a rally for recognition as a capacitor dielectric. It has been tried in the past with disappointment but recently manufactured film appears to be good. Its chief attraction in the past has been its light weight and accompanying lower cost. It does offer

some very good properties, however, and should be watched in the future as a possible contender with polystyrene and polycarbonate.

DuPont's 15-gauge Mylar (.00015 in. thick) is not actually a new film. It does, however, represent somewhat of a breakthrough in the plastic capacitor dielectric field, and should be discussed with new dielectrics. Its primary usage appears to be in metallized capacitors where the maximum in size reduction is realized.

### Importance of Combinations

Combinations of plastic capacitor dielectrics have been used for some time to obtain desired capacitor properties. However, when you view the excellent choice of new plastics which will soon be available to capacitor design engineers, the combinations appear to be virtually unlimited and properties can possibly be tailored to meet almost any capacitor application. These many new plastic dielectrics will tend to increase competition between plastic dielectric manufacturers and hopefully will tend to force continual improvement and upgrading of all such dielectrics. This is, of course, a healthy and happy situation for both the capacitor manufacturer and the capacitor user since better capacitors are the inevitable result.

## NEW TECH DATA

for Engineers.

### Printed-Circuit Booklet

Techniques for producing reliable printed circuits and assemblies are detailed in this 3-color, 10-page booklet. It covers manufacturing methods, advantages and disadvantages of each. Included are charts listing tech. data and performance characteristics of base materials, from phenolic paper to epoxy glass, an easy-to-read table giving uses and properties of plated coatings, cut-away renderings of multi-layer termination alternatives, and other illustrations. Industrial Circuits Co., 99 Main Ave., E. Paterson, N. J.

Circle 581 on Inquiry Card

### Wire and Cable

Standard Wire and Cable Co., 3440 Overland Ave., Los Angeles 34, Calif., has published a new aid to aircraft, electronic, space and missile designers, engineers and purchasing personnel who deal with military spec. wires and cables. Publication entitled, "Comparison Chart" shows characteristics of aircraft and electronic wires and cables covered by mil. specs. The brochure shows engineering, physical, and electrical characteristics for 20 most commonly used electronic and aircraft wire types.

Circle 582 on Inquiry Card

### Explosion-Proof Starters

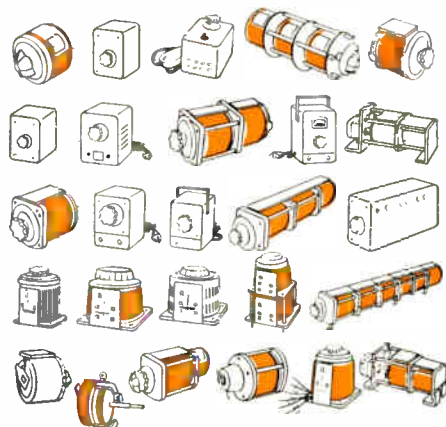
Safety and reliability features of Allis-Chalmers threaded, explosion-proof starters for hazardous locations are described in this literature. Designed for indoor and outdoor use, the enclosures have all-aluminum domes and body and stainless steel exterior hardware. Enclosures are available as complete factory-assembled starters, combination starters, and circuit breaker units. Components for field assembly of starter and circuit breaker units are also available. "TEP Starters for Hazardous Locations," 14C1488. Allis-Chalmers, Milwaukee 1, Wisc.

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**WITH METERS**—Portable cased transformers with volt-meter, ammeter, or wattmeter; single or in pairs.

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| model   | type mount | capacitance range mmf measured per JFD -5177 |      | D.C. working volts | dielectric strength measured at max. rated cap. | insulation resistance 500 VDC | Q factor measured per JFD -5178 | temp. coeff. of capacitance P.P.M. °C 25° to 125° C | material (dielectric-piston) | length (front of panel) |
|---|------------|--|------|--------------------|---|-------------------------------|---------------------------------|---|------------------------------|-------------------------|
| <b>SEALCAP MINIATURE PANEL MOUNT, PRINTED CIRCUIT, GLASS AND QUARTZ</b> |            |  |      |                    |   |                               |                                 |   |                              |                         |
| SC131*, 141 & 151   | Prt. Ct.   | 0.3  | 4.5  | 750                | 1500 VDC  | 2x10 <sup>4</sup> Meg.        | 500                             | ±50   | Glass - Invar                | 1 1/2†                  |
| SC133*, 143 & 153   | Prt. Ct.   | 0.8  | 8.5  | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±50   | Glass - Invar                | 2 1/2†                  |
| SC134*  | Prt. Ct.   | 0.7  | 12.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±75   | Glass - Invar                | 3/4                     |
| SC144 & 154   | Prt. Ct.   | 0.8  | 12.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±75   | Glass - Invar                | 1.053                   |
| SC136*, 146 & 156   | Prt. Ct.   | 0.8  | 18.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±100  | Glass - Invar                | 1 1/2†                  |
| SC139*  | Prt. Ct.   | 1.0  | 30.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±100  | Glass - Invar                | 1 1/2†                  |
| SC149 & 159   | Prt. Ct.   | 0.8  | 30.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 500                             | ±100  | Glass - Invar                | 1.928                   |
| QS171*, 181 & 191   | Prt. Ct.   | 0.6  | 1.8  | 1000               | 1500 VDC  | 2x10 <sup>4</sup> Meg.        | 1500                            | Approx. Zero  | Quartz - Invar               | 1 1/2†                  |
| QS173*, 183 & 193   | Prt. Ct.   | 0.6  | 5.5  | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 1500                            | Approx. Zero  | Quartz - Invar               | 2 1/2†                  |
| QS176*, 186 & 196   | Prt. Ct.   | 0.6  | 9.5  | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 1500                            | Approx. Zero  | Quartz - Invar               | 1 1/2†                  |
| QS179*, 189 & 199   | Prt. Ct.   | 0.8  | 16.0 | 1250               | 2500 VDC  | 10x10 <sup>4</sup> Meg.       | 1500                            | Approx. Zero  | Quartz - Invar               | 1 1/2†                  |

|  |       |                     |             |      |          |                      |      |              |                |       |
|--|-------|---------------------|-------------|------|----------|----------------------|------|--------------|----------------|-------|
| <b>STANDARD SPLIT-STATOR PANEL MOUNT, GLASS AND QUARTZ</b> |       |                     |             |      |          |                      |      |              |                |       |
| VC16G  | Panel | (A) 0.5<br>(B) 0.8  | 5.0<br>2.5  | 500  | 1000 VDC | 10 <sup>4</sup> Meg. | 700  | ±50          | Glass - Invar  | 1 1/2 |
| VC17G  | Panel | (A) 0.6<br>(B) 1.1  | 8.5<br>4.5  | 500  | 1000 VDC | 10 <sup>4</sup> Meg. | 700  | ±50          | Glass - Invar  | 1 1/2 |
| VC18G  | Panel | (A) 0.7<br>(B) 1.8  | 14.0<br>7.5 | 500  | 1000 VDC | 10 <sup>4</sup> Meg. | 700  | ±50          | Glass - Invar  | 1 1/2 |
| VC80   | Panel | (A) 0.3<br>(B) 0.4  | 2.0<br>1.0  | 1000 | 1500 VDC | 10 <sup>4</sup> Meg. | 1000 | Approx. Zero | Quartz - Invar | 1 1/2 |
| VC81   | Panel | (A) 0.4<br>(B) 0.6  | 3.2<br>1.6  | 1000 | 1500 VDC | 10 <sup>4</sup> Meg. | 1000 | Approx. Zero | Quartz - Invar | 3/4   |
| VC82   | Panel | (A) 0.5<br>(B) 0.85 | 5.5<br>2.8  | 1000 | 1500 VDC | 10 <sup>4</sup> Meg. | 1000 | Approx. Zero | Quartz - Invar | 1 1/2 |
| VC83   | Panel | (A) 4.8<br>(B) 3.0  | 11.0<br>6.0 | 1000 | 1500 VDC | 10 <sup>4</sup> Meg. | 1000 | Approx. Zero | Quartz - Invar | 1 1/2 |

|  |       |     |      |     |          |                      |     |      |             |       |
|--|-------|-----|------|-----|----------|----------------------|-----|------|-------------|-------|
| <b>HI-LIFE NVC20G MINIATURE PANEL MOUNT SERIES (May be used to replace VC20G series)</b> |       |     |      |     |          |                      |     |      |             |       |
| NVC20G°, NSC133° (Sealcap)   | Panel | 0.8 | 8.5  | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±50  | Glass-Invar | 3/4   |
| NVC21G°, NSC131° (Sealcap)   | Panel | 0.8 | 4.5  | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±50  | Glass-Invar | 3/4   |
| NVC22G°, NSC134° (Sealcap)   | Panel | 0.7 | 12.0 | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±75  | Glass-Invar | 4/4   |
| NVC23G°, NSC134° (Sealcap)   | Panel | 0.8 | 18.0 | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass-Invar | 1     |
| NVC24G°, NSC139° (Sealcap)   | Panel | 1.0 | 30.0 | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass-Invar | 1 1/2 |

†Other NVC, NMQ and NQS Hi-Life models are also available. All Hi-Life units can be used to replace other corresponding JFD trimmer capacitors without "N" prefix. All are fully described in JFD catalog C-63.

|  |          |                    |             |     |          |                      |     |      |               |        |
|--|----------|--------------------|-------------|-----|----------|----------------------|-----|------|---------------|--------|
| <b>MINIATURE SPLIT-STATOR SEALCAP SERIES</b> |          |                    |             |     |          |                      |     |      |               |        |
| SPS226G*, 236G & 246G                        | Prt. Ct. | (A) 0.8<br>(B) 0.8 | 4.2<br>2.0  | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±50  | Glass - Invar | 1 1/2† |
| SPS227G*, 237G & 247G                        | Prt. Ct. | (A) 0.8<br>(B) 1.5 | 9.0<br>4.5  | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 1 1/2† |
| SPS228G*, 238G & 248G                        | Prt. Ct. | (A) 1.0<br>(B) 2.0 | 14.0<br>7.0 | 750 | 1500 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 1 1/2† |

|   |          |     |      |      |          |                      |     |     |             |        |
|---|----------|-----|------|------|----------|----------------------|-----|-----|-------------|--------|
| <b>SUPER MAX-C SEALCAP SERIES, STANDARD PANEL MOUNT°, PRINTED CIRCUIT, GLASS AND QUARTZ</b> |          |     |      |      |          |                      |     |     |             |        |
| MCD641°, MCD661   | Prt. Ct. | 1.0 | 14.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass-Invar | 1 1/2† |
| MCD643°, MCD663   | Prt. Ct. | 1.0 | 28.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass-Invar | 1 1/2† |
| MCD644°, MCD664   | Prt. Ct. | 1.0 | 42.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass-Invar | 1 1/2† |
| MCD646°, MCD666   | Prt. Ct. | 1.0 | 60.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass-Invar | 1 1/2† |
| MCD649°, MCD669   | Prt. Ct. | 1.0 | 90.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass-Invar | 1 1/2† |

|  |          |                    |              |     |          |                      |     |      |               |        |
|--|----------|--------------------|--------------|-----|----------|----------------------|-----|------|---------------|--------|
| <b>MINIATURE DIFFERENTIAL SEALCAP SERIES</b> |          |                    |              |     |          |                      |     |      |               |        |
| DS441*, 451 & 461                            | Prt. Ct. | (1) 0.7<br>(2) 2.0 | 3.0<br>3.0   | 500 | 1000 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 3/4†   |
| DS443*, 453 & 463                            | Prt. Ct. | (1) 0.8<br>(2) 2.5 | 8.0<br>8.5   | 500 | 1000 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 4/4†   |
| DS444*, 454 & 464                            | Prt. Ct. | (1) 0.8<br>(2) 3.0 | 12.0<br>12.0 | 500 | 1000 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 3/4†   |
| DS446*, 456 & 466                            | Prt. Ct. | (1) 0.9<br>(2) 3.0 | 16.0<br>16.0 | 500 | 1000 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 1 1/2† |
| DS449*, 459 & 469                            | Prt. Ct. | (1) 1.0<br>(2) 4.0 | 28.0<br>28.0 | 500 | 1000 VDC | 10 <sup>4</sup> Meg. | 500 | ±100 | Glass - Invar | 1 1/2† |

|                             |          |     |      |      |          |                      |     |     |               |        |
|-----------------------------|----------|-----|------|------|----------|----------------------|-----|-----|---------------|--------|
| <b>MAX-C SEALCAP SERIES</b> |          |     |      |      |          |                      |     |     |               |        |
| MC601*, 611 & 621           | Prt. Ct. | 1.0 | 14.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass - Invar | 2 1/2† |
| MC603*, 613 & 623           | Prt. Ct. | 1.0 | 28.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass - Invar | 1 1/2† |
| MC604*, 614 & 624           | Prt. Ct. | 1.0 | 42.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass - Invar | 2 1/2† |
| MC606*, 616 & 626           | Prt. Ct. | 1.0 | 60.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass - Invar | 1 1/2† |
| MC609*, 619 & 629           | Prt. Ct. | 1.0 | 90.0 | 1000 | 2000 VDC | 10 <sup>4</sup> Meg. | 500 | ±50 | Glass - Invar | 1 1/2† |

| LC TUNERS*               | self-resonating frequency (MC) | nominal induct (microhenries) | nominal capacitance (MME) | Q factor | operating temperature °C | material      | length (front of panel) |
|--------------------------|--------------------------------|-------------------------------|---------------------------|----------|--------------------------|---------------|-------------------------|
| LC303*, 313, 323 & 333** | 400 MIN 725 MAX                | .0248 MIN .0277 MAX           | .54 MIN 6.56 MAX          | 170-200  | -55 to +125              | Glass - Invar | 4/4                     |
| LC304*, 314, 324 & 334** | 275 MIN 550 MAX                | .0367 MIN .0396 MAX           | .85 MIN 11.66 MAX         | 150-175  | -55 to +125              | Glass - Invar | 3/4                     |
| LC306*, 316, 326 & 336** | 200 MIN 500 MAX                | .0507 MIN .0544 MAX           | .86 MIN 20.19 MAX         | 135-170  | -55 to +125              | Glass - Invar | 1 1/2                   |
| LC309*, 319, 329 & 339** | 125 MIN 375 MAX                | .048 MIN .0798 MAX            | .88 MIN 24.49 MAX         | 145-155  | -55 to +125              | Glass - Invar | 1 1/2                   |

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\*\*Standard panel mount \* miniature panel mount †Length Applicable for Panel Mount Types Only.



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| model  | type mount    | capacitance range mmf measured per JFD #5177 |      | D.C. working volts | dielectric strength measured at max. rated cap. | insulation resistance 500 V D.C. | Q factor measured per JFD #5178 | temp. coeff. of capacitance P.P.M./°C 25° to 125°C | material (dielectric-piston) | length (front of panel) |        |
|--|---------------|--|------|--------------------|---|----------------------------------|---------------------------------|--|------------------------------|-------------------------|--------|
| <b>STANDARD PANEL MOUNT, GLASS AND QUARTZ</b>                              |               |  |      |                    |   |                                  |                                 |  |                              |                         |        |
| VC1G   | Panel         | 0.7  | 9.0  | 1500               | 2500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | -60 to +10   | Glass - Invar                | 3/32                    |        |
| VC4G   | Panel         | 0.8  | 18.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | +350 to +450                                       | Glass - Brass                | 1                       |        |
| VC5G   | Panel         | 0.8  | 18.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | -20 to +40   | Glass - Invar                | 1                       |        |
| VC11G  | Panel         | 0.6  | 14.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | -30 to +40   | Glass - Invar                | 1                       |        |
| VC11GRA  | Panel         | 0.6  | 14.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | -40 to +50   | Glass - Invar                | 1                       |        |
| VC11GRB  | Panel         | 0.6  | 14.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | +450 to +600                                       | Glass - Brass                | 1                       |        |
| VC11GRC  | Panel         | 0.8  | 18.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | +20 to +100  | Glass - Invar                | 1                       |        |
| VC30G  | Panel         | 0.8  | 30.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | -10 to +50   | Glass - Invar                | 1 1/32                  |        |
| VC2  | Panel         | 0.7  | 4.5  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 3/16                    |        |
| VCS  | Panel         | 0.6  | 6.0  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 3/16                    |        |
| VC11   | Panel         | 0.8  | 10.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 1                       |        |
| VC11A  | Panel         | 1.0  | 10.0 | 1000               | 2000 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 1 1/32                  |        |
| VC12   | Panel         | 9.0  | 21.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 1 1/32                  |        |
| VC99   | Panel         | 0.8  | 10.0 | 3000               | 5000 VDC  | 10 <sup>4</sup> Meg. Min.        | 2000                            | Approx. Zero                                       | Quartz - Invar               | 1 1/32                  |        |
| <b>SPLIT BUSHING SERIES PANEL MOUNT, PRINTED CIRCUIT, GLASS AND QUARTZ</b> |               |  |      |                    |   |                                  |                                 |  |                              |                         |        |
| VC3G   | Panel         | 0.7  | 9.0  | 1500               | 2500 VDC  | 10 <sup>4</sup> Meg. Min.        | 650                             | +350 to +500                                       | Glass - Brass                | 3/32                    |        |
| VC3GI  | Panel         | 0.7  | 9.0  | 1500               | 2500 VDC  | 10 <sup>4</sup> Meg. Min.        | 650                             | +0 to -150   | Glass - Invar                | 3/32                    |        |
| VC6GA  | Panel         | 0.7  | 17.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 750                             | +400 to +600                                       | Glass - Brass                | 1 1/32                  |        |
| VC6GC  | Panel         | 0.8  | 17.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 650                             | -100 to +100                                       | Glass - Invar                | 1 1/32                  |        |
| VC6GI  | Panel         | 0.8  | 17.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 600                             | -100 to +100                                       | Glass - Invar                | 1 1/32                  |        |
| VC7G   | Panel         | 2.0  | 30.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg. Min.        | 600                             | -100 to +100                                       | Glass - Invar                | 1 3/16                  |        |
| VC13GA   | Panel         | 0.8  | 13.0 | 3000               | 5000 VDC  | 10 <sup>4</sup> Meg. Min.        | 500                             | +225 to +375                                       | Glass - Ph. Bronze           | 1 1/4                   |        |
| VC50C  | Panel         | 5.0  | 50.0 | 1250               | 2500 VDC  | 10 <sup>2</sup> Meg. Min.        | 450                             | +250 to +450                                       | Ceram Ph Bronze              | 1                       |        |
| VC801GW  | Prt. Ct.      | 0.8  | 4.5  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 500                             | -55 to +125  | Glass - Invar                | 3/64                    |        |
| VC803GW  | Prt. Ct.      | 0.8  | 8.5  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 500                             | -55 to +125  | Glass - Invar                | 3/32                    |        |
| VC804GW  | Prt. Ct.      | 0.8  | 12.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 500                             | -55 to +125  | Glass - Invar                | 3/32                    |        |
| VC806GW  | Prt. Ct.      | 0.8  | 18.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 500                             | -55 to +125  | Glass - Invar                | 1 1/32                  |        |
| VC809GW  | Prt. Ct.      | 0.8  | 30.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 500                             | -55 to +125  | Glass - Invar                | 1 1/16                  |        |
| VC811QW  | Prt. Ct.      | 0.6  | 1.8  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 2000                            | -55 to +150  | Quartz - Invar               | 3/64                    |        |
| VC813QW  | Prt. Ct.      | 0.6  | 5.0  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 2000                            | -55 to +150  | Quartz - Invar               | 3/4                     |        |
| VC816QW  | Prt. Ct.      | 0.6  | 9.5  | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 2000                            | -55 to +150  | Quartz - Invar               | 1 1/32                  |        |
| VC819QW  | Prt. Ct.      | 0.6  | 16.0 | 1000               | 1500 VDC  | 10 <sup>4</sup> Meg.             | 2000                            | -55 to +150  | Quartz - Invar               | 1 1/16                  |        |
| <b>MINIATURE PANEL MOUNT, PRINTED CIRCUIT, GLASS AND QUARTZ</b>            |               |  |      |                    |   |                                  |                                 |  |                              |                         |        |
| VC20G*   | VC9G, VC9GW   | Prt. Ct.                                     | 0.8  | 8.5                | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±50                          | Glass - Invar           | 3/16   |
| VC21G*   | VC10G, VC10GW | Prt. Ct.                                     | 0.8  | 4.5                | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±50                          | Glass - Invar           | 3/16   |
| VC22G*   |               | Panel  | 0.7  | 12.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±75                          | Glass - Invar           | 4/64   |
| VC23G*   | VC32G, VC32GW | Prt. Ct.                                     | 0.8  | 18.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±100                         | Glass - Invar           | 1      |
| VC24G*   |               | Panel  | 1.0  | 30.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±100                         | Glass - Invar           | 1 3/16 |
| VC31G, VC31GW  |               | Prt. Ct.                                     | 0.8  | 12.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±75                          | Glass - Invar           | 1 1/32 |
| VC42G & VC42GW   |               | Prt. Ct.                                     | 1.0  | 21.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±100                         | Glass - Invar           | 1 1/4  |
| VC43G, VC43GW  |               | Prt. Ct.                                     | 0.8  | 30.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 500  | ±100                         | Glass - Invar           | 1 3/16 |
| MQ101*, 111 & 121  |               | Prt. Ct.                                     | 0.6  | 1.8                | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 1500   | Approx. Zero                 | Quartz - Invar          | 3/16   |
| MQ103*, 113 & 123  |               | Prt. Ct.                                     | 0.6  | 5.5                | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 1500   | Approx. Zero                 | Quartz - Invar          | 3/16   |
| MQ106*, 116 & 126  |               | Prt. Ct.                                     | 0.6  | 9.5                | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 1500   | Approx. Zero                 | Quartz - Invar          | 1      |
| MQ109*, 119 & 129  |               | Prt. Ct.                                     | 0.8  | 16.0               | 1000  | 1500 VDC                         | 10 <sup>4</sup> Meg. Min.       | 1500   | Approx. Zero                 | Quartz - Invar          | 1 3/16 |

\* Panel Mount

## JFD ELECTRONICS CORPORATION



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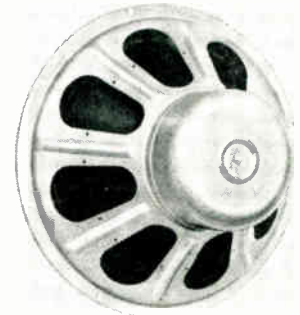


|   | DIAMETER                   | POWER RATING (watts) | RESISTANCE (ohms) | CTS SERIES        |                 |
|---|----------------------------|----------------------|-------------------|-------------------|-----------------|
| <b>COMPOSITION VARIABLE RESISTORS</b>                       |                            |                      |                   |                   |                 |
| COMMERCIAL  | 15/16"                     | 1/4-1                | 200Ω-10 megs      | 45                | *Carbon-Ceramic |
|   | 15/16"                     | 1/4                  | 250Ω-15 megs      | Q                 |                 |
|   | 3/4"                       | 2/10-3/10            | 250Ω-5 megs       | 70                |                 |
|   | 5/8"                       | 2/10-1/4             | 250Ω-2.5 megs     | 200               |                 |
|   | 9/32"                      | 1/10                 | 500Ω-10 megs      | M250              |                 |
|   | 2 & 3 section side by side | 1/4-1/3              | 250Ω-10 megs      | X52<br>X53<br>U52 |                 |
| 2 & 3 section side by side                                  | 1/4                        | 500Ω-10 megs         | X152*<br>X153*    | MIL-R-84B         |                 |
| 2"  | 2                          | 5KΩ-50 megs          | HVC               |                   |                 |
| MILITARY  | 1-1/8"                     | 2                    | 100Ω-10 megs      |                   | 96              |
| MILITARY  | 1-1/8"                     | 2                    | 100Ω-10 megs      | 95                | RV4             |
|   | 15/16"                     | 1                    | 100Ω-5 megs       | 90                | RV2             |
|   | 15/16"                     | 1/4                  | 100Ω-15 megs      | 45                | RV5<br>RV6      |
|   | 3/4"                       | 1/2                  | 100Ω-2.5 megs     | 65                |                 |
|   | 1/2"                       | 3/4                  | 100Ω-2.5 megs     | 300*              |                 |
|   |                            |                      |                   |                   |                 |
| <b>WIREWOUND VARIABLE RESISTORS</b>                         |                            |                      |                   |                   |                 |
| COMMERCIAL  | 1-17/32"                   | 4                    | 3Ω-25K            | 25                | *Carbon-ceramic |
|   | 1-17/64"                   | 2                    | 3Ω-15K            | 252               |                 |
|   | 1-1/4"                     | 2                    | 1Ω-50K            | 2W                |                 |
|   | 3/4"                       | 1-1/2 to 3           | 1/2Ω-5K           | 110               |                 |
| MILITARY  | 1-17/32"                   | 4                    | 3Ω-25K            | 25                | RA30            |
|   | 1-17/64"                   | 2                    | 3Ω-15K            | 252               | RA20            |
|   | 1-1/4"                     | 2                    | 3Ω-15K            | WP                | RA20            |
| <b>CERMET VARIABLE RESISTORS</b>                            |                            |                      |                   |                   |                 |
| (with Space Age High Stability 500°C Metal-Ceramic Element) | 1-3/64"                    | 3                    | 100Ω-2.5 megs     | 400†              | 179             |
|   | 3/4"                       | 1-1/2                | 100Ω-2.5 megs     | 500†              | 180             |
|   | 1/2"                       | 3/4                  | 100Ω-5 megs       | 600               | 175             |

†Semi-precision

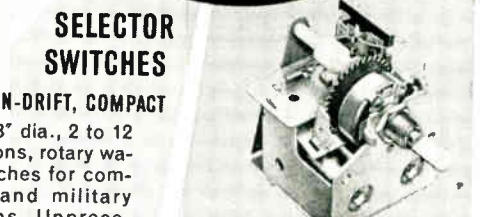
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|                                      | DIMENSIONS       | POWER RATING (watts) | RESISTANCE (ohms) | CTS SERIES |     |
|--------------------------------------|------------------|----------------------|-------------------|------------|-----|
| <b>COMPOSITION TRIMMER RESISTORS</b> |                  |                      |                   |            |     |
| COMMERCIAL                           | 1-1/4x.295x.350  | 1/4                  | 500Ω-1 meg        | 140        | 80  |
|                                      | 7/16x5/16x1/2    | 1/8                  | 250Ω-2.5 megs     | 220        | 184 |
| MILITARY                             | 1-1/4x.295x.350  | 1/4                  | 500Ω-1 meg        | 140        | 80  |
|                                      | .344 Dia. x .240 | 1/10                 | 250Ω-2.5 megs     | 380*       |     |
| <b>CERMET TRIMMER RESISTORS</b>      |                  |                      |                   |            |     |
|                                      | 1/2x1/2x.260     | 1                    | 100Ω-1 meg        | 170        | 178 |
|                                      | 1-1/4x.295x.335  | 1                    | 100Ω-1 meg        | 180        | 177 |

Request Data Sheet

\*Carbon-ceramic

Only P.C. sizes are shown. Lead sizes are smaller.



# CERMET FIXED RESISTORS

**CERAFER**—Cermet resistance element. Wafers for micromodule systems. Low cost resistor and conductor layouts for printed circuitry on ceramic. 5Ω-300K per square. Request Data Sheet 181.

**CERADOT**—Solid cermet, .050" dia. x .030" long or as required, 1/10 watt, 50Ω-100K, with or without leads. Request Data Sheet 185.



Founded 1896

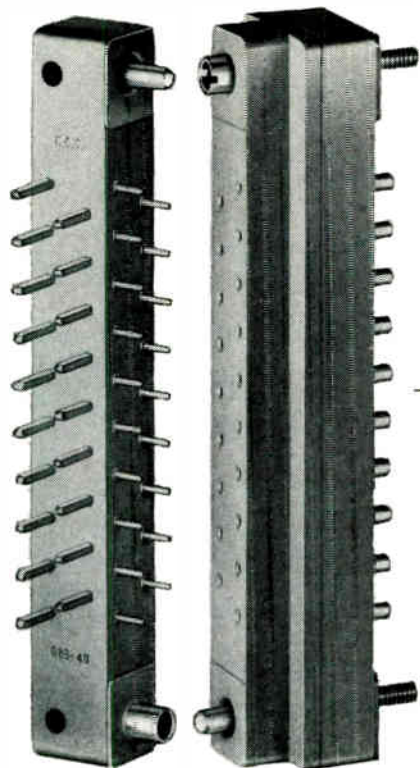
**CTS CORPORATION**  
Elkhart, Indiana

**DATA SHEET REQUESTS HONORED PROMPTLY, ASK BY NUMBER**

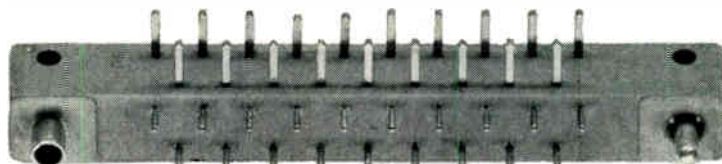
Factories coast-to-coast for your convenience: Elkhart & Berne, Indiana; South Pasadena, California; Asheville, North Carolina; Paducah, Kentucky and Streetsville, Ontario, Canada.



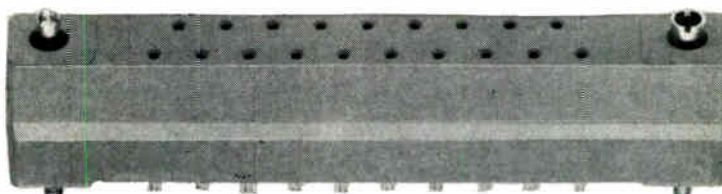
# ANOTHER CONTINENTAL CONNECTOR FOR THE POLARIS PROGRAM



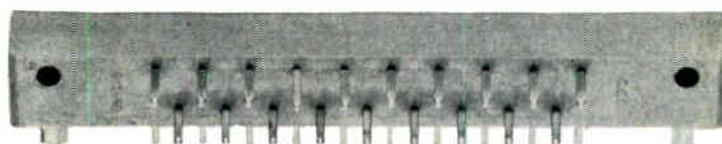
Series 683-40 and 683-41 Right Angle Plug & Socket



Feature Two Taper Receptacles for Each Solderless-



Wrap Connection and .250 Staggered Contact Spacing



...Meet All Requirements for Vibration and Impact.



**19 Solderless-Wrap Plug Terminations/38 Taper Pin Socket Terminations**  
Socket easily secured to PC board or chassis by two threaded mounting studs. Plug has through hole mounting. Guide pins and sockets are polarized to prevent mismatching. Molding is flame resistant, high dielectric, glass filled Diallyl Phthalate.

**DESIGNER'S DATA FILE.** If you're designing for right angle printed circuit applications you'll want to have Continental's Catalog RTA 362, compiled to help you select and specify the type best suited to your needs. For a free copy, write to: *Continental Connector Corporation, 34-63 56th Street, Woodside 77, New York, or call TW 9-4422.*

## DISTRIBUTORS FOR OFF-THE-SHELF DELIVERY:

**AIRWORK CORP., O.E.M. DIVISION** P.O. Box 48-194, International Airport, Miami 48, Fla. • Phone: 885-2401 • TWX 305-821-3720

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Phone: ME1rose 1-9530 • TWX 214-631-4993

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MICRO-MINIATURE • SUB-MINIATURE • MINIATURE • PRINTED CIRCUIT • RIGHT ANGLE PIN & SOCKET • CENTER SCREWLOCK

# CONTINENTAL CONNECTORS

CONTINENTAL CONNECTOR CORPORATION • WOODSIDE 77, NEW YORK

ELECTRONIC INDUSTRIES • June 1963

Circle 27 on Inquiry Card

D29



50% more capacity per unit volume, 30% more capacity per unit weight than any comparable nickel-cadmium battery—rechargeable thousands of times—these are features you may need now for transistorized field pack radios or radio telephones, rescue beacons, unmanned remote stations, test equipment, low-noise preamps and other long-life, low-rate-discharge applications.

Added to the voltage stability, rechargeability and low-temperature performance of nickel-cadmium, these cells offer exceptional efficiency—made possible by a space-saving rectangular shape and Sylvania's film forming

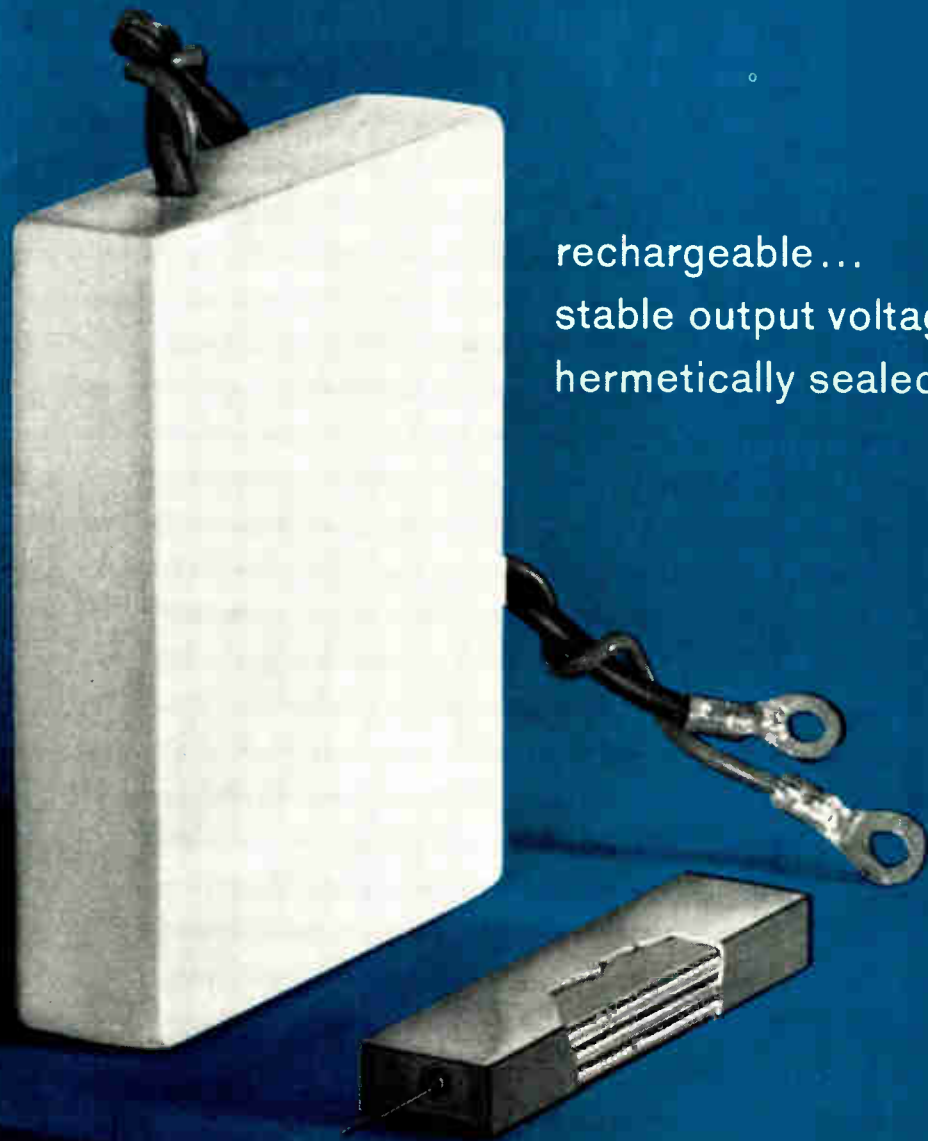
process. Cell plates are made by casting and sintering nickel to form a self-supporting, porous film, and then loading this "sponge" with chemicals. The usual plate backing is thus eliminated, and efficiency is increased.

Cells are hermetically sealed and available in a wide choice of sizes with capacities from 50 mA hrs. to 4 Amp hrs. Easily stacked in a variety of arrangements, they are strapped and jacketed in plastic to form a battery that meets shock and vibration requirements of MIL-B-55118 (Signal Corps).

To crystallize some of the advantages of Sylvania bat-

## Design small, design light—new Sylvania are up to 50% more efficient

Typical plastic-jacketed 12-volt battery—only 5.5 cubic inches, with 500 mA hr. capacity. High efficiency comes from rectangular cell shape and film formed plates shown in cutaway—sheets of porous nickel impregnated with chemicals.



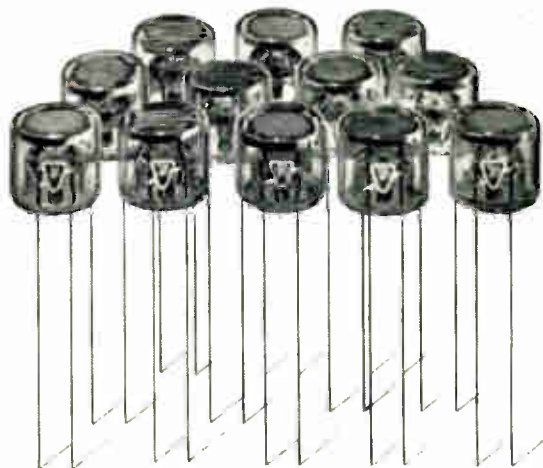
rechargeable ...  
stable output voltage ...  
hermetically sealed

series, here is a partial description of the typical 10-cell pack illustrated below:

**TYPE SRB-3428**

Dimensions (Approx.) 3 1/4 x 2 1/4 x 1 1/4 in.  
 Volume 5.5 cu. in.  
 Weight .5 lb.  
 at .20<sub>v</sub> rate.  
 Capacity (nominal) 500 mA hrs.  
 Average Operating Voltage 12 Volts

# Ni-Cd batteries than any others



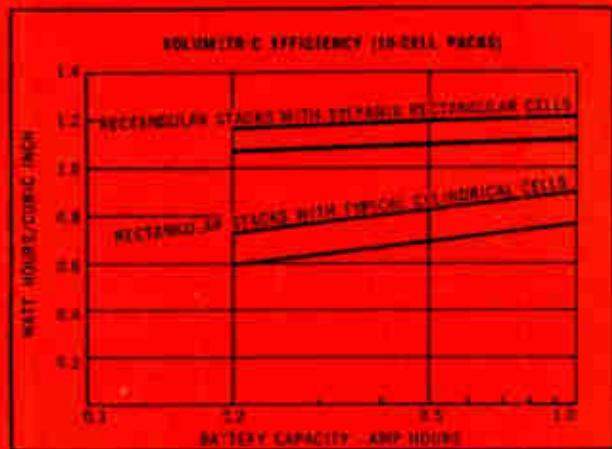
## BROADEST LINE OF T-4 CdS PHOTOCONDUCTORS AVAILABLE 400 V, 300 mW ratings... hermetic seal with blue-dot proof!

Photocell circuit designers can now have cells exactly suited to streetlighting, flame-out alarms, remote control devices and other applications—choosing from the Sylvania line, ranging from 750 ohms to 16,000. Now rated at 400 volts, with 300 mW dissipation, these photoconductors also have reliability insurance—a true hermetic seal verified by a blue dot that immediately signals the presence of as little as .02% water vapor.

Among T-4 cadmium sulfide cells, only Sylvania offers such a broad range plus these high voltage and dissipation ratings. And watch for future developments: smaller size, photoconductors for high power and ultraviolet.

| Type | 2 Ft.-Candle Resistance (ohms) | Min. Dark Resistance After 10 Sec. in Complete Darkness (ohms) |
|------|--------------------------------|--|
| 8345 | 750                            | 75,000   |
| 8142 | 1,500                          | 200,000  |
| 8346 | 3,000                          | 300,000  |
| 8100 | 5,000                          | 500,000  |
| 8143 | 9,000                          | 900,000  |
| 8347 | 16,000                         | 1,600,000  |

For more information on these two new developments from Sylvania, write Electronic Tube Division, Sylvania Electric Products Inc., Box 87, Buffalo, N. Y.



# SYLVANIA

SUBSIDIARY OF  
**GENERAL TELEPHONE & ELECTRONICS**



NEW CAPABILITIES IN: ELECTRONIC TUBES • SEMICONDUCTORS  
 MICROWAVE DEVICES • SPECIAL COMPONENTS • DISPLAY DEVICES

Circle 14 on Inquiry Card

# NEW TECH DATA

for Engineers.

## Components Catalog

Catalog 32, 44 pages, lists variable resistors, switches and ceramic capacitors. Detailed dimensional drawings and complete electrical, mechanical, and environmental specs. are given. Included are 18 and 24-position phenolic switches, lever-action switches, intercom switches, rotary switch kits, military type ceramic disc capacitors, ac line ceramic disc capacitors, 20v. micron miniature Ultra-Kaps, and polystyrene capacitors. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.

Circle 484 on Inquiry Card

## Thin-Plate Capacitors

Bulletin NPJ-122 describes subminiature thin-plate capacitors, types TPNPO, TP25, and TP89. Available in a variety of temp. coefficients, their rectangular slim design allows close assembly on printed-wiring boards. Listed are typical properties for each type, physical dimensions, etc. Aerovox Corp., New Bedford, Mass.

Circle 485 on Inquiry Card

## Nonlinear Capacitors

This new line of Mylar® dielectric permits any nonlinear function with capacitor rotation. Custom features such as trigonometric, step, discontinuous and circuit-error correcting functions can be accommodated. Total capacitance may be increased, decreased or remain constant with rotation. Western Industrial Research, Rotary Products Div., P. O. Box 404, Beverly Hills, Calif.

Circle 486 on Inquiry Card

## Low-Power Amplifier

The SA-112 amplifier gives high-gain and low-drift performance without choppers. It has less than 10mv./day drift and uses 60mw. It can be operated continuously for 1 month from 2 flashlight-size batteries and drives a galvanometer-type recorder. It is ideal for recording thermocouple signals. Self-Organizing Systems, Inc., 6612 Denton Dr., Dallas 35, Tex.

Circle 487 on Inquiry Card

## I-F Tubes

Types 6JK6 and 6JL6 are strap-frame, i-f amplifiers designed for use in television receivers. Type 6JK6 is a 7-pin miniature video i-f pentode featuring frame-grid construction, sharp cutoff characteristic, and 18,000 $\mu$ mhos; type 6JL6, also a 7-pin miniature i-f pentode, features frame-grid, has remote cutoff characteristics, is designed for acc controlled stages, and has 15,500 $\mu$ mhos. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

Circle 488 on Inquiry Card

## Power Supplies

Bulletin Series 4105 presents information on power supplies covering output from 0.7v. to 500v. at 1.0 to 110 amps. Circuits use either conventional or ferromagnetic transformers and either magnetic-amplifier, SCR, or transistor regulators. Vickers Inc., 1815 Locust St., St. Louis 3, Mo.

Circle 489 on Inquiry Card

## Power Resistors

The Greenohm "V" edge-wound resistors are available in power ratings from 90 to 375w. Temp. rise is 375°C. The units meet or exceed Mil-R-26C for un-insulated resistors. Resistance range is from 0.04 to 25 ohms. Clarostat Mfg. Co., Inc., Dover, N. H.

Circle 490 on Inquiry Card

## Voltage Sensors

Voltage hermetically-sealed sensors, consisting of input network, voltage comparator with adjustment if required, amplifier and output relay, are available. These sensors are used where critical amplitude sensing between drop-out and pull-in voltages or low voltages must be sensed. Hi-G Inc., Bradley Field, Windsor Locks, Conn.

Circle 491 on Inquiry Card

## Tin Oxide Resistors

Bulletin, "Resistor Reliability" discusses methods of manufacturing and selecting and provides information on performance of high-reliability tin oxide resistors. Two representative graphs illustrate the results of continuous life testing of standard parts for almost 6 years at 60%, and at 140% for almost 4 years. Corning Electronic Components, Corning Glass Works, Raleigh, N. C.

Circle 492 on Inquiry Card

## Trimmer Capacitors

Series Bulletin Y-63 describes a new series of low-cost trimmers which exceed Mil-C-14409A. These trimmers feature stability, high Q, ultra-linear tuning, and lack tuning reversals. Information includes physical and electrical specs. JFD Electronics Corp., 15th Ave. at 62nd St., Bklyn. 19, N. Y.

Circle 493 on Inquiry Card

## Power Resistors

Type PW wire-wound resistors are available in ratings of 2, 3, 5, 7, 10, 15, and 20w. Min. standard resistance value is 0.1 $\Omega$ , and tolerances are 5 and 10%. Boone Div., International Resistance Co., P. O. Box 393, Boone, N. C.

Circle 494 on Inquiry Card

# CALL YOUR "KEMET" REPRESENTATIVE or DISTRIBUTOR for all your needs in SOLID TANTALUM CAPACITORS

## "KEMET" SALES REPRESENTATIVES

### NEW ENGLAND AND EAST COAST

Electrical Manufacturers Services, P.O. Box 489, Hempstead, N. Y. 516 Ivanhoe 5-4321; 1784 Hempstead Turnpike, Hempstead; 3001 James St., Syracuse 6, N. Y. 315 Howard 3-4866; 1476 Force Drive, Mountainside, N. J. 201 Plainfield 6-1018; Old Lakeshore Rd., Oerby, N. Y. 716 NA 7-2121; 7 New Market St., P. O. Box 843, Poughkeepsie, N. Y. 914 471-6830; 265 Church St., New Haven 10, Conn. 203 UN 5-9104

Kitchen & Kutchnin, 1775 Massachusetts Ave., Lexington, Mass. VO 2-8230; 223 Broad St., Milford, Conn. 203 TR 8-4366

Sunday-O'Brien Corporation, 15 Potter St., Haddonfield, N. J. 609 HA 9-4013; TWX 609 429-9088

Daniel and Company, 407 Washington St., Towson 4, Md. VAlley 5-3330; P. O. Box 124, Lutherville, Md.

VA. (Except Fairfax County), TENN., GA., FLA., N. C., S. C., MISS., ALA.

Jake Rudisill Associates, 2009 N. Tryon St., Charlotte 6, N. C. 376-4792; 2454 Medway Ave., Raleigh, N. C. TE 4-6417

Roy Attaway Company, 900 Bob Wallace Ave., S.W., Huntsville, Ala. 534-2811; TWX 205 811-3424; 711 Magnolia Ave., Orlando, Fla. GA 4-9983; TWX 305 275-0841

### OHIO, Western PENNSYLVANIA

R. G. Sidnell & Company, 15120 Edgewater Drive, Cleveland 7, O. ACademy 1-1313; 30 Lynn Rae Circle, Dayton 59, O. 885-5531; 409 Hazelnut Drive, Monroeville, Pa. CHurchill 2-1476; 9012 Cherryblossom Lane, Cincinnati 31, O. 522-0732

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### WISC., Northern ILL., IOWA, IND. (Lake County)

D. Dolin Sales Company, 3553 W. Peterson Ave., Chicago 45, Ill. JUniper 8-3738; TWX 312 222-0928; 3501 W. Burleigh, Milwaukee 10, Wisc. UPTon 1-2933

### NEB., KAN., MO., Southern ILL. (Incl. Quincy)

Harris-Hanson Company, 2814 S. Brentwood Blvd., St. Louis 17, Mo. Mission 7-4350; TWX 314 962-3933; 7916 Paseo St., Kansas City 32, Mo. Highland 4-9494; TWX 816 556-2423

### MINN., NO. and SO. DAKOTA

Stan Clothier Company, Inc., 12 W. 58th St., Minneapolis 19, Minn. TAYlor 5-1234; TWX 612 321-0886

### TEX. (Except El Paso County), OKLA., ARK., LA.

Ammon & Champion Company, P. O. Box 35263; 2746 Seelco, Dallas 35, Tex. FLetwood 7-8441; TWX 214 899-8306; 615 Gilpin St., Houston. HUDson 6-2233

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### WASH., ORE.

Samuel N. Stroum Company, 621 S. Michigan St., Seattle 8, Wash. PArkway 2-7419; TWX 206 998-0403. Portland customers call Commerce 9640

### CALIF., ARIZ., NEV.

G. S. Marshall Company, 2065 Huntington Drive, San Marino, Calif. MUrray 1-3292; TWX 213 499-2953; 708 Warrington Ave., Redwood City, Calif. EMerson 6-8214; TWX 415 364-9023; No. 28 Pima Plaza, Scottsdale, Ariz. 946-4276; 4410 Kearny Mesa Rd., San Diego, Calif. BR 8-6350

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Kemet Department, Linde Company, Division of Union Carbide Corporation



**Another bull's-eye in capacitor design...!**



**"KEMET"**  
TRADE MARK

**BULLET-SHAPED**

**C-SERIES**

(Polar Type)

**SOLID TANTALUM CAPACITORS**

*Provide peak performance under severe shock/vibration conditions*

- ★ Molded shape adaptable to welded module construction or conventional point-to-point wiring... also automatic insertion equipment.
- ★ Suitable for better-grade entertainment devices, ship-to-shore and other 2-way radio communications or similar top-quality uses.

KEMET's complete line of solid tantalum capacitors has a brand new member—the C-Series polar type—designed for highly compact circuitry!

C-Series units consist of a porous tantalum anode encapsulated in an epoxy case with a *bullet-shaped* end for fast polarity identification, easy capacitor orientation, and assembly in close proximity to other components.

DC leakage current is extremely low and dissipation factor is not sacrificed. Capacitance ranges from 0.1 to 56 microfarads in  $\pm 5$ , 10, and 20 per cent tolerances. Working voltages are 6, 10, 15, 20, 35, and 50. Operation is continuous over a temperature range of  $-55^{\circ}$  to  $+85^{\circ}\text{C}$ .

For full information on the C-Series and other solid tantalums in KEMET's complete line—from 6 to 100 volts—write to:

**"THE SPECIALIST IN SOLID TANTALUM CAPACITORS"**

Kemet Department, Linde Company, Division of Union Carbide Corporation, 11901 Madison Avenue, Cleveland 1, Ohio. Telephone 216-221-0600.

**KEMET DEPARTMENT**  
**LINDE**  
**COMPANY**



"Kemet," "Linde," and "Union Carbide" are registered trade marks of Union Carbide Corporation.



**C-SERIES EXACT SIZE**

**PRESENTLY AVAILABLE IN 2 CASE SIZES**

*Case A:* Diameter .146; length .370; lead diameter .020.

*Case B:* Diameter .196; length .505; lead diameter .025.

*Case material:* Dimensionally-stable, moisture-resistant, self-extinguishing epoxy with excellent dielectric properties.

*Leads:* Solder-coated nickel wire.

**LINDE, KEMET PRODUCTS for Electronics/Aerospace**

LINDE Laser/Maser Crystals, Sapphire, Rare Gases/Mixtures, Cryogenic Materials, Single-Crystal Refractory Metals, Semiconductor Silicon, Silicon Monoxide. KEMET Barium Getters and Solid Tantalum Capacitors—6 to 100V.

Write today for technical data



# ESC

**ELECTRONICS CORP.**

534 BERGEN BOULEVARD • PALISADES PARK. N. J.

products are available from stock, or depending on your requirements, will be designed to your exact specifications. For custom requirements, we will produce a prototype and submit a detailed laboratory report on all parameters and test equipment used. When your prototype is ready for production, our rigid Inspection and Quality Control Procedures ensure that each electrical and mechanical characteristic is exactly as specified.

For complete information on the hundreds of different models manufactured by ESC, write or call today for catalog No. 9, or specific technical literature.



\*Write for Brochure

**\*MAGNETOSTRICTIVE DELAY LINES**

This new ESC line ranges from 10  $\mu$ sec to 10,000  $\mu$ sec; frequency range 200 KC to 1 MC R.Z.; temperature coefficient less than 1 PPM where required; meets MIL environmental requirements. The acoustic wire type of sonic delay line offers the most desired characteristics of a memory line — long delay, wide bandwidth and delay stability in a high density package.

| Series No. | Min. Delay     | Max. Delay      |
|------------|----------------|-----------------|
| 30M        | 250 $\mu$ SEC  | 1000 $\mu$ SEC  |
| 40M        | 1000 $\mu$ SEC | 2500 $\mu$ SEC  |
| 50M        | 2500 $\mu$ SEC | 5000 $\mu$ SEC  |
| 60M        | 5000 $\mu$ SEC | 10000 $\mu$ SEC |



**AUDIO DELAY LINES**

Hermetically sealed for most severe environmental applications; delays from 500  $\mu$ sec to 5000  $\mu$ sec and greater; bandwidth (3 db); up to 35 KC and greater; delay time/rise time ratios as high as 170/1. Frequency insertion loss less than 4 db.

Other audio delay lines up to 200 milliseconds.



**MINIATURE TRANSPONDER DELAY LINE**

Occupies only six cubic inches; Impedance: 470 ohms; delay time 20.3  $\pm$ .1; rise time: 0.45 (max); attenuation: 4 db; temperature coefficient: 65 ppm or better over a temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ . Series 52-44.

For your immediate requirements, ESC carries an extensive stock of encoding or decoding delay lines.

**DIRECT READOUT VARIABLE DECADE DELAY LINE**

|           |   |
|-----------|---|
| Model 101 | — a total delay of 9.99 $\mu$ sec, resolution $\frac{1}{1000}$ of total delay |
| Model 102 | — a total delay of 9.99 $\mu$ sec, resolution $\frac{1}{1000}$ of total delay |
| Model 103 | — a total delay of 9.99 $\mu$ sec, resolution $\frac{1}{1000}$ of total delay |

**PUSHBUTTON DECADE DELAY LINE**

| Model | Delay              | Rise Time      | Impedance | Attenuation (at max. $\mu$ sec delay) |
|-------|--------------------|----------------|-----------|---------------------------------------|
| 205   | 0- 5.075 $\mu$ sec | 0.20 $\mu$ sec | 1000 ohms | 25%                                   |
| 205R  |                    |                |           |                                       |
| 210   | 0-10.05 $\mu$ sec  | 0.30 $\mu$ sec | 1000 ohms | 40%                                   |
| 210R  |                    |                |           |                                       |
| 220   | 0-20.05 $\mu$ sec  | 0.50 $\mu$ sec | 1000 ohms | 50%                                   |
| 220R  |                    |                |           |                                       |
| 250   | 0-50.1 $\mu$ sec   | 2.0 $\mu$ sec  | 1000 ohms | 50%                                   |
| 250R  |                    |                |           |                                       |

**CONTINUOUSLY VARIABLE DELAY LINES (6 $\frac{1}{32}$ " X  $\frac{5}{8}$ " X 1 $\frac{1}{4}$ " )**

| No. | Delay (Max.)  | Rise Time (Max.) | Impedance (Ohms) |
|-----|---------------|------------------|------------------|
| 401 | .10 $\mu$ sec | .025 $\mu$ sec   | 100              |
| 402 | .20 $\mu$ sec | .030 $\mu$ sec   | 200              |
| 403 | .70 $\mu$ sec | .090 $\mu$ sec   | 500              |
| 404 | .50 $\mu$ sec | .055 $\mu$ sec   | 750              |
| 405 | .40 $\mu$ sec | .040 $\mu$ sec   | 1000             |
| 406 | .25 $\mu$ sec | .030 $\mu$ sec   | 1300             |
| 407 | .20 $\mu$ sec | .030 $\mu$ sec   | 1500             |

**CONTINUOUSLY VARIABLE VIDEO DELAY LINE (7 $\frac{1}{4}$ " X 1" X 1 $\frac{1}{8}$ " )**

| Model No. | Min. Delay @ Max. Pos. | Impedance (Ohms) | Rise Time (max) | Attenuation |
|-----------|------------------------|------------------|-----------------|-------------|
| 501       | 0.9 $\mu$ sec          | 1,000            | 0.2 $\mu$ sec   | 0.5 db      |
| 502       | 2.0 $\mu$ sec          | 470              | 0.4 $\mu$ sec   | 1.2 db      |
| 503       | 4.0 $\mu$ sec          | 220              | 0.8 $\mu$ sec   | 2.5 db      |
| 504       | 9.0 $\mu$ sec          | 100              | 1.8 $\mu$ sec   | 5.0 db      |
| 505       | 15.0 $\mu$ sec         | 56               | 3.0 $\mu$ sec   | 9.0 db      |



Series 100



Series 200



Series 400 and 500

# WORLD'S LEADING PRODUCER OF DELAY LINES

## LUMPED CONSTANT DELAY LINES

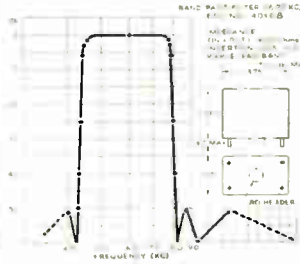
### Standard LC Series

Delay time/rise time ratios from 10 to 30 for delays of 0.25  $\mu\text{sec}$  to 50  $\mu\text{sec}$ .

### Millisecond Series

Long delay, low attenuation characteristics with delay time/rise time ratios from 20 to 50 for delays of 10  $\mu\text{sec}$  to 5 millisecc.

(Custom-built Lumped Constant Delay Lines available with delay time/rise time ratios as high as 170/1.)



## CUSTOM DESIGNED FILTERS

Phase distortion problems minimized by ESC's custom-designed low, high and band pass filters. Exacting phase characteristics in small case sizes can be met and at very competitive prices. Ruggedly constructed, these filters meet appropriate MIL and commercial environmental, shock and vibration specs.

## DISTRIBUTED CONSTANT DELAY LINES

Cylindrical or rectangular shapes for printed board mounting. Delays varying from 0.02  $\mu\text{sec}$  to 1.2  $\mu\text{sec}$  covering impedance ranges from 100 ohms to 1,800 ohms, exhibiting excellent pulse characteristics, at low cost.



## MINIATURE DELAY LINE — SERIES 37-74

This miniature features better than 35 to 1 delay/rise time ratio in a 3/2 cubic inch package. Low attenuation — less than 2 db high temperature operation —55°C to 125°C. Delay time 2.5  $\mu\text{sec}$ .



## MINIATURE NANOSECOND DELAY LINES

Designed for printed board mounting, delays range from 5 nsec. to 100 nsec. with pulse rise time from 1 nsec. to 10 nsec.



## MINIATURIZED FILTER SERIES

Attenuation of less than 3 db at cutoff frequency; greater than 40 db at and beyond 2.5 x  $F_{CO}$  (at and below 1/2.5 x  $F_{CO}$  for high pass filters.) Insertion loss is less than 2 db. Temperature range: -20°C to +85°C. Hermetically sealed.



## VARIABLE DELAY LINES (6 1/8" x 6 1/8" x 1 5/8")

| Model | Delay                | Impedance (Ohms) | Rise Time            | Attenuation |
|-------|----------------------|------------------|----------------------|-------------|
| 602   | 2.0 $\mu\text{sec}$  | 1000             | 0.17 $\mu\text{sec}$ | 1.0 db      |
| 603   | 5.0 $\mu\text{sec}$  | 1000             | 0.40 $\mu\text{sec}$ | 3.0 db      |
| 604   | 10.0 $\mu\text{sec}$ | 1000             | 0.70 $\mu\text{sec}$ | 5.0 db      |
| 605   | 15.0 $\mu\text{sec}$ | 1000             | 0.90 $\mu\text{sec}$ | 5.0 db      |
| 606   | 2.0 $\mu\text{sec}$  | 100              | 0.17 $\mu\text{sec}$ | 1.0 db      |
| 607   | 5.0 $\mu\text{sec}$  | 100              | 0.40 $\mu\text{sec}$ | 3.0 db      |
| 608   | 10.0 $\mu\text{sec}$ | 100              | 0.70 $\mu\text{sec}$ | 5.0 db      |
| 609   | 15.0 $\mu\text{sec}$ | 100              | 0.90 $\mu\text{sec}$ | 5.0 db      |

60 step switch provides resolution 1/120 of total delay.

## MINIATURE VARIABLE DELAY NETWORKS (4 1/2" x 1 1/2" x 1/2")

| Model No. | Time Delay            | Impedance | Pulse Rise Time             |
|-----------|-----------------------|-----------|-----------------------------|
| 701       | 0.125 $\mu\text{sec}$ | 1500 ohms | 0.03 $\mu\text{sec}$ (max.) |
| 702       | 0.25 $\mu\text{sec}$  | 1800 ohms | 0.06 $\mu\text{sec}$ (max.) |
| 703       | 0.50 $\mu\text{sec}$  | 1000 ohms | 0.10 $\mu\text{sec}$ (max.) |
| 704       | 0.75 $\mu\text{sec}$  | 680 ohms  | 0.15 $\mu\text{sec}$ (max.) |
| 705       | 1.0 $\mu\text{sec}$   | 560 ohms  | 0.20 $\mu\text{sec}$ (max.) |
| 706       | 1.25 $\mu\text{sec}$  | 470 ohms  | 0.25 $\mu\text{sec}$ (max.) |
| 707       | 1.50 $\mu\text{sec}$  | 390 ohms  | 0.30 $\mu\text{sec}$ (max.) |
| 708       | 0.65 $\mu\text{sec}$  | 93 ohms   | 0.10 $\mu\text{sec}$ (max.) |

Pulse Attenuation — 1.0 db (max.) all units DC Working Volts — 500 volts (max.)

## MINIATURE TRIMMER DELAY LINE "TRIMLINE"™

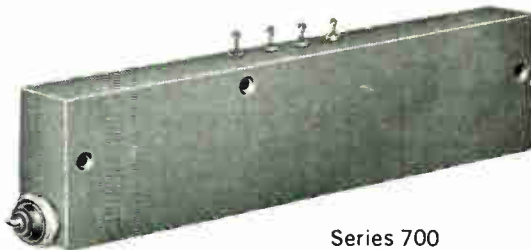
| Model | Delay* (nsec) | Char. Impedance (ohms) | Approximate TD/TR Ratio | Size (inches)      | Approx. # of Revolutions |
|-------|---------------|------------------------|-------------------------|--------------------|--------------------------|
| 801   | 50            | 200                    | 4:1                     | 2.25 x 1.800 x .35 | 6                        |
| 802   | 75            | 1000                   | 4:1                     | 2.25 x 1.800 x .35 | 6                        |
| 803   | 100           | 200                    | 7:1                     | 4.00 x 3.500 x .35 | 12                       |
| 804   | 125           | 500                    | 4:1                     | 2.25 x 1.800 x .35 | 6                        |
| 805   | 150           | 1000                   | 7:1                     | 4.00 x 3.500 x .35 | 12                       |
| 806   | 250           | 500                    | 7:1                     | 4.00 x 3.500 x .35 | 12                       |
| 807   | 10            | 100                    | 4:1                     | 2.25 x 1.800 x .35 | 6                        |
| 808   | 20            | 100                    | 7:1                     | 4.00 x 3.500 x .35 | 12                       |

\*Min. delay at max. position

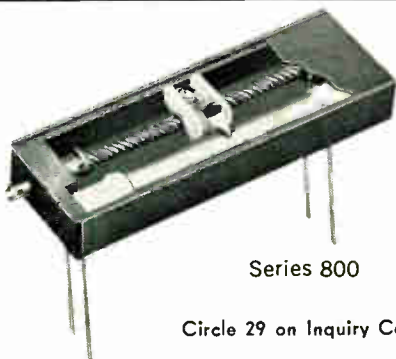
Series 600



Series 700



Series 800

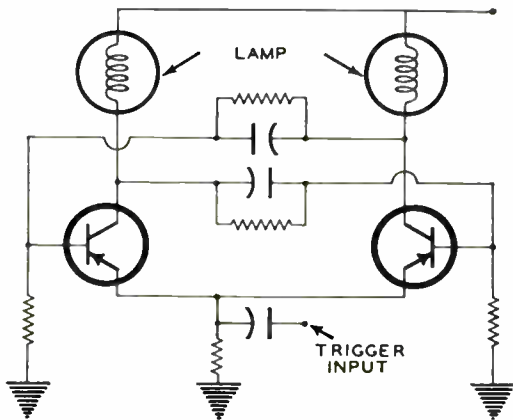


Circle 29 on Inquiry Card



# For indicators in transistorized circuits

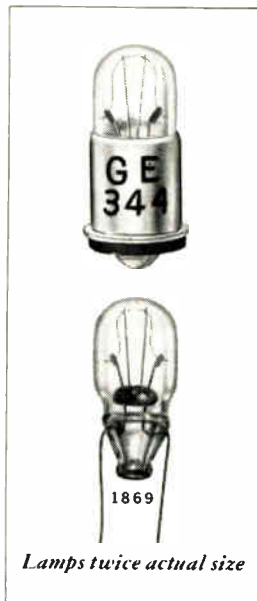
## 2 low current General Electric lamps



These G-E incandescent lamps are ideal as indicators where very low current, small size indicator lamps are desired, such as the flip-flop circuit illustrated above.

The G-E #344 lamp is only  $\frac{5}{8}$ " long ... the G-E #1869 lamp just a shade over  $\frac{1}{2}$ ". They both use only .15 watts, yet they are visible, when lighted, under 100 foot-candles of ambient illumination.

The data below will give you an idea how you can use these low cost indicator lights in transistorized equipment. For additional data, write: General Electric Company, Miniature Lamp Dept. M-22, Nela Park, Cleveland 12, Ohio. Ask for Bulletin No. 3-082-R.



### ESSENTIAL DATA

Design Volts . . . . . 10  
 Current at Design Volts . . 12.6 to 15.4 milliamperes  
 Average Design Life . . . . in excess of 50,000 hours  
 Bulb Diameter . . . . . .235 inches maximum  
 Base . . . . . . . . . . Single contact midget flange on #344  
 approximately  $\frac{1}{4}$ " wire terminals on #1869

*Progress Is Our Most Important Product*

# GENERAL ELECTRIC

## NEW TECH DATA

### Delay-Line Packages

FWS 18166-1 and 18228 epoxy-encased delay-line packages achieve delays of from 5nsec. to 1425nsec. in 5nsec. increments. Designed for mounting in standard 0.100 in. grid printed-circuit boards, the packages are encased in flame-retardant epoxy, with a raised bearing surface which prevents moisture trapping. General Instrument Corp., F. W. Sickles Div., 165 Front St., Chicopee, Mass.

Circle 495 on Inquiry Card

### Power Transistors

This 24-page reliability evaluation brochure contains the results of more than 7 million life-test hours performed on TO-36 pnp power transistors. The report verifies a reliability of 99.9983%/1000 hrs. Included are sections which cover designing for reliability, 1000-hr. stability curves, histograms, and safe operating area curves for pulse applications. Motorola Semiconductor Products Inc., P. O. Box 955, Phoenix 1, Ariz.

Circle 496 on Inquiry Card

### Crystal Filters

Bulletin F-101 gives technical specs. on the Hill Electronics 475-000 crystal filters. Center freqs. are approx. 1.75mc; units feature a very steep shape factor while maintaining low insertion loss and ripple in the passband. This series appears to be a vast improvement over current steep-sided filters. Hill Electronics, Inc., Mechanicsburg, Pa.

Circle 497 on Inquiry Card

### Voltage Surge Protection

Manual No. KL-601, 20 pages, gives complete data on the protection of silicon rectifiers and other semiconductors through the use of selenium transient-voltage suppressors. Included are charts, graphs, and schematics. International Rectifier Corp., 233 Kansas St., El Segundo, Calif.

Circle 498 on Inquiry Card

### Reliability Manual

This manual is designed for personnel engaged in high-reliability projects. It contains product construction details, failure modes, failure analysis, performance characteristics and failure rates. Actual engineering calculations are shown incorporating predetermined Chi-square values. Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

Circle 499 on Inquiry Card

### Instrument Amplifier

Tech. Data 84-B describes Model 840, a new type dc to dc hybrid amplifier which uses only 300mw. supply power. Contained are application and power-supply circuits. Acromag, Inc., Sales Dept., 15360 Telegraph Rd., Detroit 39, Mich.

Circle 500 on Inquiry Card



# STEVENS *Certified* THERMOSTATS for electronic and aerospace applications

■ If smaller size, lighter weight, utmost reliability and realistic costs are part of your product cosmos, take a long, hard look at Stevens *Certified* Thermostats.

■ Because Stevens makes the broadest line of bimetal thermostats in the industry, you can get all the special features to fit your special requirements exactly right from a proven, standard production-line Stemco thermostat, or from a minor modification thereof. This also gets your product off the ground faster... by cutting lead time, slashing engineering and development costs.

■ And we back Stemco Thermostats by Applications Engineering Service that's right out of this world. A card or call will bring our representative on the double.

**STEVENS** manufacturing company, inc.

P. O. Box 1007 • Mansfield, Ohio



## THERMOSTATS



### Type MX Hermetic

Snap-acting to open on temperature rise only. Copper housing responds more readily than steel types. Standard tolerances  $\pm 3^\circ\text{F}$  with 2 to  $6^\circ\text{F}$  differentials; 1 to  $4^\circ\text{F}$  differentials on special order. Temperature  $10^\circ$  to  $260^\circ\text{F}$ . Various terminals and mounting brackets. See Bulletin 6100.



### Type AX Hermetic

Similar to Type MX but to close on temperature rise. Wide selection of terminals and mounting provisions, highly responsive non-ferrous metal housing. 2 to  $6^\circ\text{F}$  differential. Bulletin 3200.



### Type C Hermetic

Field-adjustable, positive-acting. Electrically independent bimetal strip type for operation from  $-10^\circ$  to  $300^\circ\text{F}$ . Nickel-silver case with or without plating, depending on specifications. Turret terminals or wire leads. For ratings, etc., Bulletin 5000.

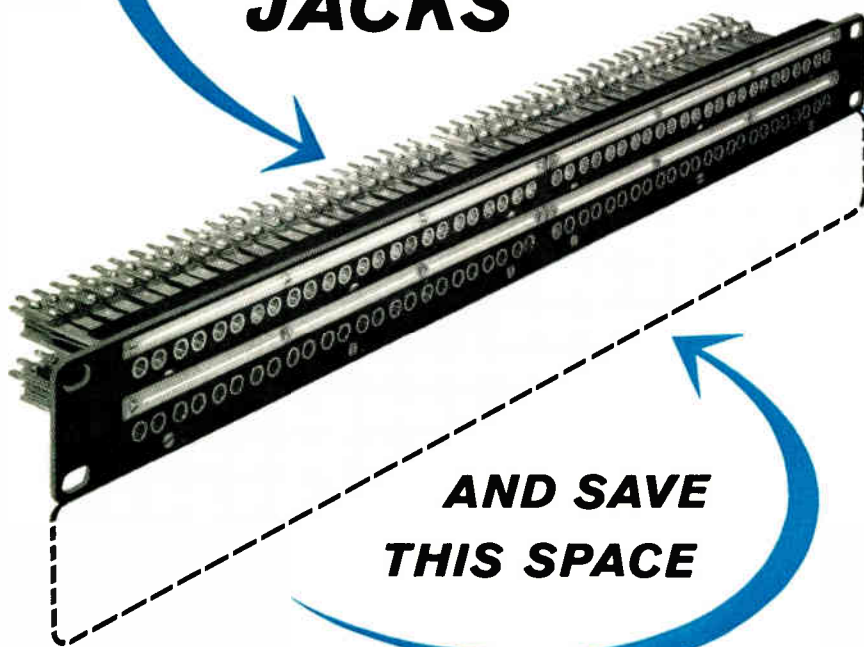


### Type A Hermetic

Electrically independent bimetal disc and high-response brass case for quick, snap-action control from  $-10^\circ$  to  $300^\circ\text{F}$ . Various non-ferrous metal enclosures, wide variety of terminal arrangements and mounting provisions, including brackets. Bulletin 3000.

\*Above Stemco Thermostats are designed and manufactured to meet most requirements of applicable MIL specifications.

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**BANTAM JACK PANELS**  
 offer **TWICE**  
**AS MANY**  
**JACKS**



**AND SAVE**  
**THIS SPACE**

Bantam Jack Panels provide 96 jacks in a 1 $\frac{3}{4}$ " x 19" conventional size rack panel. This compact panel is designed to save 50% in rack space and 65% in weight. Panels are available with both two and three conductor type jacks. Patch cords with single and double plugs are also available.

For more information on Bantam jack panels and patch cords write to:



**ADC PRODUCTS**

A DIVISION OF MAGNETIC CONTROLS CO

6325 CAMBRIDGE ST.

MINNEAPOLIS 26, MINNESOTA

## NEW TECH DATA

### Electromagnetic Compatibility

A tech. bulletin entitled, "Electromagnetic Compatibility" discusses EMC with emphasis on interference spec. compliance requirements. Includes a discussion of EMC problems and a 2-page table comparing the requirements of selected interference specs. White Electromagnetics, Inc., 4903 Auburn Ave., Bethesda 14, Md.

Circle 501 on Inquiry Card

### Noise-Source Tube

Publication RT21-13 describes a noise-source tube used in microwave measurements. When used with the RG-50/U waveguide it provides noise in the 5.85 to 8.20gc waveband. Schematics and operating data are included. The Bendix Corp., Red Bank Div., Eatontown, N. J.

Circle 502 on Inquiry Card

### Medium Range Supplies

The Series MP Minipacs cover the medium voltage range, beginning at voltage ratings beyond the reliable level for completely transistorized modules. They produce up to 425 vdc at 0.8a. Regulation is less than 0.05% with ripple and noise below 1mv. Deltron Inc., 4th & Cambria Sts., Phila. 33, Pa.

Circle 503 on Inquiry Card

### Electromagnetic Catalog

This illustrated catalog describes electromagnetic delay lines, networks, and filters. It covers constant and variable delay lines, magnetrostrictive delay lines, miniature delay lines and networks, etc. Basic performance specs., including delay, rise time, impedance and attenuation are included. ESC Electronics Corp., 534 Bergen Blvd., Palisades Park, N. J.

Circle 504 on Inquiry Card

### Technical Abbreviations

A 32-page booklet entitled, "1,001 Technical and Scientific Abbreviations," is available from Automatic Electric, subs. of General Telephone & Electronics, Northlake, Ill. Three extra sections give frequently used Latin abbreviations, chemical elements with their symbols and atomic numbers, and Greek and Latin numerical prefixes.

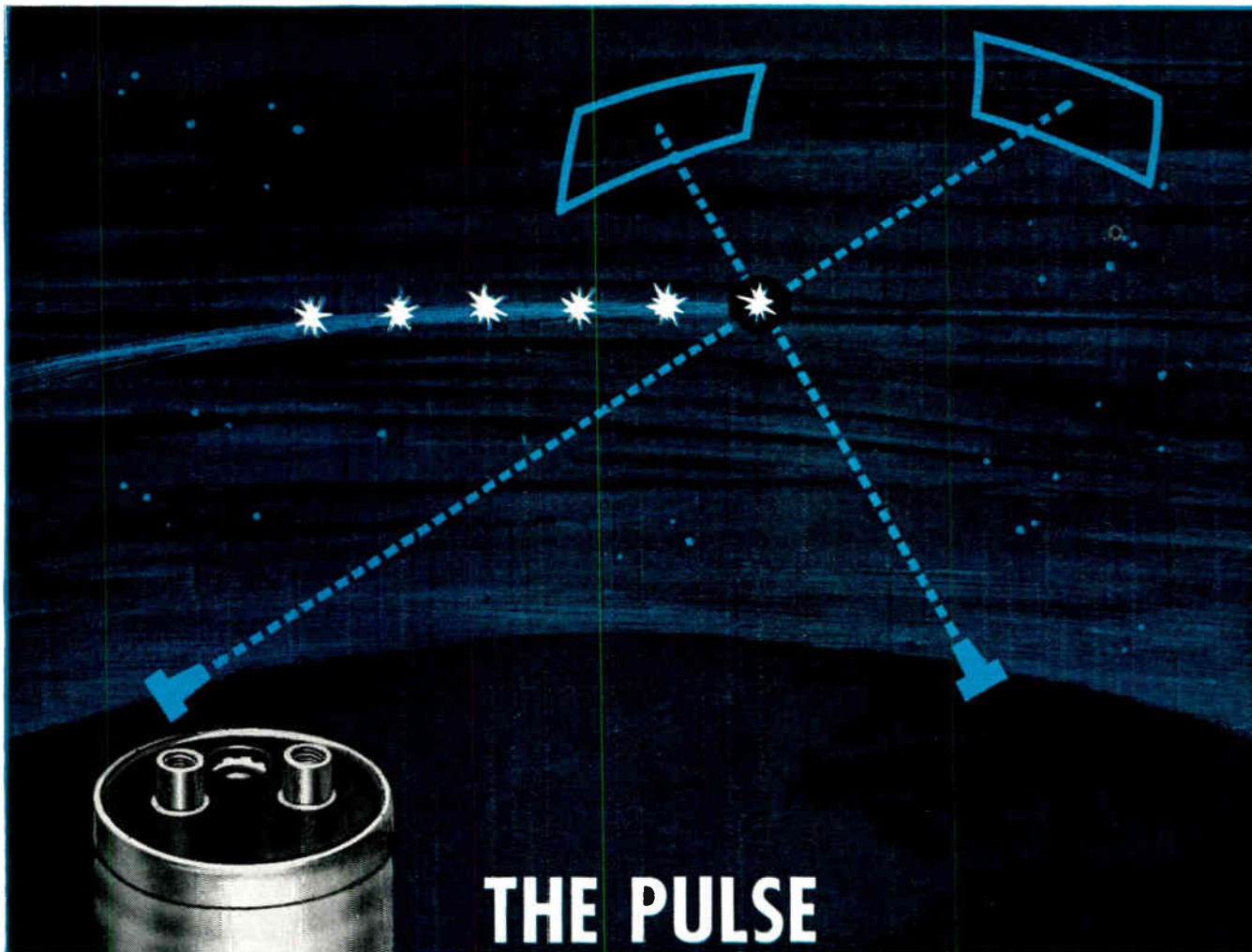
Circle 505 on Inquiry Card

### Fixed-Delay Line

Data Sheet 63437 describes the Spiradel miniature fixed-delay line. The delay line is a small diameter, distributed-constant fixed-delay line, featuring high delay-to-rise time ratio and good pulse fidelity. Included are specs. and basic configuration drawings on all current models. Helipot Information Service, Fullerton, Calif.

Circle 506 on Inquiry Card





An electrolytic capacitor specialist will be glad to discuss the application of these capacitors to *your* projects. For application engineering assistance without obligation, write to Electrolytic Capacitor Section, Field Engineering Dept. For complete technical data, write for Engineering Bulletin 3421 to Technical Literature Service, Sprague Electric Company, 233 Marshall St., North Adams, Mass.

## THE PULSE OF ANNA

Now . . . for the first time . . . aluminum electrolytic energy-storage capacitors have been employed in an orbital satellite!

Satellite *Anna* is the world's first all-geodetic satellite. *Anna* opens the door to: more precise location of world-wide target areas; more accurate orbit planning; improvement of surface and air navigation. But perhaps the most useful aspect of *Anna* was the experience gained in developing "spaceworthy" components which can function in the difficult launch and orbital environment.

*Anna's* optical beacon, developed by Edgerton, Germeshausen & Grier, Inc., flashes sequential strobe signals from satellite to ranging station. *The heart of this beacon is a bank of Sprague Type 36D Powerlytic® Capacitors.* Powerlytics were chosen for their high capacitance, their compact physical size, and their ability to withstand the stringent demands of outer space.

### SPRAGUE COMPONENTS

CAPACITORS  
TRANSISTORS  
MAGNETIC COMPONENTS  
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# THIS KELVIN RESISTANCE NETWORK IS THE INDUSTRY'S BEST . . .

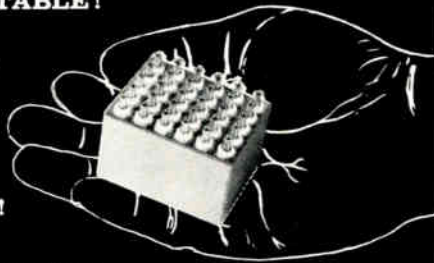
**IT'S EXTREMELY STABLE!**

**IT'S HIGHLY ACCURATE!**

**IT'S SMALL!**

**IT'S SUPERIOR QUALITY!**

**IT'S PROPERLY ENCASED!**



## . . . BUT YOU CAN'T BUY IT!!

In fact, you probably wouldn't want to, because this network was custom designed to one particular customer's specific requirements. You may need one smaller or larger or lighter with, perhaps, an even more demanding set of physical or electrical specifications. Then, our engineers will go to work for you — using all of our design knowledge, advanced techniques and experience in building networks for the most exacting performance requirements of the airborne, missile and computer industries. Kelvin engineers have solved the toughest network problems involving shock, vibration, humidity and wide temperature ranges. Our excellent results are based on one concept —

**TO BUILD SUPERIOR RESISTANCE NETWORKS . . .**

**. . . YOU MUST START WITH SUPERIOR RESISTORS!!**

Kelvin precision wire-wound resistors are the key to better resistance networks. Check these characteristics:

- Nominal resistance tolerances to  $\pm .002\%$  under closely controlled environments.
- Resistance ratio tolerances as close as  $.0005\%$  under closely controlled environments.
- Long term resistance stability of  $.0015\%$  per year.
- Low reactances to provide rise times as low as 50 nanoseconds.
- Temperature coefficients of resistors as close as  $0 \pm 2\text{PPM}/^\circ\text{C}$  from  $+25^\circ\text{C}$  to  $+95^\circ\text{C}$ —as close as  $0.5\text{PPM}/^\circ\text{C}$  over more restricted temperature ranges.
- TC tracking as close as  $.002\%$  of initial ratio value from  $-25^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $.005\%$  from  $-55^\circ\text{C}$  to  $125^\circ\text{C}$ .

**APPLICATIONS:** Military Checkout Systems • Computer Applications • Voltage Dividers • Telemetry Equipment • Reference or Ratio Standards • Summing Networks • Digital to Analog Conversion

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916 McLean Ave., Yonkers, N.Y., (914) 237-2500

## NEW TECH DATA

### Portable Magnet

Bulletin 45-951 describes a portable superconducting magnet system that produces 20,000 and 30,000 gauss. Designated Cryopak magnet system, it is ideal for laboratory investigations with high magnetic fields. Westinghouse Cryogenic Systems Dept., P. O. Box 10596, Pittsburgh 35, Pa.

Circle 507 on Inquiry Card

### Energy Discharge Capacitor

Bulletin 2610 contains reference data for electrical and mechanical design criteria covering energy discharge capacitors. Graphs, tables, and definitions are used to clarify capacitor parameters. Descriptive information and catalog listings are given. Sangamo Electric Co., Springfield, Ill.

Circle 508 on Inquiry Card

### Component Insertion Film

A new motion picture film entitled, "Inserting Components with Dynasert" is available from United Shoe Machinery, 140 Federal St., Boston 7, Mass. The 13-min. movie, in full sound and color, shows the high-speed, automatic operation of the Dynasert machine, which handles reels of strip-mounted components, clips off the axial leads, bends them to proper shape and length, inserts them into printed circuit boards, and clinches the protruding ends on the reverse side ready for soldering.

Circle 509 on Inquiry Card

### Engineering Chart

A new Nanosecond Data Chart listing 12 tables of parameters useful in the design and use of nsec. circuits is available. In addition, the chart includes condensed data on nsec. instruments. Lumatron Electronics, 116 County Courthouse Rd., New Hyde Park, N. Y.

Circle 510 on Inquiry Card

### Welding Power Supply

Model 1065 provides 2 pulse widths (discharge times): a long pulse of 0.009 sec. nominal for welding materials of high conductivity, and a normal pulse of 0.0032 sec. nominal for welding materials of high resistance. The unit operates on 2 separate stored energy ranges from a low range of 0.14 to 20 w-sec. through a high range of 0.7 to 100 w-sec. Weldmatic Div./Unitek, 950 Royal Oaks Dr., Monrovia, Calif.

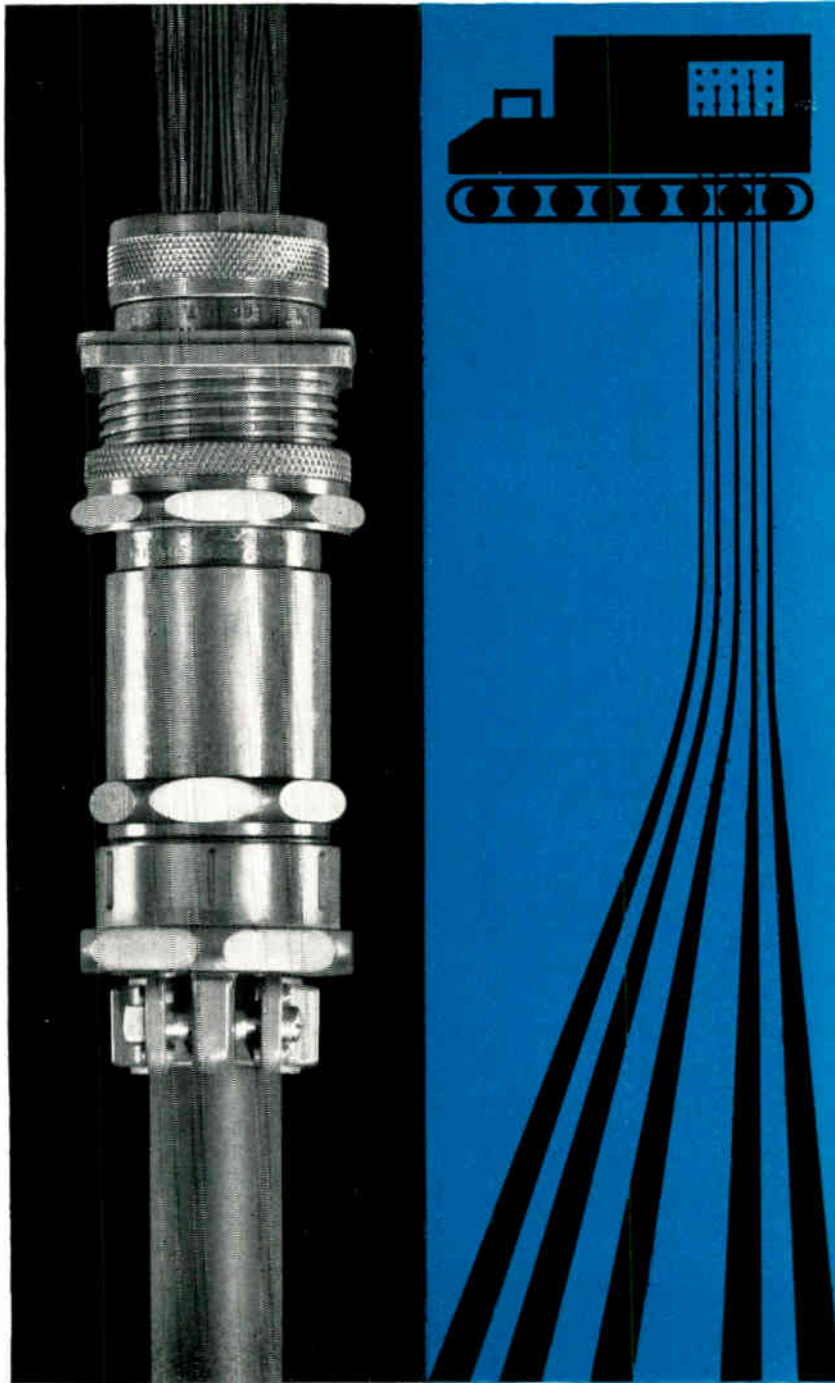
Circle 511 on Inquiry Card

### Wall Chart

A 24 x 37 in. wall chart aids in selecting heat sinks, knobs, handles, military knobs, switch guards, etc. Each item is described in detail, and characteristic graphs are provided. Vernaline Products Co., Inc., Franklin Lakes, N. J.

Circle 512 on Inquiry Card





**WHERE ENVIRONMENTAL CONDITIONS ARE AT THEIR WORST, PYLE-STAR-LINE® CONNECTORS ARE AT THEIR BEST.** Rugged, Neptune Series (ZM) heavy-duty connectors are designed to withstand the most severe operating conditions . . . to resist shock, vibration, and pressure. These compact, lightweight connectors perform with outstanding reliability under environmental extremes of temperature, humidity, moisture, dust, oil, and corrosive atmospheres.

An extensive variety of contact configurations is offered in MOD I, captive contact, inserts; and MOD II, push-in crimp-type removable contact, inserts.

*Now also being offered is MOD III inserts with collet retained, rear entry and release contacts, in sizes No. 18 to No. 4/0.*

A wide choice of cable and installation accessories enable these versatile connectors to be easily adaptable for ground support equipment, electronic packaging and cabling, electrical control, power, and communications. Hardware having RFI shielding capabilities is also available.

Design features include: reversible inserts for plug or receptacle shells, positive self-sealing insert construction, closed-entry rigid socket insulators, and closed-entry socket contacts. Power inserts have circuit-breaking capabilities, and are U.L. listed.

Years of field-performance have proven Pyle-Star-Line reliability to provide electrical and mechanical capabilities for the roughest and toughest assignments. Write today for complete technical data, and information on our engineering service.



CONNECTOR DIVISION, THE PYLE-NATIONAL COMPANY, 1334 NORTH KOSTNER AVENUE, CHICAGO 51, ILLINOIS

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ELECTRICAL CONNECTORS    LIGHTING EQUIPMENT    CONDUIT FITTINGS



# OVER 100





DIFFERENT TYPES NOW IN PRODUCTION



## JENNINGS CERAMIC VACUUM CAPACITORS

... have been accorded an enthusiastic vote of approval from users for their superior performance in the field. Now we've added many new styles to accommodate the demand for these capacitors in an even wider variety of size, capacitance, voltage and current levels.

Ceramic vacuum capacitors combine the inherent advantages of vacuum with a high strength ceramic envelope to form the most advanced high voltage capacitor ever devised. The low loss ceramic allows operation in excess of 400 megacycles. It also provides better vibration characteristics, greater shock resistance, higher current ratings, and smaller size. A few of the many ceramic vacuum capacitors available from Jennings are illustrated below.

|   |  |
|---|--|
| <p><b>Type CVFA-450</b></p> <p>Capacity Range 25-450 PF<br/>Voltage Rating 40 kv pk<br/>RF Current Rating 100 amps rms<br/>Length 9 3/4 inches<br/>Width 5 1/2 inches</p>  | <p><b>Type CVA-7</b></p> <p>Capacity Range 3.5-7 PF<br/>Voltage Rating 35 kv pk<br/>RF Current Rating 6C amps rms<br/>Length 4 1/4 inches<br/>Width 3 3/4 inches</p>      |
| <p><b>Type CFHA-1000</b></p> <p>Capacity 1000 PF<br/>Voltage Rating 50 kv pk<br/>RF Current Rating 200 amps rms<br/>Length 6 1/2 inches<br/>Width 7 inches</p>             | <p><b>Type CVHA-650</b></p> <p>Capacity Range 30-650 PF<br/>Voltage Rating 55 kv pk<br/>RF Current Rating 150 amps rms<br/>Length 10 2 1/2 inches<br/>Width 7 inches</p>  |

Our radio frequency laboratory with 12 functioning transmitters ranging from 17 kc to 600 mc and up to 100 kw cw power is at your service to test our products under your particular circuit conditions.

Write for more detailed information regarding these capacitors.

RELIABILITY MEANS VACUUM / VACUUM MEANS

*Jennings*

JENNINGS RADIO MFG. CORP., 970 McLAUGHLIN AVE., SAN JOSE 8, CALIF., PHONE CYpress 2-4025

## NEW TECH DATA

### Coaxial Patch Panel

Bulletin 8496 describes Type 27935 10 x 10 patch panel used for 3 1/8 in., 500 transmission lines. It features a panel layout of terminals in 3 concentric circles and a dummy load connection at the center of the panel. This allows a transmitter to be connected to any of the 10 antenna terminals or the dummy load. The completed patch panel is 67 x 84 x 24 in. Available from Andrew Corp., P. O. Box 807, Chicago 42, Ill.

Circle 513 on Inquiry Card

### Carbon Potentiometer

A 12-page engineering catalog, No. 42-1447, describes the RV4 style (Mil-R-94B) hot molded carbon potentiometer, known as Model 12. The catalog fully details the unit's electrical, mechanical and environmental characteristics. Photos and detailed dimensional drawings illustrate single, twin, dual, triple, quad, and front and rear-mounting rotary switch versions. Also included is a derating nomograph for multiple-element types and a listing of units available for immediate delivery. Centralab, The Electronics Div., Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.

Circle 514 on Inquiry Card

### Miniature DC Motor

Bulletin 800 describes a new low-current miniature dc motor, Model 800. Detailed specs. include size, voltage, torque and speeds. Complete schematics and application data are included. Publications Dept., Cramer Div., Giannini Controls Corp., Old Saybrook, Conn.

Circle 515 on Inquiry Card

### Voice Coil Winder

This 2-color catalog illustrates and describes Model 62-PM compact, semi-automatic voice coil winder. An experienced operator can produce over 800 finished coils/hr. with it. Geo. Stevens Mfg. Co., Pulaski Rd. at Peterson, Chicago 46, Ill.

Circle 516 on Inquiry Card

### High-Vacuum Equipment

Two 4-page illustrated brochures describe high-vacuum equipment, one covering stainless steel gate valves and the other, high-vacuum baffles. Royal Research Corp., 11727 Dublin Blvd., Hayward, Calif.

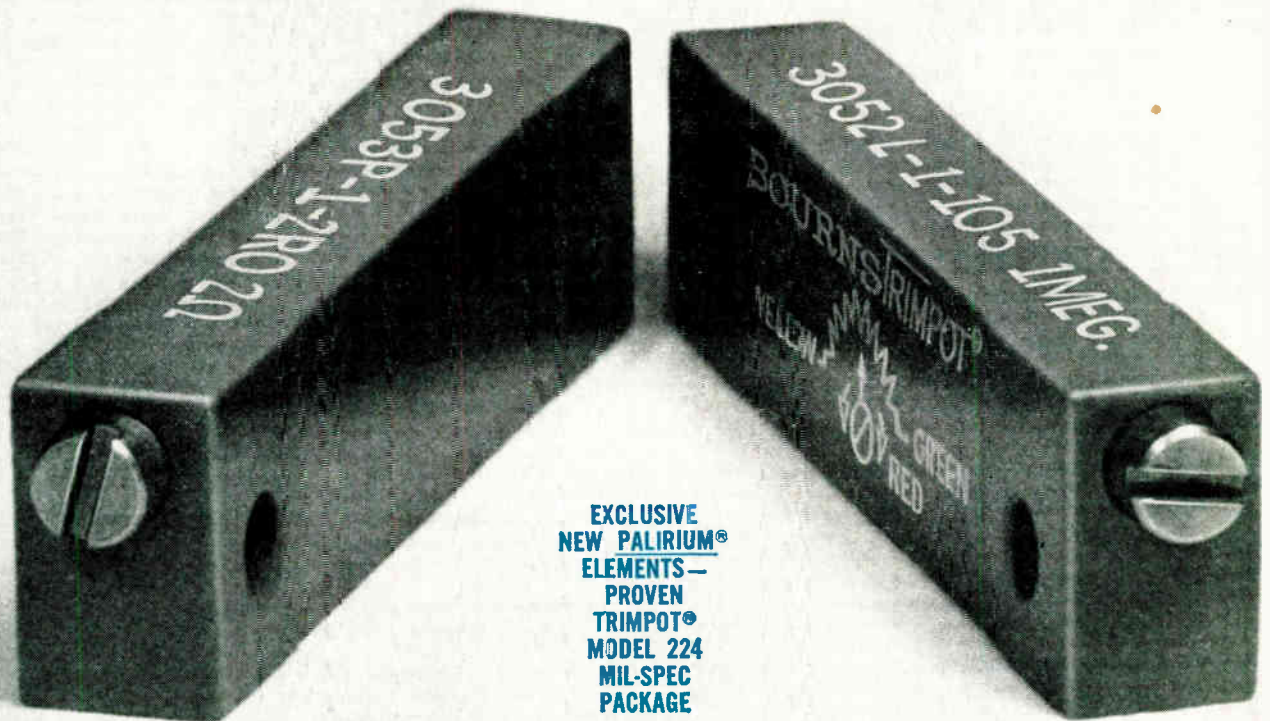
Circle 517 on Inquiry Card

### Logic-Operated Relay

The DS-2000 series of Sensireed relays draws a max. of 1/4ma from a 6v logic level input, and operates an electrically isolated SPST contact rated at 1/2a. These units are encapsulated for printed-circuit applications. Relay contacts are rated at 10w dc, 0.5a, 250v. Actuate time is lms. Data Systems Corp., Valley Forge Industrial Park, Norristown, Pa.

Circle 518 on Inquiry Card

# DOUBLE-BARREL NEWSBREAK IN INFINITE-RESOLUTION POTENTIOMETERS



**EXCLUSIVE  
NEW PALIRIUM®  
ELEMENTS—  
PROVEN  
TRIMPOT®  
MODEL 224  
MIL-SPEC  
PACKAGE**

## NOW — INFINITE ADJUSTABILITY IN A 2-OHM POTENTIOMETER!

Now you can bring the convenience of infinite adjustability to applications that have always required an arduous fixed-resistance approach. The new TRIMPOT Model 3053, with its exclusive PALIRIUM film element, overcomes the problems in resolution and contact resistance that heretofore have made a low-resistance unit of this kind impossible. Stability of the infinite-resolution Model 3053 is outstanding, enhanced by an unusually low temperature coefficient and the time-proven Mil-Spec configuration of Bourns' famous TRIMPOT Model 224. This potentiometer should help you develop new circuit-design approaches.

|  |                            |
|--|----------------------------|
| Total resistance range:                  | 2 $\Omega$ to 100 $\Omega$ |
| Resolution:                              | Infinite                   |
| Power rating:                            | 1/2 W @ 70°C               |
| Contact resistance variation:            | 2% max.                    |
| Temperature coefficient (2.5 $\Omega$ ): | + 400 PPM/°C max.          |
| Temp. coefficient (10 to 100 $\Omega$ ): | + 300 PPM/°C max.          |
| Humidity:                                | Exceeds MIL-R-22097B       |
| Max. operating temperature:              | 175°C                      |
| Environmental stability:                 | 1% or less                 |
| Load life stability:                     | 2% or less                 |

AVAILABLE IMMEDIATELY FROM FACTORY STOCK AT COMPETITIVE PRICES.  
Write for latest Trimpot potentiometer summary brochure.

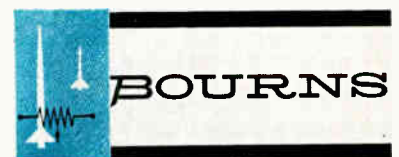


ACTUAL SIZE

## NOW — TWICE THE STABILITY IN RESISTANCES UP TO 1 MEGOHM!

At the other end of the scale, TRIMPOT Model 3052 offers you two to four times the stability of competitive high-performance potentiometers over the resistance range of 100K to 1 megohm. Like the companion low-resistance unit, Model 3052 features the approved Mil-Spec configuration of Bourns' high-temperature, humidity-proof Model 224. Its spec of 500 maximum applied volts is approximately 60 per cent better than that of other available units, and its total resistance tolerance of  $\pm 10\%$  cuts the usual competitive figure in half. The new high-resistance, infinite-resolution element is also available in Model 3012 with the popular 1/4" x 3/8" x 1/4" package. The prices? Less than you've been paying!

|                               |                      |
|-------------------------------|----------------------|
| Total resistance range:       | 100K to 1 Meg.       |
| Resolution:                   | Infinite             |
| Power rating:                 | 1 W @ 70°C           |
| Contact resistance variation: | 2.5% max.            |
| Temperature coefficient:      | Less than 300 PPM/°C |
| Humidity:                     | Exceeds MIL-R-22097B |
| Max. operating temperature:   | 175°C                |
| Environmental stability:      | 2% or less           |
| Load life stability:          | 2% or less           |



BOURNS, INC., TRIMPOT DIVISION  
1200 COLUMBIA AVE., RIVERSIDE, CALIF.  
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filters, delay lines,  
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**POLYPHASE INSTRUMENT COMPANY**

Bridgeport, Pennsylvania

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**NEW TECH DATA**

**Coaxial Cable**

Bulletin PS4, 32 pages, details engineering data, performance curves and mechanical characteristics of Styroflex® semi-flexible, air-dielectric coaxial cable. Curves for each cable dia. indicate attenuation and power ratings in kc and mc for each impedance. Phelps Dodge Electronic Products Corp., 60 Dodge Ave., New Haven, Conn.

Circle 519 on Inquiry Card

**Connector Wall Chart**

This 34 x 45 in. connector wall chart illustrates a selected line of connectors and tools. Photos and illustrations of each connector accompany physical-characteristic and application information. Deutsch Electronic Components Div., Municipal Airport, Banning, Calif.

Circle 520 on Inquiry Card

**Laser Tube**

Gas-filled laser tube LT-40 operates in the visible (6328Å) or the infrared (11.530Å) region with suitable mirrors and r-f excitation equipment. This all-quartz tube contains quartz windows at the Brewster angle. It contains a gas mixture of 0.9mm of helium and 0.09mm of neon; other mixtures are available. The tubes are high-temp. processed (above 420°C) to assure cleanliness. Litton Industries, Electron Tube Div., San Carlos, Calif.

Circle 521 on Inquiry Card

**Procurement Specs.**

Procurement specs. for an entire line of silicon power transistors are available as a series of 5 booklets. These specs. aid the design or component engineer in preparing a military procurement spec. for npn silicon power transistors which meet the requirements of Mil-S-19500C. The electrical and environmental tests and procedures form a comprehensive quality-assurance lot-acceptance program for each of the silicon power transistors. Requests on company letterhead to Westinghouse Semiconductor Div., Youngwood, Pa.

Circle 522 on Inquiry Card

**Coax Catalog**

Bulletin FF Issue 3, 33 color pages, presents photos, graphs, and charts pertaining to a wide range of coaxial cable. Accompanying each cable is a general description, applicable equations, temperature and freq. charts. Phelps Dodge Electronic Products Corp., N. Haven, Conn.

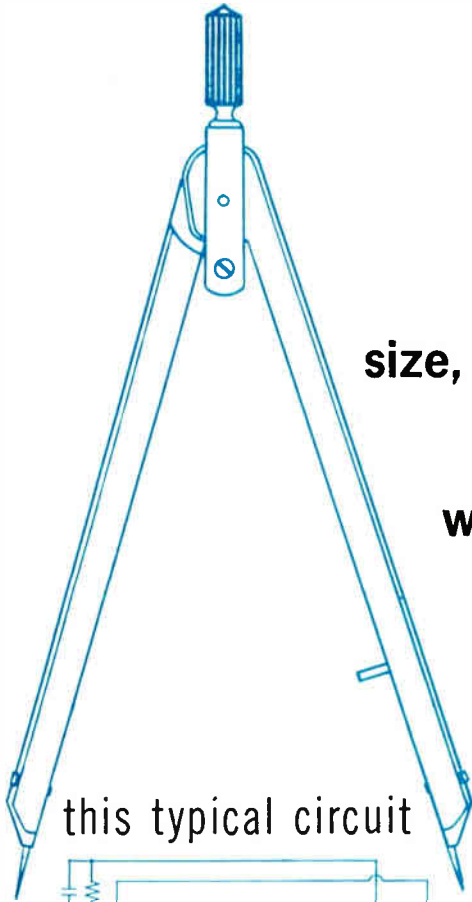
Circle 523 on Inquiry Card

**Custom Assemblies**

Information is available which describes Renwell's capabilities in custom electronic assemblies, wiring harnesses, and electromechanical assemblies. Renwell Electronic Corp., 755 New Ludlow Rd., So. Hadley Falls, Mass.

Circle 524 on Inquiry Card



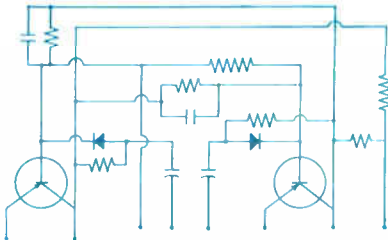


size, shape, and component content  
to your requirements

with

# CENTRALAB INTEGRATED CIRCUITS

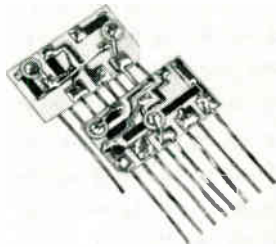
this typical circuit



or any comparable circuit, can be supplied to your specifications

For design flexibility in integrated circuitry specify PEC's. With the Centralab PEC technique, equipment design considerations dictate the package rather than package requirements dictating the design. You have an unlimited choice of sizes, shapes, and component content, in addition to the benefits of uniformity, reliability, and ease of assembly.

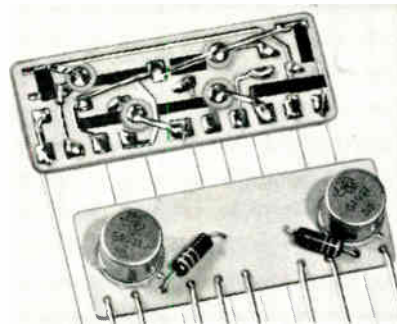
Typical of this flexibility is the flip-flop shown here. It, or any comparable circuit can be supplied in a variety of protective encasements and terminations at low cost with delivery in a matter of weeks. For additional information write for Bulletin #42-1281.



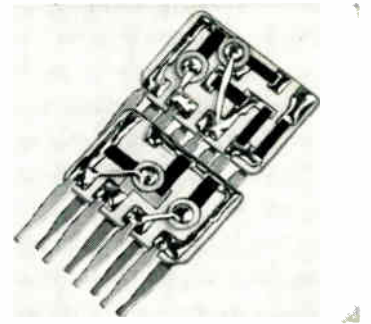
**WITH MINIATURE SEMICONDUCTORS—**  
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Where space is limited but is secondary to cost, a PEC can be designed whose shape is best suited to your equipment without sacrificing uniformity, reliability, and ease of assembly. Cost is 20-50% of other packaging techniques and 10-30% less space is required.



**OR WITHOUT SEMICONDUCTORS—**  
Where space and ease of assembly are important and the user wishes to install his own semiconductors separately. Uniformity and reliability exceeds that of individual components. Cost is generally less than, and units require 20-30% the space of individual components.

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# 2 VOLTS CONTROL NEON INDICATORS



MTL Series

TBL Series

Solve high voltage problems inherent in neon lamps with TEC-LITE Transistorized MINI-LITE and BUTTON-LITE indicators. Switch rugged, long life, neon lamps ON and OFF using the low level signals common in computers, industrial control, missile guidance and other solid state systems. High voltage lamp supply is confined entirely to the panel area and to the circuitry inside the indicators. Sensitive logic areas are protected from high voltage damage and signal cross talk.

TBL Series offers every feature of the MTL Series plus isolated SPST normally open or normally closed switches rated at 100 ma at 120V, non-inductive, with a life rating exceeding 500,000 cycles. Use this combination indicator and switch to conserve panel space and simplify design.

Contact your TEC-Rep. or write for detailed specifications.

- 20 cataloged models cover a wide range of signal voltages.
- Supply voltage: + or -45VDC  $\pm$ 3V. Other supplies available in custom designed units.
- MTL Series, size: 9/16" dia. x 1-5/6" long  
price: As low as \$3.72 each in 100-499 quantities.
- TBL Series, size: 9/16" dia. x 2" long.  
price: As low as \$5.12 each in 100-499 quantities.
- A variety of lens styles and colors and terminals available.
- Mount on 5/8" centers.



*Originator of  
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Indicating Devices*

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### .3ma CONTROLS INCANDESCENT INDICATORS



TIL Series controls replaceable incandescent lamp with small current signal. TIB Series adds isolated SPST switch.

### 3VDC SUPPLY LIGHTS NEON INDICATOR



LVN Series amplifies low voltage supply to fire neon. Can also be controlled by small signals.

### 2 $\mu$ SEC PULSE TURNS ON INCANDESCENT INDICATOR



TML Series with replaceable incandescent lamp turns ON with small signal, remains ON when signal is removed.

### 2 VOLT BINARY CODED INPUT SIGNAL CONTROLS DIGITAL READOUT



TNR Series display controlled by low level decimal or binary signals. Memory optional. Mounts on 1" centers.

TEC-LITE Transistorized Indicators are protected by one or more of the following patents: U.S. Pat. Nos. 2,985,874; 3,041,499. French Pat. No. 1,291,911, Italian Pat. No. 647,414.

## NEW TECH DATA

### Capacitor Catalog

Catalog N-1, 12 pages, 2 colors, contains complete specs. for a variety of sub-miniature ceramic capacitors. Information includes capacitances, sizes, tolerances, leads, power factors, temp. characteristics and ranges. Also included is information concerning UHF standoff capacitors, UHF ribbon-lead capacitors, and low-voltage, transistor-circuit capacitors. Requests on company letterhead to Mucon Corp., Dept. B, 9 St. Francis St., Newark 5, N. J.

Circle 525 on Inquiry Card

### Connector Brochure

Bulletin 668, 36 pages, provides information on environmental capabilities, design features, the sequence of component selection, and the interchangeability of components. Also included is complete spec. data on contact inserts, barrels, adapters and accessories. The Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill.

Circle 526 on Inquiry Card

### Instrument Catalog

The 8 - page Quick - Reference Catalog contains capsule descriptions, prices and illustrations of all Sierra products. These include voltmeters, transistor testers, line fault analyzers, signal generators, oscilloscopes, r-f power monitors and amplifiers, precision power measuring instruments, power sources, waveguide and coaxial leads, directional couplers, detectors, and low pass filters. Sierra Electronic Div. of Philco, Marketing Dept., 3839 Bohannon Dr., Menlo Park, Calif.

Circle 527 on Inquiry Card

### High-Voltage Rectifiers

Data bulletin gives performance curves and specs. on high-voltage stacked silicon rectifiers. The small, hermetically sealed rectifiers are rated from 1500 to 25,000 peak inverse volts, up to 500ma average rectified current. Diodes, Inc., 9261 Independence Ave., Chatsworth, Calif.

Circle 528 on Inquiry Card

### Epitaxial PNP Switch

Brochure describes planar epitaxial pnpn switch with gate turn-off gain. It discusses the switch's design and advantages of the planar process. Characteristics of the component and schematics are included. Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

Circle 529 on Inquiry Card

### CRT Image Print-Out

A system which makes possible the direct print-out of images from a fiber optic CRT face to Kalvar film is described in 3 data bulletins available from Display Devices Dept., Litton Industries Electron Tube Div., 960 Industrial Rd., San Carlos, Calif.

Circle 530 on Inquiry Card

## ELECTRA X-4C METAL FILM RESISTORS

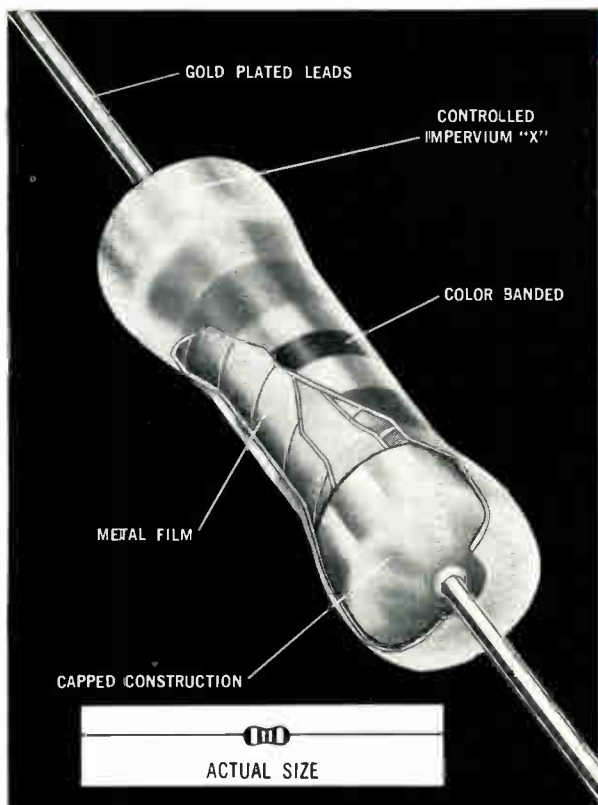
# MULTI-RATED

### NEW VERSATILITY AND IMMEDIATE DELIVERY

New Electra X-4C metal film resistors have amazing versatility. Multi-rated, they have rugged resistance to overload, are widely applicable. Example: The 1/10 watt X-4C also handles 1/8, 1/4, or 1/2 watt, depending on temperature.

Indicated for printed circuitry applications, they all connect on 1/4" centers. Capped construction for added strength, and "GP-25" gold-plated leads are weldable or solderable. Conformally coated with Electra's exclusive Impervium "X" and color banded for value identification.

Rated from 20-Ohms to 301-K. Controlled meniscus means film never laps over to leads. Write for information about "Proto-Pak", the special designer's selection. And look to Electra for excellence in carbon and metal film resistors, high reliability resistors, tantalum capacitors, integrated circuits and micro-modular packaging.



# ELECTRA

MANUFACTURING COMPANY, INDEPENDENCE, KANSAS

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Circle 40 on Inquiry Card

## CONNECTOR DESIGN CRITERIA

by *Vip*



VISUALLY INSPECTABLE FOR CORRECT ASSEMBLY AND INSTALLATION

(our connectors are visually inspectable too!)

# DEUTSCH

Circle 41 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963

## New Transistorized DC to AC Power Inverters



- Sine Wave Output
- 50 VA to 1,000 VA
- 400 Cycle Output/  
22-30 VDC Input

### DRS SERIES

- 0.5% Frequency Regulation
- 1% Harmonic Distortion
- 0.5% Voltage Regulation

| Model    | 400 Cycle Output |                     | D.C. Input | Dimensions<br>HxWxD |
|----------|------------------|---------------------|------------|---------------------|
|          | VA               | Single $\phi$ Volts | Volts      |                     |
| DRS-50   | 50               | 115                 | 22-30      | 4"x11"x 4"          |
| DRS-100  | 100              | 115                 | 22-30      | 4"x11"x 4"          |
| DRS-250  | 250              | 115                 | 22-30      | 5"x12"x 9"          |
| DRS-500  | 500              | 115                 | 22-30      | 8"x16"x14"          |
| DRS-1000 | 1000             | 115                 | 22-30      | 10"x16"x17"         |

Features all solid state components, reliable short circuit protection, light weight, and exceptional temperature stability (voltage: max. 0.005% / °C, frequency: max. 0.05% / °C).

Ideal for powering switching-type loads (no notching in output waveform). Excellent as a versatile power source for airborne or ground support applications.

60 CYCLE OUTPUT units also available. Write for complete information on several new series of sine wave and square wave inverters and frequency converters.



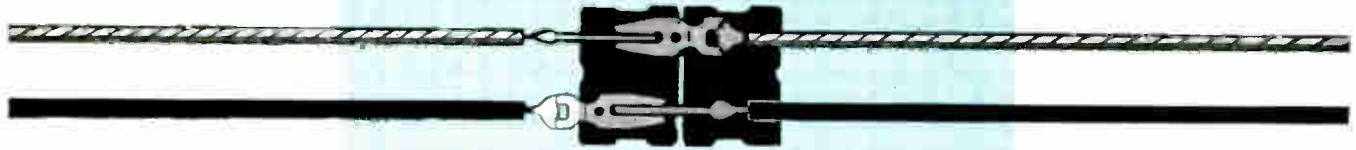
## COMMUNICATION MEASUREMENTS LABORATORY, INC.

A Subsidiary of Tenney Engineering, Inc.

350 Leland Avenue, Plainfield, N. J. (201) 754-5502

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*isn't it time  
somebody exploded the  
"just as good as"  
connector myth?*



Don't let anyone tell you his connector is "just as good as" ours. At least, not without making him try to explain how! Does it offer the proven reliability of the ELCO Connector, sold under the trade-mark VARICON? Does it provide equal application versatility? Or production economy? Or the fork-like design with 4 surfaces mating at 90° to allow contacts to engage along their entire length? Don't stop there; press on. Ask him about the additional contact surface provided by a 45° bevel running the full length of the

fork. And about the "spring" contacts with wiping action which maintain pressure under all operating conditions. Then startle him with your knowledge of our plating; our next-to-limitless selection of sizes; our variety of tail-end terminations for every wiring technique. Chances are he'll now admit there is nothing "as good as" the ELCO VARICON\* Connector except the ELCO VARICON Connector. Send for complete literature on the subject to be forewarned and forearmed when he arrives.

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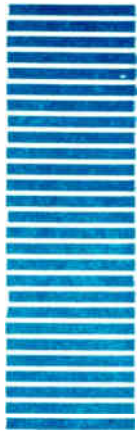


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| 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 |
| 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 |
| 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 |
| 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 |

Please send me further information on the items I have circled above.



# NEW Subscription Order

I wish a new complimentary Subscription to  
**ELECTRONIC INDUSTRIES**

Company Name \_\_\_\_\_  
Name \_\_\_\_\_  
Company Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Mail Stop  
or  
Div./Dept. \_\_\_\_\_

Position/Title \_\_\_\_\_

## IMPORTANT

FOR OUR STATISTICAL RECORDS PLEASE CHECK THE ONE APPROPRIATE CATEGORY THAT BEST DESCRIBES YOUR COMPANY OR DEPARTMENT. Failure to do so will delay your subscription.

- Mfr. of non-military electronic receiving and transmitting equipment.
- Mfr. of non-military electronic instruments, measuring, control and test equipment.
- Mfr. of non-military electronic computers, data processing, analysers, business machine.
- Mfr. of Guided Missiles and Accessories; Aircraft and Accessories, All Type of Military Products and Equipment.
- Mfr. of electronic components, parts, tubes and like products.
- Mfg. Co. (non electronic) using any of the above equip. in mfr., research or development work.
- Broadcasting or telecasting station.
- Commercial communication user (Tel & Tel, Police, Airports, Recording Studio, Etc.).
- Independent research, test, design laboratories and independent consultants—not part of a mfg. Co.
- Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- Wholesaler, mfg. representative, service firm.
- University (educational) Public Library.
- Other (Please explain) .....

## CHANGE OF ADDRESS

I wish to continue receiving **ELECTRONIC INDUSTRIES**  
Change my address as indicated.

OLD

Paste wrapper imprint here, or . . .  
Write in complete old address

NEW

Company \_\_\_\_\_  
Mail Stop or  
Div./Dept. \_\_\_\_\_

Title/Position \_\_\_\_\_

Company Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Signature \_\_\_\_\_

## IMPORTANT

FOR OUR STATISTICAL RECORDS PLEASE CHECK THE ONE APPROPRIATE CATEGORY THAT BEST DESCRIBES YOUR COMPANY OR DEPARTMENT. Failure to do so will delay your address change.

- Mfr. of non-military electronic receiving and transmitting equipment.
- Mfr. of non-military electronic instruments, measuring, control and test equipment.
- Mfr. of non-military electronic computers, data processing, analysers, business machine.
- Mfr. of Guided Missiles and Accessories; Aircraft and Accessories, All Type of Military Products and Equipment.
- Mfr. of electronic components, parts, tubes and like products.
- Mfg. Co. (non electronic) using any of the above equip. in mfr., research or development work.
- Broadcasting or telecasting station.
- Commercial communication user (Tel & Tel, Police, Airports, Recording Studio, Etc.).
- Independent research, test, design laboratories and independent consultants—not part of a mfg. Co.
- Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- Wholesaler, mfg. representative, service firm.
- University (educational) Public Library.
- Other (Please explain) .....

FIRST CLASS  
PERMIT NO. 36  
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Philadelphia 39, Pa.

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*Eliminate contact damage in Multi-Contact connectors with Cinch*

# HINGE CONNECTORS\*

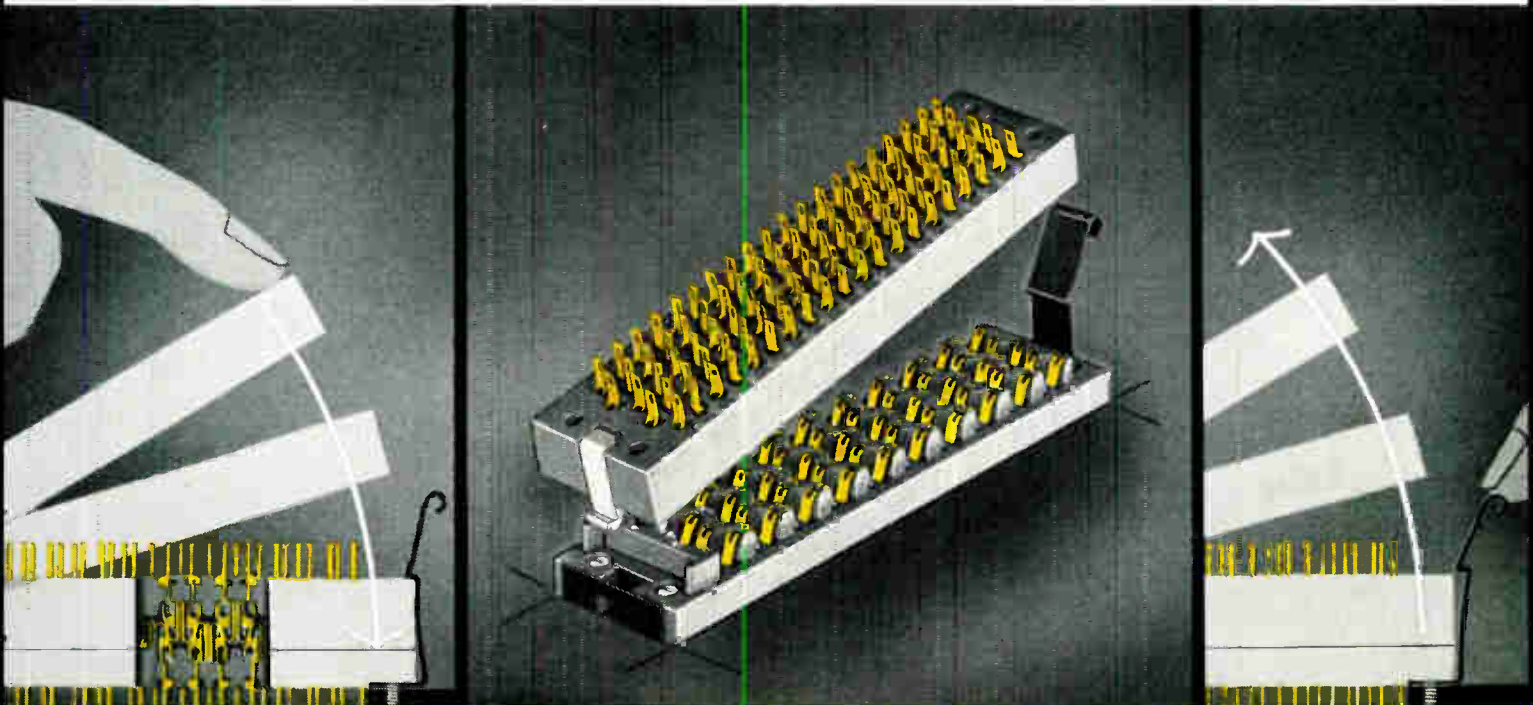
\*U.S. Pat. No. 2,899,699

**20**  
**to 100**  
*contact connectors*  
*for high density*  
*applications*

High insertion and extraction forces that wreak havoc with ordinary multi-contact connectors are no problem at all with the Cinch Hinge Connector. A flexible contact design eliminates the excessive insertion and extraction forces; positive contact is always maintained because of the pressure action of the wiping contacts. An ingenious Hinge and Latch principle permits opening and closing Cinch Hinge Connectors *using only one finger!*

These exclusive features are available in both Standard Cap models (for use with 20 to 100 contact Hinge Connectors) and space saving Shallow Cap models (for use with 20 to 50 contact Hinge Connectors). Both types can be supplied with cable entry holes in top or end, with or without cable clamps.

For detailed information and technical data, write for Catalog CM-16.



CM-6311

## CINCH MANUFACTURING COMPANY

1026 South Homan Avenue, Chicago 24, Illinois  
Plants located in Chicago, Illinois; Shelbyville, Indiana;  
City of Industry, California; and St. Louis, Missouri.

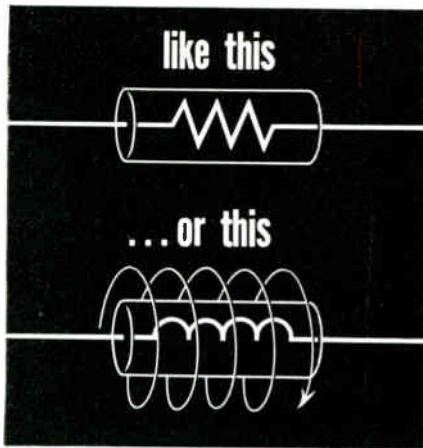
Circle 44 on Inquiry Card



A DIVISION OF UNITED-CARR FASTENER CORPORATION, BOSTON, MASSACHUSETTS



## HOW DOES YOUR CIRCUIT SEE A RESISTOR AT 100Mc?



# WESTON<sup>®</sup> VAMISTORS

PRECISION METAL FILM RESISTORS

### offer superior HF response

Inductance has an important place in high frequency design—but *not* where your circuit calls for resistance! Weston Vamistors are *engineered* for critical HF applications. From dc to 100 Mc, inductance remains *virtually unchanged* at 0.007  $\mu$ h, and d-c resistance shifts less than 10% in units up to 50K! Distributed capacitance is less than 0.6 pf.

Vamistors offer many other features of importance to design engineers. They're the *most reliable* precision metal film resistors available. Average noise level is -33db (0.023  $\mu$ V/V), using NBS measurement techniques. And the current established failure rate is .015% per 1000 hrs @ 60% confidence level (full load @ 125C) based on over 6 million unit hours of testing.

The Vamistor's superior HF response is a result of advanced Weston design and special production techniques:



Alloy is thermally-bonded into internal glaze with patented Weston process.

Weston developed and produced resistance alloy offers uniformity and ideal metallurgical properties for vacuum deposition.

Length of resistance spiral is automatically controlled to minimize heat spots.

Incoming materials inspection, in-process control, testing and quality assurance programs guarantee specifications!

Weston Vamistors are available with highest ratings from  $\frac{1}{8}$  to 2 watts. Tolerance: to 0.05%. Temperature coefficient: 0 $\pm$ 25 or 50ppm/ $^{\circ}$ C. Stability: exceed all MIL R-10509D specs.

Write for details. We'll include Weston Spec 9800 covering High Reliability Vamistors.

## WESTON Instruments & Electronics

Division of Daystrom, Incorporated, Newark 14, N. J.

Circle 45 on Inquiry Card

D54

## NEW TECH DATA

### Capacitor Bulletin

A short form data bulletin describes miniature and plastic dielectric tubular, fixed capacitors meeting the requirements of Mil-C-27287 (USAF) Engineering Data 27287 is available from Dearborn Electronic Laboratories, Inc., Orlando, Fla.

Circle 300 on Inquiry Card

### Carbon Resistors

Bulletin NPJ 115-16 Rev., describes Aerovox Carbofilm<sup>®</sup> Types CPX and CPM precision deposited carbon resistors. Characteristics given include temp. coefficient, moisture resistance and load life. Mil-Bell and commercial stock values are listed. Aerovox, New Bedford, Mass.

Circle 301 on Inquiry Card

### Light-Sensing Amplifier

Data is available on a photo-Darlington light-sensing amplifier packaged in a TO-18 can with lens window. Designated RM3002, unit has a light-current sensitivity of 25ma./ft.-C. with a 12v. collector-to-emitter voltage. Raytheon Co., Semiconductor Div., 350 Ellis St., Mountain View, Calif.

Circle 302 on Inquiry Card

### Delay Lines

Andersen Labs is offering brochures on electromagnetic, magnetostrictive, digital, and variable delay lines. Each item is fully described by equations, curves, and characteristic tables. Andersen Labs Inc., 501 New Park Ave., West Hartford, Conn.

Circle 303 on Inquiry Card

### Commercial Oscillators

Synopsis of 1-1000mc commercial oscillators details production models to 400mc and development models to 1000mc. Each production model will generate 30w. into a 50 $\Omega$  load. Diagnostic Instrumentation, Inc., 49 Hampshire St., Cambridge, Mass.

Circle 304 on Inquiry Card

### Microminiature Connectors

Catalog MM-1, 24 pages, describes a complete line of microminiature connectors. Specs. for all series and information on Wire-Form Poke-Home<sup>®</sup> contacts and contact tools are given. Booklet also depicts suggested uses for all series. Amphenol Connector Div., Amphenol-Borg Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Circle 305 on Inquiry Card

### Ceramic Capacitor

The MC-70 ceramic capacitor has capacity ranges from 10 $\mu$ mf to 20,000 $\mu$ mf. Information available includes capacity tolerance, power factor, and physical dimensions. Hi-Q Div., Aerovox Corp., Olean, N. Y.

Circle 306 on Inquiry Card



# 24 Hour Delivery

COAST-TO-COAST

- **DM Series** — push-pull, meets Mil-C-26482
- **DS Series** — push-pull, insertable, removable, crimp contacts
- **DTK Series** — bayonet lock, meets or exceeds applicable requirements of Mil-C-0026482C
- **DRS Series** — rectangular rack and panel, advanced application performance
- **DC Series** — push-pull, environmental, crimp-type RF connector
- **DM and DH Hermetics** — leak proof glass to metal seals
- **MDR Series** — rigid insert connector with snap-in crimp contacts

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CONNECTOR DIVISION

COMMUNITY DRIVE, GREAT NECK, N. Y.  
516 Hunter 7-0500 TWX: 516-466-0235

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**ARCO CAPACITORS INC.**  
1548 So. Robertson Blvd., Los Angeles 35, Calif.  
213 Crestview 1-1151 TWX: 213-273-4092

DALLAS

**ARCO ELECTRONICS INC.**  
2523 Farrington St., Dallas 7, Texas  
214 Melrose 1-0270 TWX: 214-631-5910

Circle 46 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963



## Much higher reliability ...slightly higher price

In order to furnish parts with a confidence level acceptable to the user, manufacturers must design beyond nominal or "standard" usage requirements. At Deutsch, this concept is the guideline for all design criteria. We exceed the minimums in every applicable specification to assure our customers of continuous performance above and beyond documented requirements. For instance, our DD ball-lock and BTK bayonet-lock connectors exceed, by far, the latest revision to MIL-C-0026482. Here are just a few examples:

☛ Deutsch-developed silicone materials provide better wire and interfacial seals against altitude and moisture...assure temperature performance above 300°F...guarantee better dielectric characteristics and dimensional stability under exposure to oils and fuels.

☛ Contact retention of 25# exceeds the 15# specification by more than 60%.

☛ Fixed coupling rings make sure the connector remains a complete unit throughout assembly...provide grope free engagement...insure proper mating and lock of plug and receptacle.

☛ Positive visual lock indicators afford inspect-



ability for correct connector assembly and engagement.

☛ Millivolt drop, measured by the latest specification techniques, is 50% below the minimums before and after corrosion testing. And insulation resistance is at least four to five times higher at 300°F. than the specification's minimum at room temperature.

☛ Insertable and removable contacts are crimp terminated to military standard geometry, and are held in place by mechanical devices that insure retention, contact alignment and are replaceable if damaged.

☛ MIL-C-0026482 electrical performance ratings, at altitude, are met and exceeded at 110,000 ft. instead of at the specified 80,000 ft.

These and the many additional advantages of DD and BTK connectors may cost a little more, but in terms of value analysis are priced lower due to assembly time savings, repairability and, perhaps most important, favorable MTTF ratios under actual use. If you are faced with criteria calling for a high confidence level rather than just meeting a specification, we suggest you get all the facts on DD and BTK performance from your local Deutschman, or write for Data File A-6.

# DEUTSCH

*Electronic Components Division • Municipal Airport • Banning, California*

ADVANCED SPECIFICATION MINIATURE ELECTRICAL COMPONENTS

## NEW TECH DATA

### Lamp Catalog

Catalog L-170 gives information on twin-lamp placard lights, which conform to the environmental and operational needs of Mil-E-5272, ABMA-XPD-1023 and 1064. Discussed are ways of grouping placard lights, methods of mounting, and other optional features. Dialight Corp., 60 Stewart Ave., Bklyn. 37, N. Y.

Circle 307 on Inquiry Card

### Inductors Shielded

Information on ultra-reliable, shielded subminiature r-f inductors which range from  $0.1\mu\text{H}$  to  $180,000\mu\text{H}$  in 76 values is available. The WE-DUCTOR is encapsulated and shielded for min. coupling in high-density packaging. They meet the requirements of Mil-C-15305B, Grade 1, including resistance to moisture and immersion, and operate from  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$ . Nytronics, Inc., 550 Springfield Ave., Berkeley Heights, N. J.

Circle 308 on Inquiry Card

### Instrumentation

Bulletin GEA-7749 covers GE's line of solid-state electronic instrumentation for process-control uses. Controllers, recorders, transmitters, accessories and computing elements are described and illustrated. General Electric Co., Schenectady 5, N. Y.

Circle 309 on Inquiry Card

### HV Zener Diodes

The JEDEC series 1N4057 through 1N4085 operate between 12.4v. and 200v. with a temp. coefficient of  $0.005\%/^\circ\text{C}$  and nominal voltage tolerances of  $\pm 5\%$ . A special series have voltage tolerances as tight as  $\pm 1\%$ , and temp. coefficients as low as  $0.001\%/^\circ\text{C}$ . Dickson Electronics Corp., P. O. Box 1387, Scottsdale, Ariz.

Circle 310 on Inquiry Card

### Power Supplies

Specs. on semiconductorized precision power supplies are given in a new short form catalog. The 2-color catalog pictures the units and includes outline drawings of rack panel adapters. A chart lists the specs. of vacuum tube supplies. Power Designs, Inc., 1700 Shames Dr., Westbury, N. Y.

Circle 311 on Inquiry Card

### Stretchable Cable

Information on a coaxial, multiconductor cable which stretches up to 400% is available from NRA, Inc., Sales Dept., 35-01 Queens Blvd., Long Island City, N. Y. Suited for underwater uses, cable can be covered with jacket of synthetic fiber, plastic or silicone rubber.

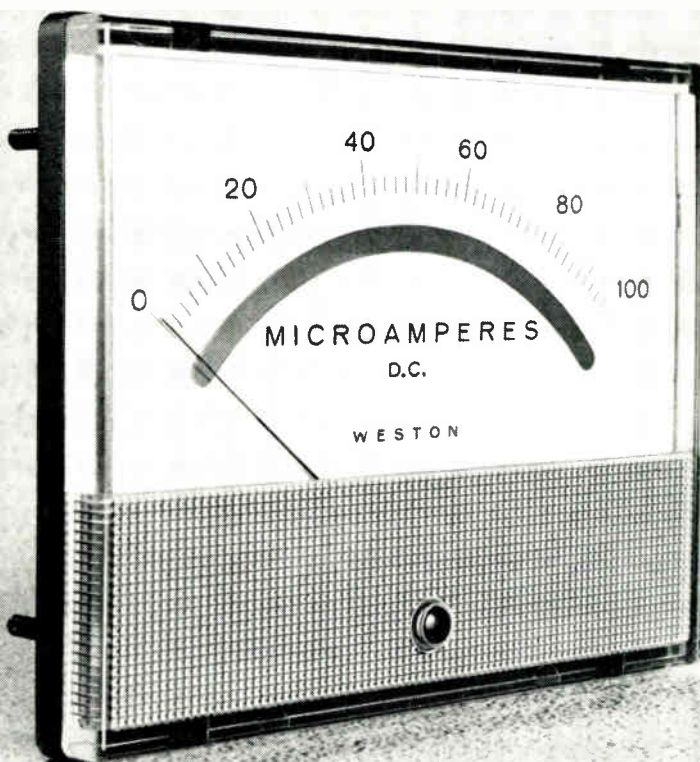
Circle 312 on Inquiry Card

### Ceramic Capacitors

A 9-page test report, TR 322, gives acceptance test data on Vitramon "VK" microminiature capacitors per Mil-C-11015C. Vitramon, Inc., P. O. Box 544, Bridgeport 1, Conn.

Circle 313 on Inquiry Card

RELIABILITY BY DESIGN:



Unequaled flexibility  
with one basic meter!

No other single line of matching panel meters can equal the flexibility and performance of Weston Series 1900. That's because these instruments are designed to give you almost unlimited freedom of choice in all important electrical and physical characteristics. Now, there's no need to compromise on any feature!

These instruments are supplied with Weston pivot and jewel movements or new Weston Taut Band Suspension for highest accuracy and sensitivity. You select the mechanism you want—self-shielded Cormag®, external magnet or iron vane. And all instruments of the same size are physically interchangeable... regardless of the mechanism or movement.

This unique line is supplied in five sizes from  $2\frac{1}{2}''$  to  $7\frac{1}{2}''$ , in a wide variety of a-c and d-c functions, with full-scale accuracies of  $\pm 2\%$ ,  $\pm 1\%$ , or higher on special order. All meters have  $100^\circ$  arcs for easy reading.

Styling is important, too. You can choose conventional Bakelite fronts or modern, clear plastic with provision for inserts for color coding. And only Weston Series 1900 Panel Meters offer a choice of three mounting methods—surface, flush or recess. Write for detailed technical bulletin.



**WESTON**  
INSTRUMENTS & ELECTRONICS

614 Frelinghuysen Ave.,  
Newark 14, New Jersey  
Division of  
Daystrom, Incorporated

Circle 48 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963

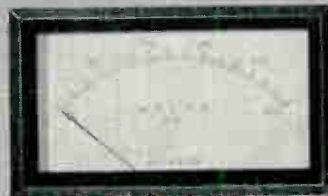
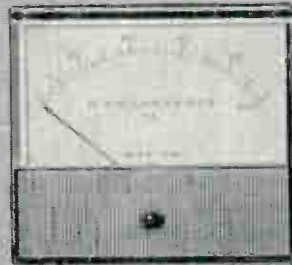


5½"

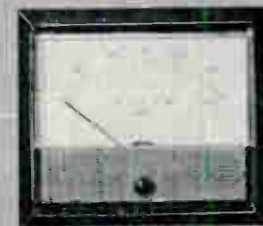
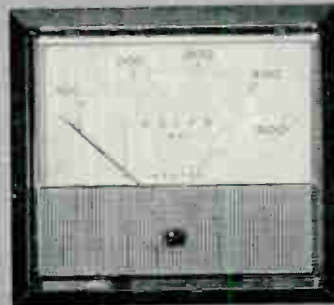
4½"

3½"

2½"



## WESTON 1900 SERIES



## You choose size, function, accuracy, mounting and style!

Illustrated above are only 15 Weston Series 1900 Panel Meters. The possible combinations of features these instruments offer is almost unlimited. In fact, for any given function and range, you can select from more

than 100 possible configurations of size, accuracy, style and type of mounting. Specify the features you want, and you'll see why this line of matching instruments is the broadest and most flexible ever offered!

**Size:** Weston Series 1900 Panel Meters are available in five sizes: 2½"; 3½"; 4½"; 5½"; and 7½".

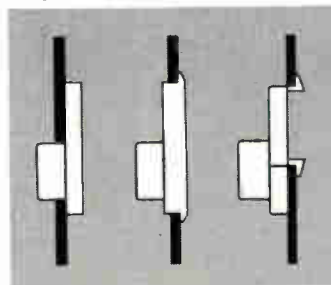
**Function:** d-c; a-c; VU; Thermo; Rectifier; and Log-scale. **Range, full scale:** Ten standard d-c  $\mu$ a ranges (20 to 500); d-c ma in 9 ranges (1 to 500); d-c amps in 7 ranges (100 to 500); d-c volts in 11 ranges (2 to 500). Three standard a-c  $\mu$ a ranges (100 to 500); a-c ma in 9 ranges (1 to 500); a-c amps in 6 ranges (1 to 30); a-c volts in 16 ranges (3 to 500); Thermo amps in 5 ranges (1.5 to 15). Other ranges on request.

**Accuracy:**  $\pm 2\%$ ;  $\pm 1\%$ ; higher on request.

**Pointers:** Lance pointer, 100° arc scale; knife-edge pointer and mirror scale for highest accuracy.

**Movement:** Iron vane; external magnet; or Cormag®

### THREE MOUNTING METHODS



Surface Flush Recess

to protect against external magnetic fields. With proved Weston pivot and jewel movement, or new Weston Taut Band Suspension with Co-planar™ Suspension which provides complete control of ribbon length and movement. **Style:** Conventional Bakelite fronts for all except 7½" size; all sizes available with modern clear plastic cases with provision for inserts for color coding or styling.

**Mounting method:** Only Weston Series 1900 can be mounted in three ways—surface, flush or recess.

**Illumination:** Available for recess mounting.

No matter what features you've indicated above, layout problems are simplified because all instruments of the same size are directly interchangeable.

Full information is contained in our technical bulletin.

 **WESTON**  
INSTRUMENTS & ELECTRONICS

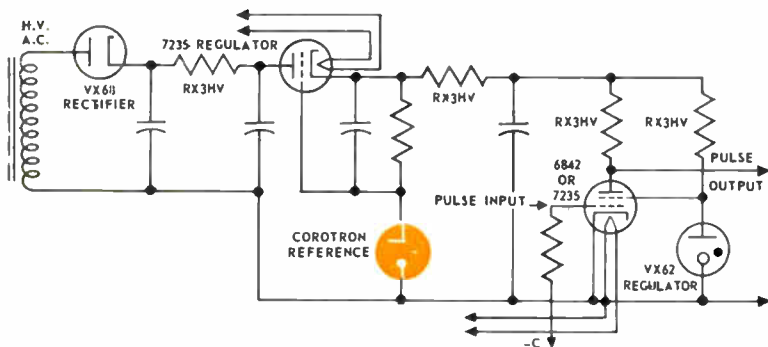
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Newark 14, New Jersey  
Division of  
Daystrom, Incorporated

## NEW TECH DATA

# Rx for ach·lu·o·pho·bia\*

Much high voltage regulation circuitry comes right out of the "dark ages"—compared to the circuit simplification possible with Victoreen Corotrons. Anywhere in the 400 to 27,000 volt range, Corotrons give positively exotic performance from simple, low-cost circuits. As pass tubes for voltage regulation, or for HV pulse amplifiers, Victoreen pentodes and triodes are capable of high power efficiency. Current is in the low  $\mu$ a to high ma range. Design with reliability in mind. Let our Applications Engineering Department throw some much-needed light on this dark subject.

\*Fear of darkness



THE VICTOREEN INSTRUMENT COMPANY  
5806 HOUGH AVE. • CLEVELAND 3, OHIO

A-8234A

### DC Power Supplies

Catalog 63 features index-tab selection of dc power supplies by regulation mode: constant-voltage, constant-current or dual mode. Data is presented in tabular format for fast-scan location of operating parameters and prices. Describes Electronic Measurements' new PVC all-silicon constant-voltage/constant-current power supplies, offering more than a 1kw. of dc power with voltage regulation of 0.01% and current regulation of 0.05%. Electronic Measurements Co., Eatontown, N. J.

Circle 314 on Inquiry Card

### Temperature Transducers

Bulletin 100 describes resistance temperature transducers. The 4-page, 2-color bulletin lists transducers, materials used to make them, military specs., operating principles, and calibration methods. It includes photos, an applications drawing and generalized specs. Free applications-engineering service is also described. Nova-Netics Corp., 232 Glasgow Ave., Inglewood 1, Calif.

Circle 315 on Inquiry Card

### Coax Connectors

A new 24-page catalog furnishes information on Wirelok and PDE Connectors for air dielectric, semi-flexible cables. Connector design and installation data is given. Bulletin WH 3. Phelps Dodge Electronic Products Corp., 60 Dodge Ave., North Haven, Conn.

Circle 316 on Inquiry Card

### Magnetostrictive Delay Lines

Booklet on magnetostrictive delay lines includes technical review, standard case sizes available from stock and discussion of standard specs. For digital circuit engineers. Andersen Laboratories, Inc., 501 New Park Ave., W. Hartford, Conn.

Circle 317 on Inquiry Card

### R-F Transformer

Data is available on an r-f transformer designed to operate at 1.85mc with bandwidth of 43kc at 3.0db. Coefficient of coupling is .019. Unit measures 1 x 1 x 2 3/8 in., not including terminals. Relcoil Products Corp., Windsor Locks, Conn.

Circle 318 on Inquiry Card

### Dipped Capacitors

A 12-page illustrated Bulletin, 2323, entitled "Dipped Mica Capacitors," contains design and manufacture data, including parameters and characteristics. Sangamo Electric Co., Springfield, Ill.

Circle 319 on Inquiry Card

### Variable Filters

Bulletin 717, 4 pages, describes the Series 300 Variable Electronic Filters. Specs., characteristics, photos and charts are included. Available from Spencer-Kennedy Laboratories, Inc., 1320 Soldiers Field Rd., Boston 35, Mass.

Circle 320 on Inquiry Card





ACTUAL SIZE

# IEE low cost Status Indicators give you up to 12 message displays in 3 square inches

*...simultaneously!*

## SPECIFICATIONS

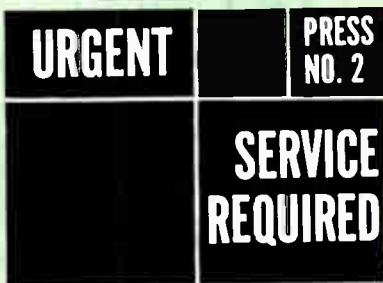
**Message Areas:** Up to 12 per unit; each  $\frac{7}{16}$ " sq. • **Message Displays:** Numbers, letters, words, symbols, colors • **Input:** Straight decimal system • **Lamps:** Any T3- $\frac{1}{4}$ " bayonet base lamp • **Voltage:** 6 to 28 volts • **Ambient Temp.:** 140°F maximum with all 12 lamps lit • **Unit Price:** \$12.50 in 1-9 quantities; engraved screens slightly higher.

You get up to 12 message displays individually, in combination, or all simultaneously... *at costs as low as 80 cents per indication*... with the IEE Status Indicator.

Each of the 12 message positions is back lighted by an individual lamp—easily replaceable from the front.

All messages are displayed on a single-plane viewing screen.

Messages can be engraved on the viewing screen, placed on film, or by use of both methods, you can obtain combination effects.



Larger message displays can be obtained by combining message areas and lighting message with more than one lamp. This unit shows dividing lines engraved on screen, messages on film. Unit can be mounted vertically or horizontally.

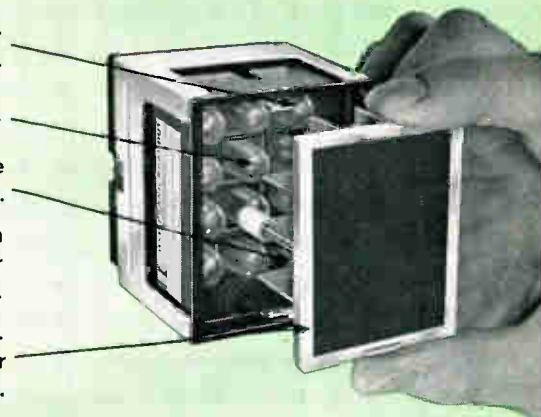
Quick, easy lamp replacement from front of unit.

Redundant lamping available.

Message film behind screen can be replaced easily for field changes.

Messages can be typed or lettered on mylar film or parchment for development jobs.

No mounting screws on face of unit. Two screws inside Status Indicator draw unit tight against front of panel.



Write today for Status Indicator message designer sheet and complete specifications.

## INDUSTRIAL ELECTRONIC ENGINEERS, INC.

5528 Vineland Avenue • North Hollywood, California • Phone: (213) 877-1144 • TWX: (213) 769-1636

Circle 52 on Inquiry Card





### SUB-MINIATURE R. F. CONNECTORS

Designed and manufactured to meet the industry's demand for a better connector. Real gold-plated, not just flashed. Maximum impedance match, minimum VSWR. Available in Crimp-On or Clamp-On designs.



**SCREW-ON**  
Clamp-On



**SNAP-ON**  
Clamp-On, Crimp-On

### PRESS-FIT®

### TEFLON TERMINALS

Sealectro and only Sealectro makes Press-Fit terminals. Ultra-quality provides optimum reliability and assembly ease. Available in all standard EIA colors.



**SUBMINIATURE STANDOFFS**

Teflon bushings in diameters from .148" to .218". Choice of lugs, including turrets.



**SUBMINIATURE FEEDTHRUS**

For connections through chassis or casing. Choice of lug designs including hollow-tube.



**MINIATURE STAND-OFFS**

For components and assemblies stressing higher voltages. Wide choice of lugs and turret designs.



**MINIATURE FEEDTHRUS**

For handling voltages up to 4000 VDC. Wide choice of bushing diameters and lengths.

## SEAELECTRO COMPONENTS OFFER PROVEN RELIABILITY IN ALL INDUSTRIAL AND MILITARY APPLICATIONS

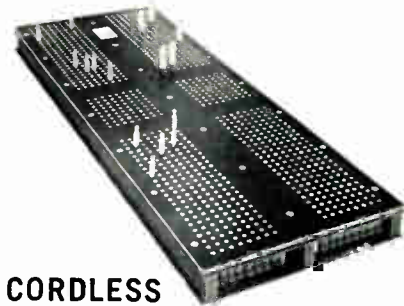
### PRESS-FIT®

### TEST JACKS AND PLUGS



Male and female. Ideal for test instrument probes, jumper plugs and multiple pin plugs. Test jacks for printed circuitry.

### SEAELECTROBOARD



### CORDLESS PROGRAM BOARDS

The revolutionary program board. Simplifies multi-channel switching. Provides complete connections with insertion of single pin. No cord clutter. Accessories include component holders for inserting diodes, resistors, or other components at any circuit point. Available in any X- and Y- configuration. Standard Proto-Kits including board, shorting pins and component holders available from distributors.

### DELTIME MAGNETOSTRICTIVE DELAY LINES

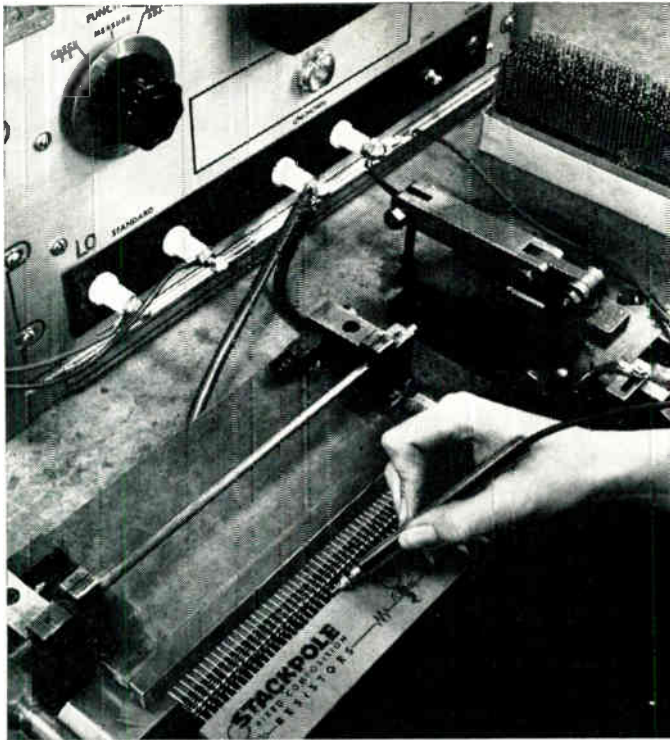


Longer delay times utilizing the magnetostrictive principle for maximum stability and mechanical ruggedness. Delay times up to 10 milliseconds at repetition rate of 655 KC with return-to-zero, or 5 millisecond delay at 1 MC with return-to-zero. Suitable for data storage. Completely humidity and magnetically shielded. Many standard fixed and variable models available.

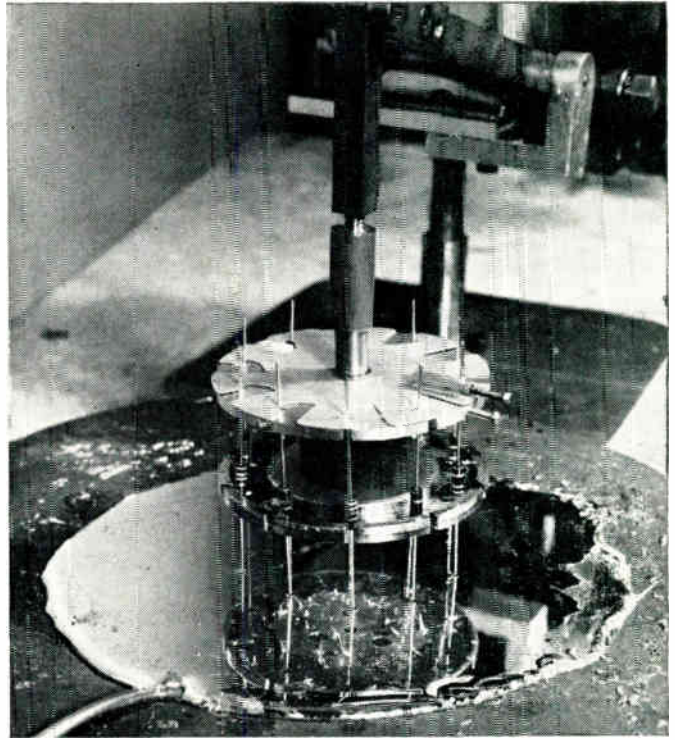
WRITE FOR CATALOGS . . .  
STATING PRODUCT INTEREST



139 HOYT STREET • MAMARONECK, N. Y.



**Tested 200% plus!** Production line machines automatically classify every Stackpole resistor to insure that specified resistance and tolerance are unerringly met. Then, just before packaging, resistors are again tested individually as the final step in a series of critical inspections that start even before production begins.



**Effect-of-soldering test!** Samples from Stackpole resistor runs are laboratory tested regularly to make certain that soldering heat will have negligible effect on performance. Equally rigid tests at every important stage of production assure quality second to none in every Stackpole COLDITE 70+ resistor you specify.

## Some Stackpole resistors are not for you

Stackpole COLDITE 70+® Fixed Composition Resistors roll down our line, and out to customers, by the tens of thousands every day.

But does this mean sheer volume at the sacrifice of quality?

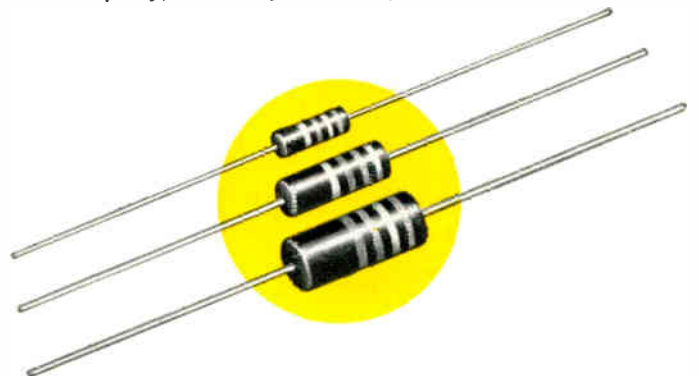
On the contrary!

It calls for one of the most rigid, comprehensive testing and quality control programs in the resistor industry . . . just to spot the one Stackpole resistor that is not for you (or any other Stackpole customer). Two of the tests are shown above.

This is why you can specify COLDITE 70+ resistors without a second thought about their solder-

ability, load life, humidity and temperature characteristics. And why they exceed every important MIL-R-11 requirement.

If you're ever in our area, drop in and say, "Hello!" We'll be glad to chat about your design problem. Meantime, buzz your Stackpole distributor and prove our point: you get more out of Stackpole resistors because we put more in them. Or write: Electronic Components Division, Stackpole Carbon Company, St. Marys, Pennsylvania.



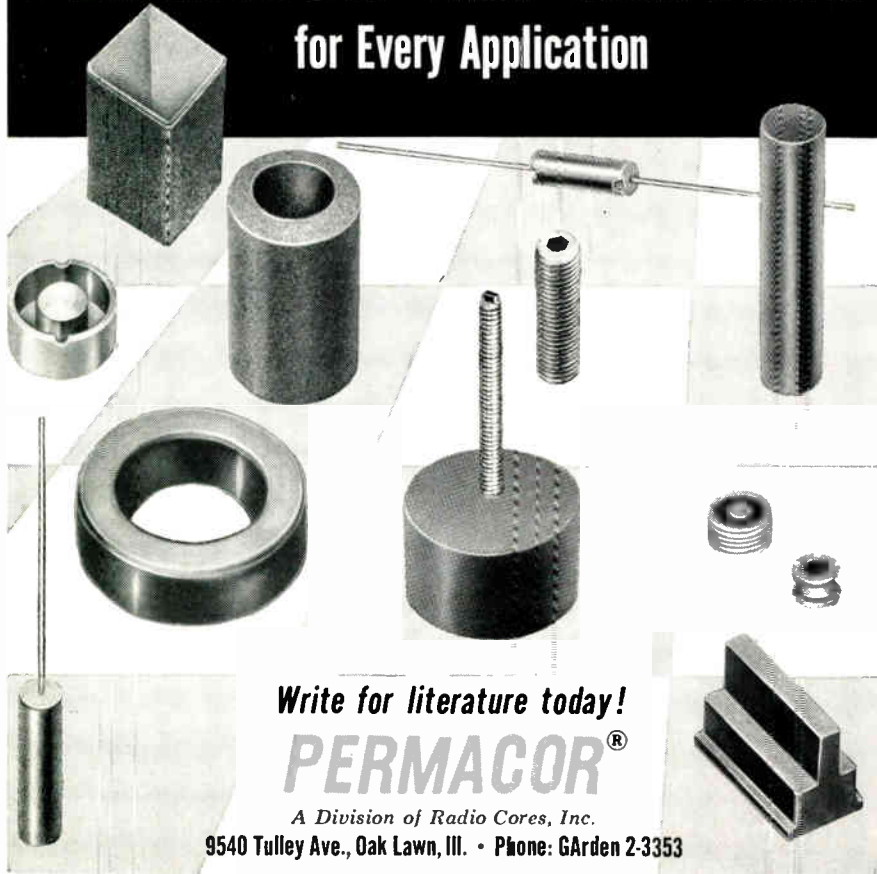
# STACKPOLE

CARBON COMPANY, *Electronic Components Division*  
St. Marys, Pennsylvania



# PERMACOR<sup>®</sup> Electronic Powdered IRON CORES

for Every Application



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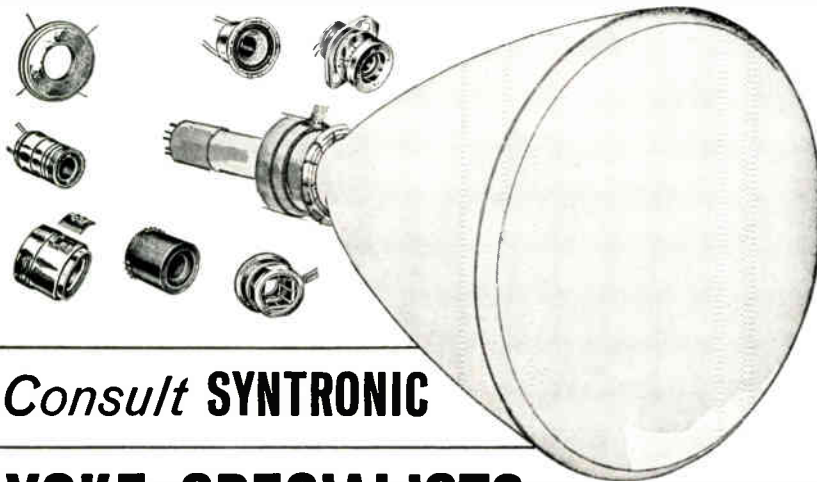
**PERMACOR<sup>®</sup>**

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Circle 55 on Inquiry Card

## WHICH DEFLECTION YOKE FOR YOUR DISPLAY ?



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## YOKE SPECIALISTS

Syntronic's team of experts knows more about yoke design, engineering and quality control than anyone else. A solid 10-year record of leadership—acknowledged throughout the industry. Benefit from it.

***syntronic*** INSTRUMENTS, INC.  
100 Industrial Road, Addison, Illinois  
Phone: Kingswood 3-6444

Circle 56 on Inquiry Card

## NEW TECH DATA

### Piezoelectric Accelerometers

High-performance piezoelectric accelerometers and companion amplifiers are described in this 4-page brochure available from Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. Specs., illustrations and general information are included.

Circle 321 on Inquiry Card

### DC Amplifier

Complete specs. are available on Model 260 solid-state wideband potentiometric dc amplifier. These specs. include: bandwidth, down 3db at 200kc minimum; gain accuracy,  $\pm 0.002\%$  at dc; input impedance, 1,000 megohms minimum; output,  $\pm 10v$ ,  $\pm 10ma$ . Redcor Corp., 7760 Deering Ave., P. O. Box 1031, Canoga Park Calif.

Circle 322 on Inquiry Card

### R-F Capacitors

Tech. Bulletin 402 lists low-loss silicone oil-impregnated r-f capacitors with ratings from 2.5kv to 30kv. Capacitance ranges from 0.00005 $\mu$ fd to 0.1 $\mu$ fd. Capacitors are primarily designed for ultrasonic oscillating circuits, r-f and pulse uses. Captronics, Inc., 9 Cricket Terrace, Ardmore, Pa.

Circle 323 on Inquiry Card

### Voltage Regulator

"Statex Voltage Regulators," Bulletin 14C1523, has a diagram of the printed-circuit elements of the voltage regulator, and a block diagram of the complete excitation system. Regulator can handle exciter field power requirements up to 5250w., provides regulation of  $\pm 1\%$ . Allis-Chalmers, Milwaukee 1, Wisc.

Circle 324 on Inquiry Card

### Conveyor Furnaces

An 8-page bulletin, C-1, gives basic design facts for radiant equipment, air-circulated equipment, conveying mechanisms and muffle or chamber arrangements, along with recommended areas of use. Drawings and photos are used, parts labeled, and processes clearly described. Trent, Inc., 201 Leverington Ave., Philadelphia 27, Pa.

Circle 325 on Inquiry Card

### DC Power Supply

This 4-page brochure describes Model R2432-100 Regulated DC Power Supply, a portable unit providing 0-100a of current at 24-32vdc. Available from Tung-Sol Electric, Inc., 1 Summer Ave., Newark 4, N. J.

Circle 326 on Inquiry Card

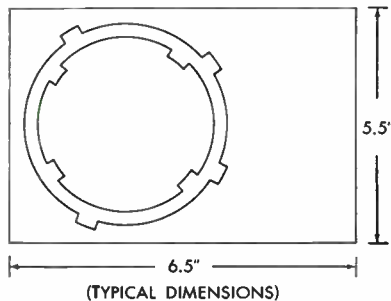
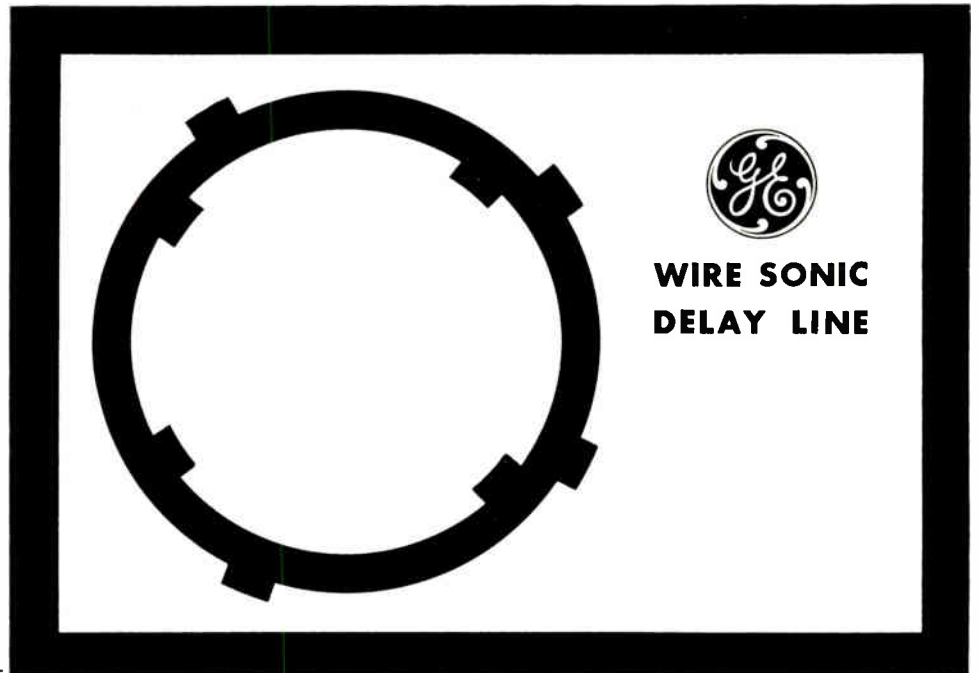
### Wire-Wound Resistors

High-temp., wire-wound resistors of fireproof inorganic construction are described in Bulletin P-7b. Units, designated type PW, are available in 2, 3, 5, 7, 10, 15 and 20w ratings. International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.

Circle 327 on Inquiry Card



Provides higher PRF (2.5mc RZ or 5mc NRZ) . . . and satellite flights demonstrate reliability



General Electric has achieved an important technical breakthrough in sonic delay lines—devices that operate at 2.5mc and 5mc PRF. These unique G-E delay lines, the only ones in industry capable of such high-frequency operation, give more storage per unit volume, faster access time to data, and enable higher operating frequencies for associated equipment. This continuous-operation performance has been demonstrated in actual satellite flights—from high-vibration launch through in-space operation.

Durable General Electric-developed direct drive torsional delay lines replace delicate mode converters with sturdy piezoelectric transducers. In addition to high vibration tolerance (up to 30Gs 20–2000 cps), these low-loss, completely passive devices withstand shock of 200Gs (11 Msec), and temperature variations from  $-5^{\circ}\text{C}$  to  $+65^{\circ}\text{C}$  ( $-55^{\circ}\text{C}$  to  $+100^{\circ}\text{C}$  with special considerations).

IN MISSILES, SATELLITES, AND INDUSTRIAL EQUIPMENT, G-E wire sonic delay lines can perform a variety of functions, including computer serial memories, buffer data storage, signal processing, and pulse timing. Input/output circuitry is furnished where desired.

To meet the specific requirements of your equipment and systems, General Electric's Specialty Devices Operation will custom-design these reliable, high-frequency devices.

Free, detailed information on G-E sonic delay lines is available. Write to Section 179-14, General Electric Company, Schenectady, New York.

SPECIALTY DEVICES OPERATION

**GENERAL**  **ELECTRIC**

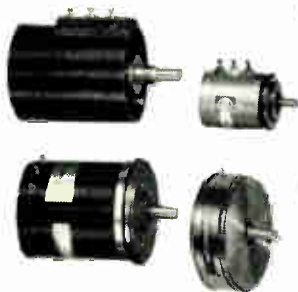
DEFENSE ELECTRONICS DIVISION

# BORG MICROPOT® POTENTIOMETERS

... a complete line of single-turn, multi-turn, and trimming potentiometers for commercial and military applications

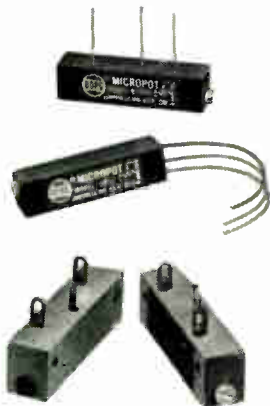
You can get quick delivery of any potentiometer listed below. If you need a special, take advantage of Borg's Quick Reaction Facility. We can build prototypes to your specs for the fastest possible delivery.

## PRECISION MICROPOT® POTENTIOMETERS



|                    | Model  | Standard Resistances (Ohms) | Resistance Tolerance                              | Temperature Range (°C) | Maximum Power Rating (Watts) | Size (Inches) |          | Linearity Tolerance (Standard %)                   | Number of Turns |
|--------------------|--------|-----------------------------|---|------------------------|------------------------------|---------------|----------|--|-----------------|
|                    |        |                             |   |                        |                              | Length        | Diameter |  |                 |
| <b>205 SERIES</b>  | 205    | 1.15 to 100K                | ±10% to 50<br>±3% over 50                         | -55 to +105            | 5                            | 2-1/8         | 1-3/4    | ±.1  | 10              |
|                    | 205-3T | 10 to 50K                   | ±3%   | -55 to +105            | 3                            | 1-31/64       | 1-3/4    | ±.5  | 3               |
| <b>900 SERIES</b>  | 901    | 25 to 100K                  | ±3%   | -55 to +125            | 5                            | 2-1/16        | 2        | ±.1  | 10              |
|                    | 931    | 15 to 60K                   | ±3%   | -55 to +125            | 3                            | 1-3/8         | 2        | ±.5  | 3               |
| <b>2100 SERIES</b> | 2101   | 25 to 120K                  | ±10% to 100<br>±3% 100 to 100K<br>±5% over 100K   | -55 to +125            | 5                            | 1.573         | 7/8      | ±.5  | 10              |
|                    | 2131   | 10 to 40K                   | ±10% to 30<br>±3% over 30                         | -55 to +125            | 4                            | 1.055         | 7/8      | ±.5  | 3               |
|                    | 2151   | 100 to 100K                 | ±3%   | -55 to +105            | 3                            | 1.455         | 7/8      | ±.25   | 10              |
| <b>2200 SERIES</b> | 2201   | 25 to 200K                  | ±3% to 100K<br>±5% over 200K                      | -55 to +105            | 5                            | 2-1/8         | 1-13/16  | ±.25   | 10              |
|                    | 2251   | 25 to 200K                  | ±5% to 100<br>±3% 100 to 100K<br>±5% 100K to 200K | -55 to +105            | 5                            | 2-1/8         | 1-13/16  | ±.5 to 100<br>±.25 100 to 100K<br>±.5 100K to 200K | 10              |
| <b>2400 SERIES</b> | 2441   | 500 to 50K                  | ±5% to 10K<br>±3% over 10K                        | -55 to +125            | 3                            | .781          | 7/8      | ±.5  | 1               |
|                    | 2461   | 500 to 100K                 | ±5% to 5K<br>±3% over 5K                          | -55 to +125            | 4                            | .800          | 1-7/16   | ±.5  | 1               |
|                    | 2481   | 100 to 125K                 | ±5% to 5K<br>±3% over 5K                          | -55 to +125            | 5                            | 1             | 2        | ±.5  | 1               |
|                    | 2491   | 100 to 200K                 | ±5% to 5K<br>±3% over 5K                          | -55 to +125            | 6                            | 1             | 3        | ±.5  | 1               |

## TRIMMING MICROPOT® POTENTIOMETERS



|                    | Description   | Resistance Range | Resistance Tolerance                  | Temperature Range (°C) | Maximum Power Rating | Size |     |       | Turns | Termination*       |
|--------------------|---|------------------|---------------------------------------|------------------------|----------------------|------|-----|-------|-------|--------------------|
|                    |   |                  |                                       |                        |                      | H    | W   | L     |       |                    |
| <b>990 SERIES</b>  | High-Temperature Wirewound                          | 10 ohms to 50K   | ±10% to 100 ohms<br>±5% over 100 ohms | -55 to +175            | 1                    | .36† | .28 | 1-1/4 | 40    | L<br>SL<br>PC<br>T |
| <b>992 SERIES</b>  | General Purpose Wirewound                           | 10 ohms to 50K   | ±10% to 100 ohms<br>±5% over 100 ohms | -55 to +105            | 1                    | .36† | .28 | 1-1/4 | 40    | L<br>SL<br>PC      |
| <b>993 SERIES</b>  | General Purpose Carbon                              | 20K to 1 meg     | ±20%                                  | -55 to +105            | .5                   | 5/16 | .28 | 1-1/4 | 25    | L<br>SL<br>PC      |
| <b>994 SERIES</b>  | General Purpose Humidity-Proof Wirewound            | 10 ohms to 50K   | ±10% to 100 ohms<br>±5% over 100 ohms | -55 to +105            | 1                    | .36† | .28 | 1-1/4 | 40    | L<br>SL<br>PC      |
| <b>995 SERIES</b>  | General Purpose Humidity-Proof Carbon               | 20K to 1 meg     | ±20%                                  | -55 to +105            | .5                   | 5/16 | .28 | 1-1/4 | 25    | L<br>SL<br>PC      |
| <b>2700 SERIES</b> | Miniature High-Temperature Humidity-Proof Wirewound | 100 ohms to 30K  | ±5%                                   | -55 to +175            | 1                    | .315 | .18 | 1     | 15    | L<br>W             |
| <b>2750 SERIES</b> | High-Temperature Humidity-Proof Wirewound           | 10 ohms to 100K  | ±5%                                   | -65 to +175            | 1                    | .32  | .19 | 1.25  | 22    | L<br>SL<br>PC      |
| <b>2800 SERIES</b> | High-Temperature Humidity-Proof Wirewound           | 10 ohms to 50K   | ±10% to 100 ohms<br>±5% over 100 ohms | -55 to +175            | 1                    | .36† | .28 | 1-1/4 | 40    | L<br>SL<br>PC      |

†Except L models: 5/16".

\*L: Color-coded wire leads.  
T: Solder Terminals.

W: Uninsulated tinned copper leads.  
PC: Printed circuit pins.  
SL: Gold-plated solder lugs.



### BORG MICRODIAL® TURNS-COUNTING DIALS

Do you prefer digital or concentric scales? Borg offers you the widest selection of precision dials for potentiometer control. Large, easy-to-read numerals. Thousand-to-one indexing accuracy. Rugged construction unaffected by "panic" handling. Positive braking option. Write for data.



### SUB-FRACTIONAL H.P. INSTRUMENT MOTORS

Synchronous, induction, and control models. Two or four pole types. With or without geartrains. Gear trains interchangeable in some models for maximum versatility. Write for data.



### FREQUENCY AND TIME STANDARDS

Borg Frequency and Time Standards offer 24-hour stability of up to 5pp 10<sup>11</sup>. Some models transistorized. Fully militarized and radiation-free. Integral power supply. Fail-safe frequency dividers. Crystal controlled. Time comparator for fast WWV comparisons. Write for complete data.



## BORG EQUIPMENT

A Division of Amphenol-Borg Electronics Corporation  
Janesville, Wisconsin



## Cool indifference—up to 310°C.

That's the big difference with AMPLIMICA\* Capacitors!

This stacked foil capacitor goes right on giving dependable performance in control systems, high voltage power supplies, pulse forming networks, and atomic reactors under temperature ratings up to 310°C. And the big reason for this is our new dielectric—a processed mica which takes all the advantages of raw mica and makes them more readily controllable for today's miniaturization and operational requirements.

In addition to being effectively resistant to high temperatures, our new AMPLIMICA Capacitors are also

resistant to radiation . . . even high dosage rates cause no appreciable capacitance loss.

If your requirements call for a capacitor that assures reliable, stable performance under temperatures ranging up to 310°C., we offer AMPLIMICA Capacitors in a complete range of sizes and configurations . . . ready to do the job. Send for complete information today.

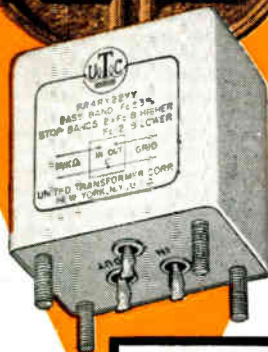
\*Trademark of AMP INCORPORATED

**AMP** | **CAPITRON**  
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 155 PARK STREET, ELIZABETHTOWN, PA.

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# STANDARD LINE & INTERSTAGE FILTERS



**IMMEDIATE  
DELIVERY  
From Stock**  
Hermetically sealed  
to MIL-F-18327A

**UTC** STANDARDIZED FILTERS have been developed to cover the more common mid-range frequency filter requirements with stock units. All are in compact drawn hermetically sealed cases shielded to reduce hum pick-up. They are divided into seven basic types.

BMI filters are band pass interstage units designed to operate between a vacuum tube plate (or 10,000 ohms) and a grid. They provide a gain of 2 at center frequency. BTI units are same as BMI, but 10,000 ohms output for transistor application.

BML band pass filters, similarly, work into a grid, but have an input impedance of 500/600 ohms. They provide a gain of 9. HMI filters are high pass interstage units. LMI filters are low pass interstage units. HML filters are high pass with input and output impedance of 500/600 ohms. LML filters are low pass filters with input and output impedance of 500/600 ohms.

BMI, BTI, BML, HMI, and HML special filters can be obtained for any frequency from 60 to 12,000 cycles. LMI specials are available from 140 to 12,000 cycles. LML filters are available from 500 to 12,000 cycles.

## UNITED TRANSFORMER CORPORATION

150 Varick Street, New York 13, N.Y.

PACIFIC MFG. DIVISION

3630 Eastham Drive, Culver City, Calif.

EXPORT DIVISION

13 East 40th Street, New York 16, N. Y.

**WRITE FOR LATEST CATALOG**

Circle 60 on Inquiry Card

# NEW TECH DATA

for Engineers.

## Multiple Headers

A 4-page bulletin on high-temp., vacuum-sealed multiple pin headers has been released. Fully illustrated with photos and dimensional sketches, Bulletin FT-3 includes headers having from 1 to 8 pins for use from  $-325^{\circ}\text{F}$  to  $+800^{\circ}\text{F}$  and above. Several types not cataloged before are shown. Catalog Dept., Physical Sciences Corp., 314 E. Live Oak Ave., Arcadia, Calif.

Circle 443 on Inquiry Card

## Photoelectric Controls

The 8-page Transistor Photoelectric Control Catalog, in color, describes sensitive, self-contained transistorized photoelectric controls. It covers controls with magnetic amplifiers, tubeless controls, controls with time delays, and light sources for use with the above. Also described are transistorized on-off photoelectric controls and time-delay controls with small and regular size sensing and light source heads, including infrared and fluorescent light filter assemblies. Autotron, Inc., 3627 N. Vermilion, Danville, Ill.

Circle 444 on Inquiry Card

## Coaxial Cable Bulletin

The 20-page illustrated Bulletin CT-3 describes Spirafil coaxial cable. This air dielectric, semi-flexible cable is used in community TV systems and feed networks for guidance, telemetry, space surveillance and radar. Data covers electrical and mechanical characteristics, average power rating, and attenuation vs. freq. performance curves. Phelps Dodge Electronic Products, 60 Dodge Ave., North Haven, Conn.

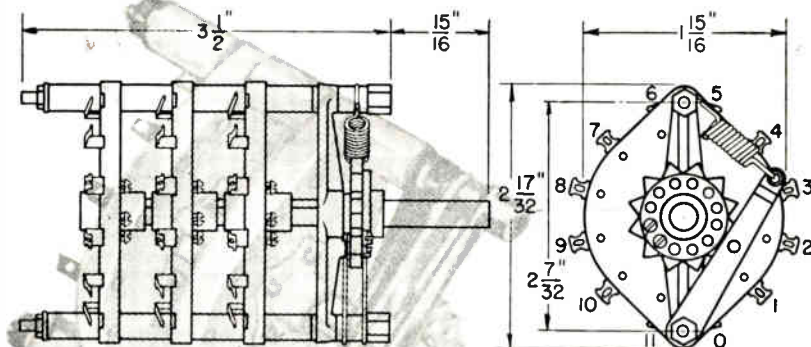
Circle 445 on Inquiry Card

## High-Power Amplifiers

Bulletin 1306-1 describes high-power series of magnetic amplifiers. Completely static amplifiers meet medium-power industrial needs and are ideal for ac and dc motor control, electric furnace control, or other power control. Bulletin lists features, specs., dimensions and other physical data of the super-power series, and shows typical connection diagrams. It also charts typical control characteristics and provides a silicon rectifier selection guide. Electric Products Div., Vickers, Inc., 1815 Locust St., St. Louis 3, Mo.

Circle 446 on Inquiry Card

## Switch to the Best



### MODEL 80 SWITCH

- 4500 volt peak flashover at 60 cps
- 10 ampere current carrying capacity
- Current carrying members heavily silver plated
- Kel-F stators and rotors
- Black anodized die cast aluminum support bracket
- Nylon detent wheel
- Oil impregnated bronze sleeve bearing
- Steatite spacers
- Stainless steel detent arm



## RADIO SWITCH CORPORATION

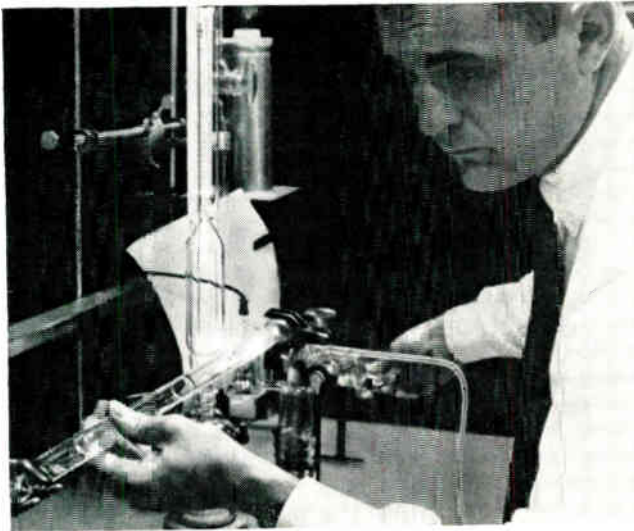
MARLBORO, NEW JERSEY • Telephone: HOPKINS 2-6100

Circle 61 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963

**IBM** asks basic questions in materials

## How can we develop better semiconductors?

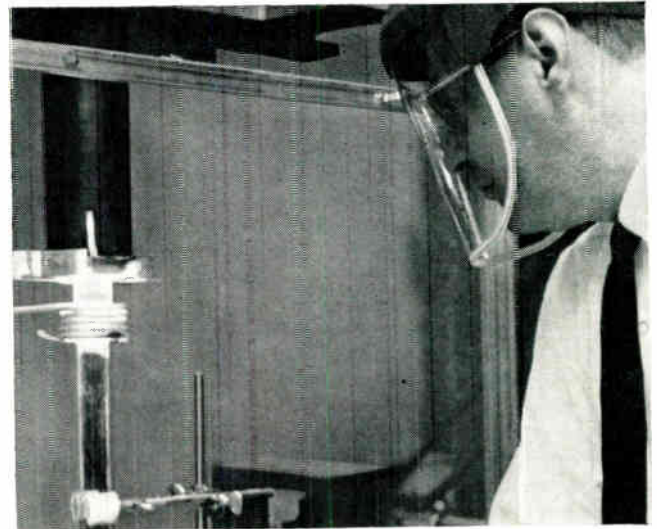


*In this method of preparing ultrapure gallium arsenide, gallium reacts with arsenic in a quartz tube with oxygen added under pressure to suppress dissociation of  $\text{SiO}_2$ .*

The immense speeds at which computers must operate place stringent requirements on the transistors and diodes which perform calculations. To increase further the speed of semiconductor devices now operating in millionths or even billionths of a second requires not only refinements in present designs and fabrication techniques, but also new materials that are inherently superior to materials presently being used, like germanium and silicon. IBM has been working to transform the great potential of one such new material, gallium arsenide, into useful devices. Gallium arsenide has a much higher electron mobility than germanium and silicon. Thus it is potentially much faster. It has a larger band gap, permitting operation at higher temperatures. It is chemically and mechanically stable. However, the difficulty of producing gallium arsenide of sufficient purity has, until recently, limited its application.

IBM scientists have developed the reproducible processes, shown above, which greatly improve the purity of the material. Using their new processes, they can produce materials with electron mobilities—an important measure of purity—of about 8,000  $\text{cm}^2/\text{volt-sec.}$ , as compared with previously reported mobilities of about 6,000  $\text{cm}^2/\text{volt-sec.}$  Mobilities in this high-purity gallium arsenide are about twice those of germanium and four times those of silicon. These mobilities may make it feasible to fabricate semiconductor devices of higher speed than previously available.

The potential of high-purity gallium arsenide was



*In this alternative method, gallium arsenide crystals are pulled from gallium and arsenic melted in aluminum nitride crucibles, which do not liberate silicon contaminants.*

first exploited by IBM scientists in a new gallium arsenide-germanium heterojunction diode. The difference in conduction band energies between gallium arsenide and germanium permits a diode to be made using n-type material on both sides of the junction. In other words, n-type gallium arsenide is used on one side of the junction and n-type germanium on the other. Such a configuration virtually eliminates minority carriers. Since the chief barrier to faster diode switching has been minority-carrier storage time, the heterojunction device has the potential for much faster switching than conventional p-n junction diodes. Its calculated switching time is on the order of a few picoseconds (trillionths of a second). Measurements have shown it to be faster than the fastest available measuring circuits. This configuration had been tried earlier, but was unsuccessful until better gallium arsenide was made by IBM scientists. This is an example of the way in which the development of new materials like gallium arsenide makes it possible to produce components which can keep up with the increasing speeds of new generations of computers.

If you have been searching for an opportunity to make important contributions in materials, space, programming systems, or any of the other fields in which IBM scientists and engineers are finding answers to basic questions, please contact us. IBM is an Equal Opportunity Employer. Write to: Manager of Professional Employment, IBM Corp., Dept. 557F, 590 Madison Avenue, New York 22, N. Y.



F O R E X P E R I M E N T A L U S E



MICROMINIATURE  
CERAMIC CAPACITOR

# Labstock Kit



**Specially  
Priced**

Wide assortment of over 600 "VK" ceramic capacitors, ranging in value from 39 pf to 10,000 pf in both 10% and 20% tolerances, for prototype and breadboard use. Units are packaged and sorted by value in individual, labeled drawers for fast, easy selection. 32-drawer, enameled metal cabinet is compact, sturdy — takes up less than 1/2 ft. of bench space. VK® Kit #3, as shown, **specially priced at \$349.00.**

Contact us for information concerning VK® Kit #4 with 120 **specially selected units priced at \$75.00.**

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"VITRAMON" Porcelain and Ceramic Capacitors

**Vitramon**

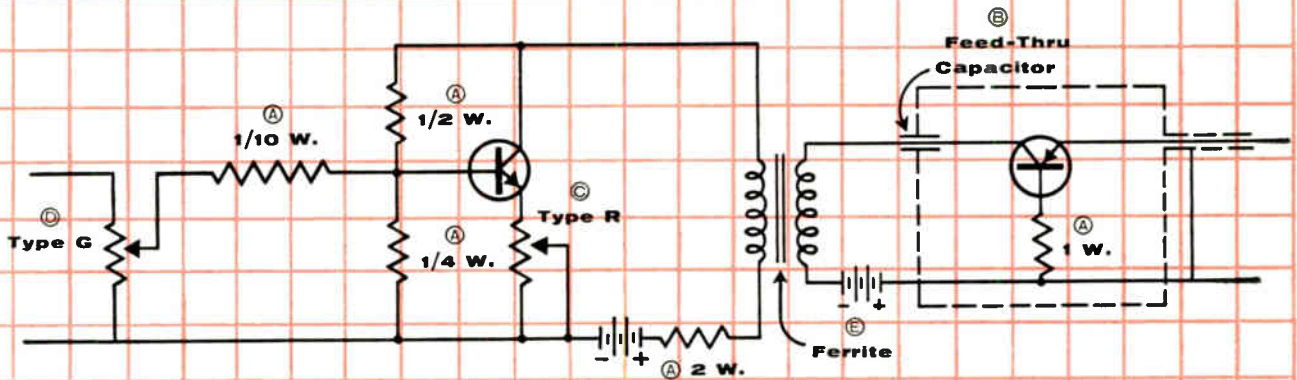
INCORPORATED

BOX 544 • BRIDGEPORT 1, CONNECTICUT



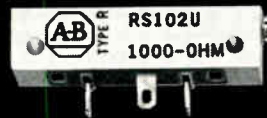


# Allen-Bradley's "time-proven" components bring the ultimate in reliability to your circuit design



**A** HOT MOLDED FIXED RESISTORS are available in all standard EIA and MIL-R-11 resistance values and tolerances.

**B** FEED-THRU CAPACITORS—Available in standard values of 470 mmf = 20% and 1000 mmf G.M.V. Special values from 6.8 to 1000 mmf. Rated to 500 v DC max.



**C** HOT MOLDED ADJUSTABLE FIXED RESISTORS—Rated 1/4 watt at 70°C. Values to 2.5 meg. Tol: ± 10 and 20%.



**D** TYPE G HOT MOLDED POTENTIOMETERS—Only 1/2" diam. Rated 1/2 watt at 70°C. Resistance values to 5 meg. Tol: ± 10 and 20%.



**E** FERRITES in a wide range of "items," such as flared rings, quarter rounds, U cores, E cores, cup cores, etc., can be supplied.

■ With the quality of the components which you select, you automatically establish the "quality" of your product. Consequently, there's no surer way of making certain of optimum performance than by using Allen-Bradley electronic components. Such stable characteristics insure against catastrophic failure, and conservative ratings are way beyond the "promise" of any similar products. Hundreds of customers of many years standing have learned from their experience with Allen-Bradley hot molded resistors, that today's shipments are as uniform in quality as they were ten or twenty years ago—and such uniform quality can always be expected.

Remember also that with billions of A-B resistors in use, there is *not one instance* of catastrophic failure on record! Allen-Bradley's *exclusive* hot molding process results in such uniformity that long term resistor performance can be accurately predicted.

Then there's the compact Type G potentiometer. The solid, hot molded resistance element assures exceptionally smooth control throughout its long life—there are never any abrupt resistance changes during adjustment. The

noise factor is remarkably low initially, and it actually decreases with use.

Allen-Bradley's Type R adjustable fixed resistors are also made by this same hot molding process—resistance element, terminals, and insulating base are all molded into a solid unit. Stepless adjustment is provided, and the moving element is self-locking at its "setting."

In the higher frequencies—up to 1,000 mcps—A-B ceramic feed-thru and stand-off capacitors' unique discoidal design eliminates all parallel resonance effects.

Entirely new answers to design problems are possible with A-B's broad line of ferrites . . . reducing product size, weight, or cost, and improving performance. They can be supplied in a wide range of shapes and sizes—while maintaining extremely uniform electrical and mechanical characteristics.

For more details on all A-B quality electronic components—types, ratings, dimensions—please send for Publication 6024: Allen-Bradley Co., 1342 S. Second St., Milwaukee 4, Wisconsin. In Canada: Allen-Bradley Canada Ltd., Galt, Ontario.

QUALITY ELECTRONIC COMPONENTS

# ALLEN-BRADLEY

# Assure High Reliability and Effective Display

with DIALCO Twin Lamp

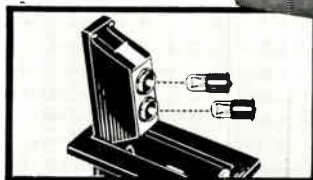
## PLACARD LIGHTS

Maximum reliability and safety are achieved by DIALCO'S twin lamp and Press-to-Test construction: Burnout of one lamp will not result in failure of the indication. The Press-to-Test feature enables instant checking of both lamps without removing them from the Placard Light assembly.

Flexibility in application is provided by: Choice of single units or stacks of 2 to 10 indicators; maximum area for legend display and wide variety of legend colors and styles; 4 mounting methods—with an escutcheon plate, or flush-to-panel with end-mounting, side-mounting, or "L" angle brackets...DIALCO Placard Lights conform to applicable Military Standards.

### THE LIGHT SOURCE: ▷

Two T-1¾ Incandescent Bulbs (with midget flanged base); available in voltages from 1.3 to 28 V. Lamps are easily replaced from the front—without removing the assembly.



A typical stack of 10 Placard Light assemblies with an escutcheon plate. (approx. 3/5 size)

For complete data, request Catalog L-170

Foremost Manufacturer of Pilot Lights  
**DIALIGHT**  
CORPORATION



60 STEWART AVENUE  
BROOKLYN 37, N.Y.  
(212) HYacinth 7-7600

Circle 64 on Inquiry Card

## NEW TECH DATA

### Mica Capacitor Chart

The Mica Minder is a 17 x 22 in. wall chart to help circuit designers select mica capacitors. More than 40 types of mica capacitors are listed with line drawings and dimensions. For each type, chart shows capacitance, tolerance, voltage, operating temp., temp. characteristics and insulation resistance. Three smaller charts augment the above information. Cornell-Dubilier Electronics Div., Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.

Circle 447 on Inquiry Card

### Connector Facilities Booklet

Expanded facilities for producing electrical connectors are described in a 19-page illustrated booklet. Bulletin #665 outlines and illustrates the connector manufacturing facilities and capabilities of Pyle-National Co. Areas covered include elastomer compounding and molding, testing, quality control, and cable terminating and molding. The Pyle-National Co., 1334 N. Kostner Ave., Chicago 51, Ill.

Circle 448 on Inquiry Card

### Selection Guide

How to specify 1,500 standard infrared detector elements is outlined in a series of Servotherm® detector spec. sheets. A new method for the systematic selection of various component elements simplifies detector procurement to a marked degree. Consequently, Mil-quality infrared detectors can be specified as standard components instead of requiring special designs. Servo Corp. of America, 111 New South Rd., Hicksville, L. I., N. Y.

Circle 449 on Inquiry Card

### H-F Rectifier

Technical information and prices on a new h-f diffused-junction rectifier for high-radiation uses are available from TRW Electronics/Pacific Semiconductors, Inc., 14520 Aviation Blvd., Lawndale, Calif. Rectifier Type PS3200 has a top operating freq. of 250kc and a 10kv. rating.

Circle 450 on Inquiry Card

### Metallized Paper Capacitors

Bulletin No. 131E8 contains complete specs. on high-temp., metallized paper capacitors, designed to meet critical operating requirements and reliability. Temp. ranges, performance characteristics and case dimensions are included. Aerovox Corp., New Bedford, Mass.

Circle 451 on Inquiry Card

### Power Supplies

This 44-page catalog, B-631, describes over 230 dc-regulated power supplies, including programmable voltage/current regulated models. Included are performance features and physical specs. Kepco, Inc., 131-8 Sanford Ave., Flushing 52, N. Y.

Circle 452 on Inquiry Card

## SHIELDED SUBMINIATURE ADJUSTABLE R.F. COILS



Approx. Dim.:  
½" x ½" x ¾" High

### FEATURES:

- Tuning is accessible from top and bottom of coil.
- Magnetically and Electrostatically shielded.
- Mounting constructed for Printed Circuit application.

### ELECTRICAL SPECIFICATIONS

| MILLER PART No. | L Min. @ Freq.     | Nom. Q @ L Min. | L Max. @ Freq.     | Nom. Q @ L Max. | Rdc (Ohms) | Typical Dist. C (pF) |
|-----------------|--------------------|-----------------|--------------------|-----------------|------------|----------------------|
| 9050            | 1.5 uh @ 7.9 Mc.   | 50              | 3.0 uh @ 7.9 Mc.   | 50              | 0.60       | 3.5                  |
| 9051            | 3.0 uh @ 7.9 Mc.   | 55              | 7.0 uh @ 7.9 Mc.   | 50              | 0.85       | 4.3                  |
| 9052            | 7.0 uh @ 7.9 Mc.   | 55              | 14.0 uh @ 2.5 Mc.  | 70              | 1.25       | 7.6                  |
| 9053            | 14.0 uh @ 2.5 Mc.  | 60              | 28.0 uh @ 2.5 Mc.  | 70              | 1.75       | 10.3                 |
| 9054            | 28.0 uh @ 2.5 Mc.  | 60              | 60.0 uh @ 2.5 Mc.  | 60              | 2.60       | 11.0                 |
| 9055            | 60.0 uh @ 2.5 Mc.  | 55              | 120.0 uh @ 790 kc. | 80              | 4.00       | 10.3                 |
| 9056            | 120.0 uh @ 790 kc. | 60              | 280.0 uh @ 790 kc. | 85              | 5.75       | 9.0                  |
| 9057            | 280.0 uh @ 790 kc. | 65              | 650.0 uh @ 790 kc. | 80              | 9.00       | 8.0                  |
| 9058            | 650.0 uh @ 790 kc. | 60              | 1.3 Mh @ 250 kc.   | 65              | 15.00      | 8.0                  |
| 9059            | 1.3 Mh @ 250 kc.   | 50              | 3.0 Mh @ 250 kc.   | 60              | 23.00      | 16.0                 |
| 9060            | 3.0 Mh @ 250 kc.   | 35              | 10.0 Mh @ 79 kc.   | 45              | 76.00      | 7.0                  |
| 9061            | 8.0 Mh @ 250 kc.   | 40              | 20.0 Mh @ 79 kc.   | 45              | 110.00     | 7.0                  |
| 9062            | 15.0 Mh @ 79 kc.   | 40              | 40.0 Mh @ 79 kc.   | 45              | 150.00     | 7.0                  |
| 9063            | 20.0 Mh @ 79 kc.   | 30              | 60.0 Mh @ 79 kc.   | 60              | 160.00     | 10.0                 |

J. W. MILLER COMPANY • 5917 So. Main St., Los Angeles 3, Calif.





# ENGINEERED QUALITY

IS ASSURANCE OF BETTER PERFORMANCE

Dependable performance beyond the acceptable average is the result of engineered quality in these Acme Electric products. Our research and engineering staff can apply a wealth of experience, and the facilities of a new, completely equipped, modern engineering laboratory to help resolve the application of electronic and magnetic components.

## Acme Electric POWER SUPPLIES

Acme Electric has designed, over the period of 15 years, more than 1000 different types of Power Supplies in ratings from 1/8 watt to 600 KW. This significant experience can be of value to you in the selection of a standard Power Supply or custom built units to specific applications.

### POPULAR STANDARD DESIGNS

| Cat. No.  | A.C. Input Volts | Watts | Amperes | D.C. Volts | Approx. Regulation | Approx. Efficiency | Shipping Weight |
|-----------|------------------|-------|---------|------------|--------------------|--------------------|-----------------|
| PS-41422  | 100-130          | 50    | 2.08    | 24         | ±1%                | 73%                | 14              |
| PS-41423  | 100-130          | 150   | 6.25    | 24         | ±1%                | 76%                | 23              |
| PS-41424  | 100-130          | 200   | 4.15    | 48         | ±1%                | 81%                | 25              |
| PS-41425  | 100-130          | 250   | 2.0     | 125        | ±1%                | 86%                | 26              |
| PS-41426  | 100-130          | 300   | 2.0     | 150        | ±1%                | 86%                | 30              |
| PS-41427  | 100-130          | 200   | 1.0     | 200        | ±1%                | 80%                | 25              |
| PS-41428  | 100-130          | 250   | 1.0     | 250        | ±1%                | 85%                | 26              |
| PS-39787  | 120              | .125  | 0.005   | 0-25       |                    |                    | 15              |
| PS-1-6757 | 95-130           | 112.5 | 0-2.5   | 0-45       | ±5%                |                    | 21              |
| PS-39600  | 120±15%          | 250   | 0-5     | 0-50       | ±1%                |                    | 21              |
| PS-39590  | 115±15%          |       |         | 0-52       | ±.015              |                    |                 |

### CUSTOM DESIGNS TO SPECIFICATIONS



Custom power supplies are designed with regard to regulation, frequency response, recovery time, transient disturbances, ripple, noise-level, isolation, temperature drift, stability and the most practical physical size consistent with the component and circuitry requirements. Our suggestions on your application may be of considerable value.



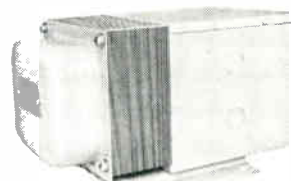
## MAGNETIC AMPLIFIERS



Solid state electronic components and magnetic reactors of advanced design provide high ratio between power input and power output. Self saturating. Bias control winding and independent gain control circuit are adjustable by independent potentiometers. Operates from extremely low signal source. Isolated signal and load circuits. Write for Bulletin #24.



## CONSTANT VOLTAGE STABILIZERS



A standardized line, available from stock shipment in any quantity. Output voltage stabilized ±1% of normal. Bulletin #09.

| OUTPUT CAPACITY | INPUT VOLTAGE |         | OUTPUT VOLTAGE |
|-----------------|---------------|---------|----------------|
| 15              | 95-130        |         | 6.3 120        |
| 25              | 95-130        |         | 6.3 120        |
| 50              | 95-130        |         | 6.3 120        |
| 100             | 95-130        | 190-260 | 120 240        |
| 200             | 95-130        | 190-260 | 120 240        |
| 300             | 95-130        | 190-260 | 120 240        |
| 500             | 95-130        | 190-260 | 120 240        |
| 1000            | 95-130        | 190-260 | 120 240        |
| 2000            | 95-130        | 190-260 | 120 240        |
| 3000            | 95-130        | 190-260 | 120 240        |
| 5000            | 95-130        | 190-260 | 120 240        |

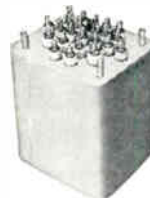
Note: Ratings are available with single output voltage only and only one input voltage range.



## TRANSFORMERS

ENCAPSULATED, MOLDED, HERMETICALLY SEALED

Complete facilities for designing, producing and testing transformers for high frequency, high temperature and high performance applications.



## STATIC POWER RECTIFIERS

Our production of static, magnetic, rectified DC power supply units have now advanced beyond 600 KW capacity types. Custom engineered rectifiers can be supplied with low level or high level dc output voltages.



SA 3650/2089

## ACME ELECTRIC CORPORATION

876 Water St.

Cuba, New York

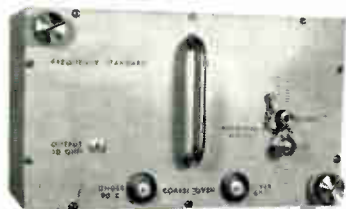
In Canada: Acme Electric Corp. Ltd., 50 Northline Rd., Toronto, Ont.



TRANSFORMERS

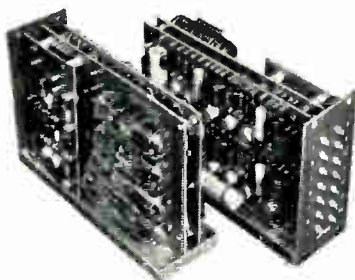


# REEVES-HOFFMAN FREQUENCY STANDARDS, CRYSTALS, OVENS, FILTERS



## FREQUENCY STANDARDS

Highly reliable, ultra-stable standards with a basic frequency of 5 mc are available with circuitry for division to 100 kc and 1 mc and doubling up to 10 mc. Stability is up to 1 part in  $10^9$  per day. Precision standards use crystals of our own manufacture and are packaged to your specifications.



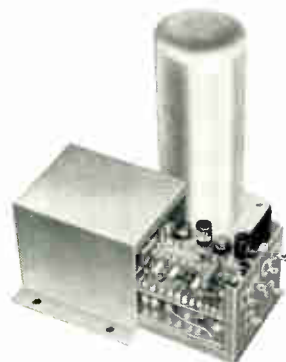
## PACKAGED OSCILLATORS

Transistorized and Hard Tube Types of Reeves-Hoffman packaged oscillators are available in a frequency range from 100 cps to 100 mc. Stability is up to 1 part in  $10^9$ . Packaged to your specifications.



## CRYSTALS

STANDARD TYPES of Reeves-Hoffman crystals, for all commercial and military applications, are available in a frequency range from 1 kc to 100 mc. Hermetically sealed in metal holders. PRECISION TYPES of Reeves-Hoffman crystals, for use in high precision oscillators and secondary frequency standards, are available in a frequency range from 1 kc to 5 mc. Hermetically sealed in glass holders with standard radio tube bases.

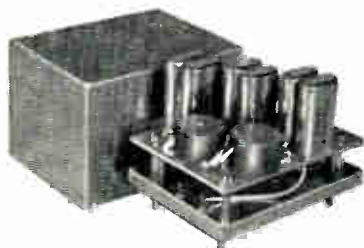


## OVENS

OVENS for precise temperature control are available in three types: PROPORTIONALLY CONTROLLED, for precise frequency standards, hold within  $0.001^\circ\text{C}$  at any fixed ambient.

THERMOSTATICALLY CONTROLLED, for high reliability requirements, hold within  $0.005^\circ\text{C}$  at any fixed ambient.

SNAP-ACTION CONTROLLED, for rugged military requirements, hold within  $1.0^\circ\text{C}$  at any fixed ambient.



## FILTERS

Crystal filters are available in a frequency range of audio to 30 mc. Filters, using crystals of Reeves-Hoffman manufacture, can be packaged to your specifications.



## MODEL S2075 2.5 MC FREQUENCY STANDARD

Stability of  $2 \times 10^{-11}$  per day after one year (at a constant ambient). Provides simultaneous output frequencies of 100 kc, 1 mc, 5 mc. Double proportional control oven, transistorized, fits into  $5\frac{1}{4}$  -in. rack panel. Crystal is AT-cut, 5th overtone with frequency adjustable to within  $1 \times 10^{-11}$ .

Reeves-Hoffman also manufactures fractional horsepower motors and resolvers.



# REEVES- HOFFMAN

CARLISLE, PENNSYLVANIA

DIVISION OF DYNAMICS CORPORATION OF AMERICA



**WE HAVE MADE**

**OVER 1,000,000 SPECIAL POTS**

Which means: (a) we know how (b) we welcome the unusual, including complex non-linears (c) you get quicker delivery; chances are we've already solved the problem (or close to it) for somebody else (d) you save money since minimum design time is required (perhaps none at all) (e) we can meet your specs.

May we make one (or 1,000) for you? It costs you nothing to inquire. Why don't you try us?

**SPECTROL** ELECTRONICS CORPORATION

1704 South Del Mar Avenue  
San Gabriel, California

Adams Court  
Plainview, L. I., New York

P. O. Box 130  
Brampton, Ontario

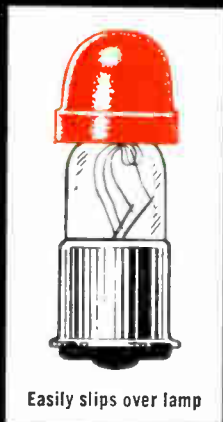
Circle 69 on Inquiry Card  
World Radio History



**INSTANT COLOR!**



**CHANGE COLORS OF  
CLEAR INCANDESCENT  
MINIATURE LAMPS  
INSTANTLY with  
SILIKROME™  
COLORED FILTERS**



Easily slips over lamp

- Elastomeric, unbreakable, reuseable

Send for **FREE SAMPLES** and literature

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Circle 76 on Inquiry Card

## NEW TECH DATA

for Engineers.

### Toroidal Inductor

An 8-page booklet, entitled "Toroidal Inductor Application Guide," includes specs., curves, construction and operating range, inductance data, reactance nomograph, plus other pertinent information on miniaturized transformers. Microtran Co., Valley Stream, L. I., N. Y.

Circle 437 on Inquiry Card

### Transistor Power Supply

Bulletin S-2-37 describes Model 591-H regulated switching transistor power supply for military use (Mil-E-5272A). It converts low-voltage dc to higher voltage dc. Specs., schematics and characteristics are included. Arnold Magnetics Corp., 6050 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 438 on Inquiry Card

### Piezo Components

High-performance piezoelectric accelerometers and companion amplifiers are described in a new 4-page brochure from Statham Instruments, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. Complete specs. are included on AK series piezoelectric accelerometers and SA series piezoelectric amplifiers.

Circle 439 on Inquiry Card

### RFI Filter Catalog

This 6-page catalog, Data-Log No. RFI-2000, describes 11 typical categories of RFI filter design solutions, including more than 2,000 different designs. It includes guide for complete design information to specify filters. Hopkins Engineering Co., P. O. Box 191, San Fernando, Calif.

Circle 440 on Inquiry Card

### Cable Finder

Electronic Wire Catalog has chart entitled "Cable Finder" referencing conductors and shielding to trade numbers and catalog. By using color coding to separate the different shields, it is easy to find the exact cable required. Catalog describes 3 new instrumentation cables. Belden Mfg. Co., 415 S. Kilpatrick, Chicago 44, Ill.

Circle 441 on Inquiry Card

### Printed-Circuit Connectors

Comprehensive 40-page printed-circuit connector catalog lists 210 contacts available with various terminations, including eyelet lug, solderless-wrap, taper tap and dip solder. Continental Connector Corp., 34-63 56th St., Woodside 77, N. Y.

Circle 442 on Inquiry Card

## Signalite MINIATURE GLOW LAMPS

Offer

- Reliability
- Stability
- Uniformity
- Brilliance
- Ruggedness

Whether you use Glow Lamps as Indicators or as Electronic Circuit Components . . . the combination of features offered by Signalite Glow Lamps makes them suitable for a wide variety of applications. OUR extensive line can provide you with the design flexibility needed to achieve circuit reliability at low cost. When you want glow lamps — think of Signalite, the only company specializing in glow lamps.

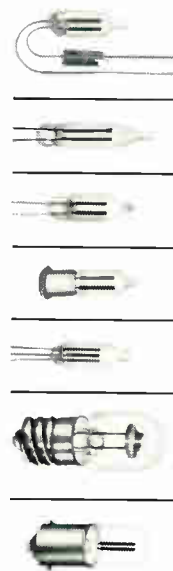
Today, the performance of our line of glow lamps has been proved in each diverse application as: counting, voltage regulation, voltage & frequency dividing, digital readouts, coupling, switching, memory, oscillators, surge protection, limiters, logic, timing, trigger, film marking, flip-flops, gating, photo choppers, amplification, noise generation, variable resistors, etc.

Write today

on your company's letterhead describing your particular application. We will analyze your needs and send you samples and complete technical bulletins.

Signalite

INCORPORATED NEPTUNE, NEW JERSEY  
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Circle 77 on Inquiry Card



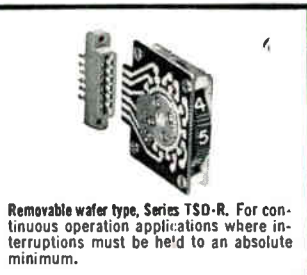
# THUMBWHEEL SWITCHES

TABET U.S. Patent 2,841,660

**Binary & Digital. Meet MIL-S-22710**



- For Critical Reliability Applications.
- Available with internal lighting MIL-L-25467A.



## CHICAGO DYNAMIC INDUSTRIES, Inc.

**C-D-I** PRECISION PRODUCTS DIVISION  
1725 Diversey Blvd., Chicago 14, Illinois  
Phone: WEllington 5-4600

Circle 78 on Inquiry Card



# ROTARY SWITCHES

TABET U.S. Patent 2,841,660

- For Critical Reliability Applications. Meet MIL-S-22710
- Quick changing of programs, configurations, circuits.
- Maintenance problems completely eliminated by unique 5-second wafer replacement models.

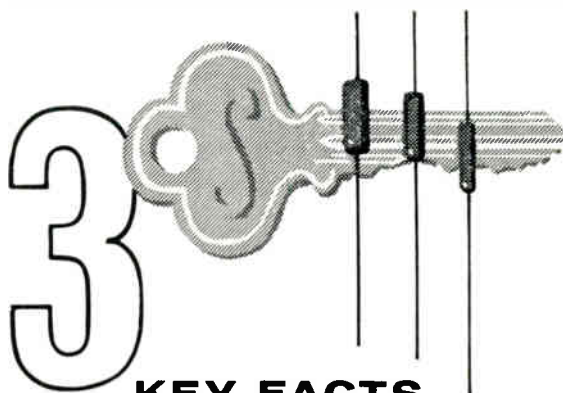


## CHICAGO DYNAMIC INDUSTRIES, Inc.

**C-D-I** PRECISION PRODUCTS DIVISION  
1725 Diversey Blvd., Chicago 14, Illinois  
Phone: WEllington 5-4600

Circle 79 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963



## KEY FACTS TO CONSIDER WHEN YOU SPECIFY POWER RESISTORS

### FACT 1

#### PRODUCT SPECIALIZATION

Only Sage Electronics offers 14 years of highly specialized experience in the design, test and application of sophisticated power resistors.

### FACT 2

#### UNSURPASSED PERFORMANCE

By concentrating exclusively on miniature precision wirewound designs Sage provides the broadest variety of features available from any source.

- 20 axial lead styles; 3 chassis mount styles; 1/2 to 50 watts
- tolerance and stability as close as .05%
- T.C. 20 ppm/°C
- 1000 volt rms body insulation
- low values not available in other resistors (specials to .01<sup>Ω</sup>)
- characteristic G or V wattage rating; to 275°C or 350°C
- power load life stability < .5%/1000 hours
- weldable leads when specified
- non-inductive winding when specified
- exceed MIL-R-26C and MIL-R-18546C as well as MIL-R-93C (appropriately derated)

### FACT 3

#### RELIABILITY

Systems contractors such as those supporting Polaris, Titan, Atlas and Minuteman have found Sage product reliability second to none.



For full technical details request catalog R-62



# SAGE

**SAGE ELECTRONICS CORP.**  
Country Club Road • East Rochester, N. Y.

Circle 80 on Inquiry Card

# NEW TECH DATA

for Engineers.

## Mylar Capacitors

This data sheet covers complete specs. for new thin-film metallized mylar capacitors. They are in hermetically sealed rectangular and round tubulars, wrap-and-fill and epoxy-case styles. Electron Products, 1960 Walker Ave., Monrovia, Calif.

Circle 453 on Inquiry Card

## Miniature Precision Resistors

Two miniature precision resistors, which feature wirewound stability and tolerances up to 0.05%, are available from International Resistance Co., Boone, N. C. Designated AS- $\frac{1}{2}$  and AS-1, they dissipate  $\frac{1}{2}$ w and 1w respectively at ambient temps. of 125°C.

Circle 454 on Inquiry Card

## Miniature Bearings

A 16-page illustrated catalog describes standard RMB miniature bearings. Catalog 51263 covers radial, angular contact, pivot, miniature roller, and special type bearings. Dimensional data and drawings, including size drawings, are given. Landis & Gyr, Inc., 45 W. 45th St., New York 36, N. Y.

Circle 428 on Inquiry Card

## Flangeless Rectifiers

New bulletin, entitled "Double Diffused Avalanche Regulated Silicon Flangeless Rectifiers," covers products with operating characteristics up to 1a., 1,000v. It contains mechanical outlines, plus performance and environmental features. The 1a. flangeless rectifier, available in a general-purpose and in a high-temp. series, has all ratings and characteristics outlined in chart form. Atlantic Semiconductor, Inc., 905 Mattison Ave., Asbury Park, N. J.

Circle 429 on Inquiry Card

## Power Supplies

A 16-page illustrated catalog covers standard power supplies, insulation testers and power packs. Catalog gives data on 51 standard high-voltage power supplies ranging from 1kv. to 1,000kv., 9 highly regulated high-voltage dc power supplies, dc, ac and ac/dc insulation testers. Power packs described range from 2 to 150kv. Kilovolt Corp., 238 High St., Hackensack, N. J.

Circle 430 on Inquiry Card

## Electrical Integrators

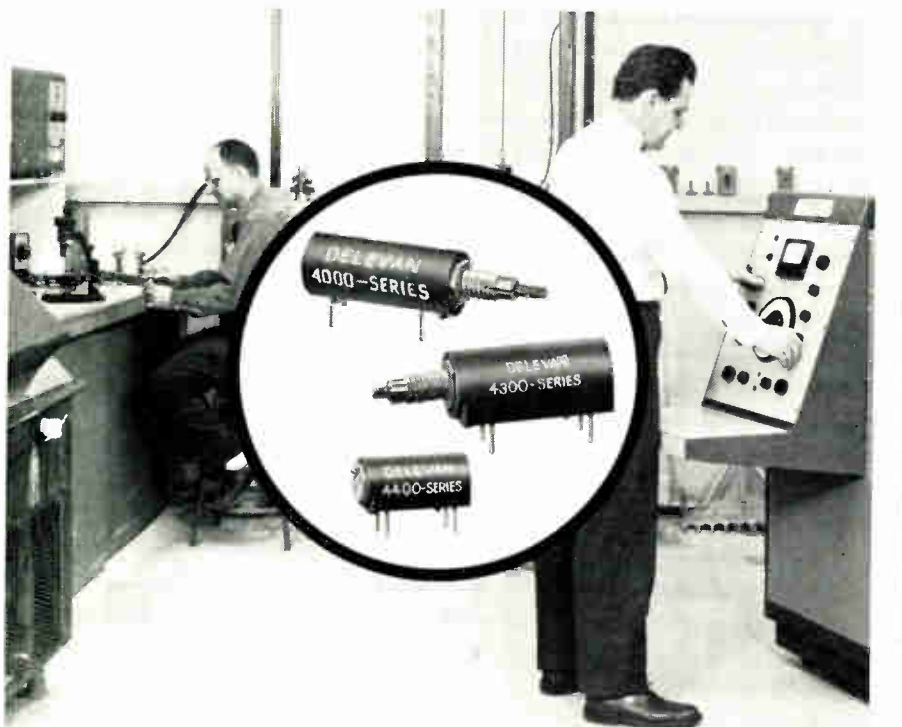
A new 4-page brochure, Technical Data 90A, describes Models 921 and 1201 electrical integrators. Data brochure contains specs., schematics and drawings of basic circuits and uses. Uses shown include strain gauge belt weighing system, gas chromatograph integration, and nuclear dosimeter integrator. Sales Dept., Acromag, Inc., 1530 Telegraph Rd., Detroit 39, Mich.

Circle 431 on Inquiry Card

## RFI/EMI Brochure

This brochure discusses r-f and electromagnetic interference problems in designing and operating electronic and microwave systems. It is divided into the following major sections: Control Programs, Measurements and Corrections, R&D, and RFI/EMI Components. Brochure lists firm's accomplishments and capabilities in the RFI/EMI field. Genitron, Inc., 6320 W. Arizona Circle, Los Angeles, Calif.

Circle 432 on Inquiry Card



## First to Bring You Repeated Dependability in Molded Tunable COILS AND TRANSFORMERS

Final evaluation of every product is its repeated dependability throughout its intended service. Delevan has made an outstanding break-through in producing a production line series of molded tunable coils and transformers that definitely contribute to the advancement of the "State-of-the-Art" in consistent environmental dependability at economical prices. Extensive product testing in Delevan's certified environmental test laboratory assures repeated dependability and conformance to Grade 1 Class B MIL-C-15305. Write for Delevan's Molded Tunable Coil and Transformer "State-of-the-Art" Catalog #S-186. *Delevan Electronics Corporation, 270 Quaker Road, East Aurora, New York.*

Kit 1 — 15 dependable Series 4000 molded tunable coils with powdered iron cores. Value ranges of your choice from 31 standard values.



Kit 2 — All the necessary components to design your own tunable coils and transformers. Coils wound on these forms can be molded at Delevan.



**Delevan Electronics Corporation**   
A SUBSIDIARY OF AMERICAN PRECISION INDUSTRIES INC.



**OVER 6500**

### Grayhill Concentric Shaft Switch

Greatest flexibility available in any rotary tap switch. Actually two switches in one.

- 2 shafts (2 switches)
- 2 to 6 decks—up to 3 decks controlled by each shaft
- 2 to 10 positions per deck
- Shorting or Non-Shorting contacts
- Break 1 amp, 115 VAC resistive, carries 5 amps.
- SPECIALS—Non-standard shafts, contact arrangements, insulated studs, etc., available on special order.

**Combinations  
of Decks  
and Positions**



Current Grayhill Catalog on request "N. Gineer"

**Grayhill**  
INC.

Phone:  
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543 Hillgrove Ave., La Grange, Ill.

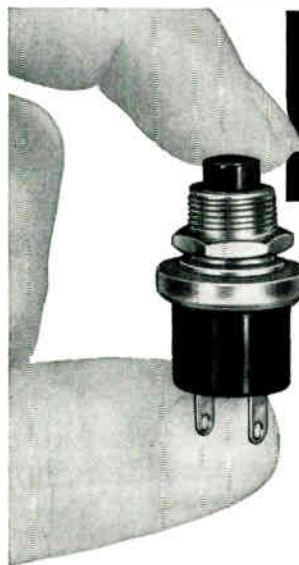


"PIONEERS IN MINIATURIZATION"

Circle 82 on Inquiry Card

### MINIATURE PUSH BUTTON SWITCHES

For Many Applications



Switches Actual Size

Miniature  
Sub-Miniature  
Ultra-Miniature

Long Life—to 1 million operations  
depending on Series

Low Contact Resistance—.004 ohms typical  
Insulation Resistance—over 50,000 megohms typical

Write for complete specifications

**Grayhill**  
INC.

543 Hillgrove Avenue  
La Grange, Illinois  
Phone: Area 312 354-1040

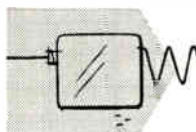
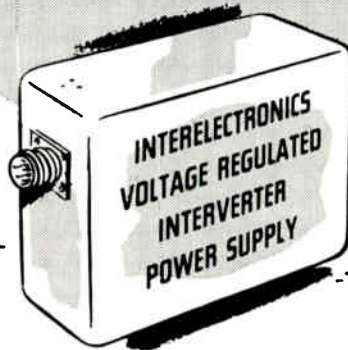
"PIONEERS IN MINIATURIZATION"

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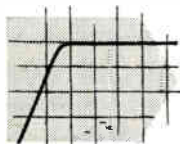
ELECTRONIC INDUSTRIES • June 1963

## PROVEN RELIABILITY—

**SOLID-STATE POWER INVERTERS,**  
over 260,000 logged operational hours—  
voltage-regulated, frequency-controlled,  
for missile, telemeter, ground support,  
135°C all-silicon units available now—



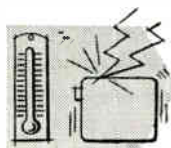
Interelectronics all-silicon thyatron-like gating elements and cubic-grain toroidal magnetic components convert DC to any desired number of AC or DC outputs from 1 to 10,000 watts.



Ultra-reliable in operation (over 260,000 logged hours), no moving parts, unharmed by shorting output or reversing input polarity. High conversion efficiency (to 92%, including voltage regulation by Interelectronics patented reflex high-efficiency magnetic amplifier circuitry.)



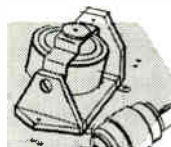
Light weight (to 6 watts/oz.), compact (to 8 watts/cu. in.), low ripple (to 0.01 mv. p-p), excellent voltage regulation (to 0.1%), precise frequency control (to 0.2% with Interelectronics extreme environment magnetostrictive standards or to 0.0001% with fork or piezoelectric standards.)



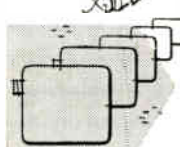
Complies with MIL specs. for shock (100G 11 msec.), acceleration (100G 15 min.), vibration (100G 5 to 5,000 cps.), temperature (to 150 degrees C), RF noise (I-26600).



AC single and polyphase units supply sine waveform output (to 2% harmonics), will deliver up to ten times rated line current into a short circuit or actuate MIL type magnetic circuit breakers or fuses, will start gyros and motors with starting current surges up to ten times normal operating line current.



Now in use in major missiles, powering telemeter transmitters, radar beacons, electronic equipment. Single and polyphase units now power airborne and marine missile gyros, synchros, servos, magnetic amplifiers.



Interelectronics—first and most experienced in the solid-state power supply field produces its own all-silicon solid-state gating elements, all high flux density magnetic components, high temperature ultra-reliable film capacitors and components, has complete facilities and know how—has designed and delivered more working KVA than any other firm!

For complete engineering data, write Inter-electronics today, or call LUDlow 4-6200 in New York.

**INTERELECTRONICS CORP.**  
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ACTUAL SIZE  
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## WHICH CHOPPER WOULD YOU DESIGN INTO YOUR SYSTEM?

*Experienced pilots recognize the versatility of the big chopper pictured above. Upon inspection, seasoned electronic engineers will be quick to recognize the versatility of USEC's new line of Talon DC-AC choppers.*

*They offer extremely low noise level, low driving power and are inherently reliable. Offered in many different packaging configurations, both plug-in and wire-in, the new line of Talon DC-AC choppers are hermetically sealed and provide unequalled flexibility of application. The new line of Talon DC-AC choppers are normally supplied for operation from a DC-450 CPS 6V source. Inquiries for special requirements are welcomed.*

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(A Subsidiary of Talon Inc.)  
300 Mt. Lebanon Blvd., Pittsburgh 34, Pa.  
Telephone (412) 561-3440

Ad #634

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D78

## NEW TECH DATA

### Crystal Filters

A 12-page brochure entitled "What is an H.O. Crystal Filter" describes new class of crystal filters designed by insertion loss, or modern synthesis, methods. Brochure lists differences in characteristics between insertion loss and image parameter filters. List of stock filters is attached. Midland Mfg. Co., 3155 Fiberglass Rd., Kansas City 15, Kans.

Circle 434 on Inquiry Card

### Cost Control

"Value Control Design Guide" will help determine lowest cost to reliably accomplish basic and secondary functions. Information is in 3 sections: Classification of Shapes, Comparison of Manufacturing Processes, and Description of Manufacturing Processes. Value Analysis, Inc., 141 N. Broadway, Schenectady 5, N. Y.

Circle 435 on Inquiry Card

### AC-DC Power Supplies

Illustrated 23-page catalog, in color, describes solid-state dc power supplies, ac inverters and plug-in oscillators. Electrical and mechanical specs. are listed. Available to engineers from Behlman-Invar Electronics Corp., 1723 Cloverfield Blvd., Santa Monica, Calif.

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## BREW DELAY LINES

Advanced design, engineering and manufacturing facilities make R.D. Brew and Company, Inc. your best source of supply for:

LUMPED CONSTANT,  
DISTRIBUTED CONSTANT,  
AND ULTRASONIC DELAY LINES

Also: High Voltage Pulse Cable Connector Assemblies

- Pioneers and specialists in the design and development of delay lines and related equipment since 1946.
- Brew delay lines meet all pertinent military specifications and can satisfy any commercial design requirement.
- Highly skilled engineers and the best available electronic test and measuring equipment guarantee reliability, precision.
- Complete environmental test facilities available.
- Nationwide engineering service.

**BREW** ELECTRONIC DIVISION  
RICHARD D. BREW AND COMPANY, INCORPORATED CONCORD, NEW HAMPSHIRE

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World Radio History



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CELCO Solid State Amplifiers, Deflection Yokes and Focus Coils make a complete Package for your Display applications.

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ELECTRONIC INDUSTRIES • June 1963

VACUUM PRODUCTS, INC.

**SPECIALISTS IN THE  
DESIGN & MANUFACTURE  
OF HIGH QUALITY  
THERMOELEMENTS**

**ALL TYPES  
AVAILABLE  
AT THE LOWEST  
POSSIBLE PRICES**



- VACUUM THERMOCOUPLES with contact or insulated heater wires.
- HEAVY CURRENT "AIR" THERMOCOUPLES.
- SPECIAL THERMOCOUPLES for applications involving VHF, UNF, high millivolt output, slow or fast response time, matched pairs and square law output.

Inquiries invited from users with quality requirements. Discounts given on yearly volume. VACUUM THERMOCOUPLES furnished as replacements for overloaded elements in all portable and panel electrical indicating instruments. Available with calibration charts traceable to NBS.



**VACUUM PRODUCTS, INC.**  
19 Beechwood Ave., Mt. Vernon, N. Y.  
Phone 914 OWens 9-9717

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**NEW TECH DATA**

**Power Modules**

An illustrated, 34-page catalog describing four lines of regulated ac-dc solid-state power modules is available from Technipower, Inc., a Benrus subsidiary, 18 Marshall St., S. Norwalk, Conn. Modules are designed primarily as system components, but can also be supplied in rack mounts for general purpose use in laboratories and production tests.

Circle 418 on Inquiry Card

**Capacitor Bulletin**

Data on electrical and mechanical design of energy discharge capacitors is included in Bulletin 2610. Graphs, tables, and definitions are used to clarify capacitor parameters. Catalog listings are given. Sangamo Electric Co., Springfield, Ill.

Circle 419 on Inquiry Card

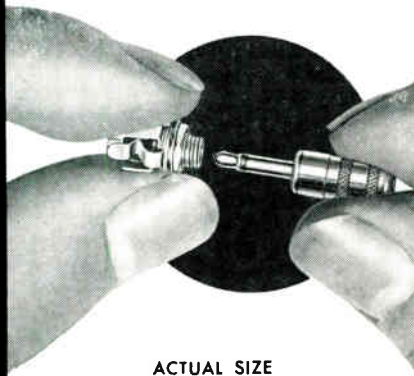
**Crystal Catalog**

Covered in this catalog are over 11,000 standard crystals, 360 oscillators, 46 freq. standards and 56 filters. For standard crystal units, the purchaser need specify only code number and nominal freq.; for military types, only Mil type number and nominal freq. The standardized crystals range in center freq. from 400cps to 1Mc. Hill Electronics, Inc., Mechanicsburg, Pa.

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**A Major Technological Advancement in Miniaturization**

**SWITCHCRAFT  
"MICRO-PLUG"  
AND  
"MICRO-JAX"**



ACTUAL SIZE

- "MICRO-PLUG" Series 850
- Only 1-1/64" long; 1/4" O.D.
- Sleeve circuit cable clamp.
- Nylon insulation between tip and sleeve circuit.

- "MICRO-JAX" TR-2A
- Two-conductor single closed circuit design. Available as a two-conductor open circuit type.
- Internally keyed nylon insulation—mechanically interlocks springs and solder lugs—eliminates shorts.

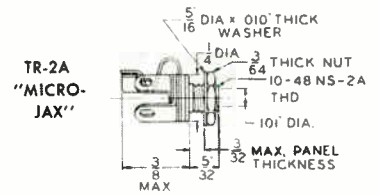
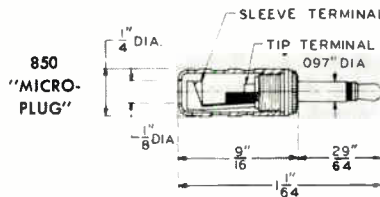
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**NARROW - CAPS**  
Subminiature CERAMIC  
CAPACITORS

For 1/10" modular spacing. Intermediate values obtainable. W.E.P.A. Spec. nickel leads available for welding.

**35 STOCK VALUES**

| Part No. | Capac. mmf. | Tol. | W.V. D.C. | Max. Body Lgth. |
|----------|-------------|------|-----------|-----------------|
| NC-5     | 5           | ±15% | 50        | 1/4"            |
| NC-7.5   | 7.5         | ±15% | 50        | 1/4"            |
| NC-10    | 10          | ±15% | 50        | 1/4"            |
| NC-15    | 15          | ±15% | 50        | 1/4"            |
| NC-22    | 22          | ±15% | 50        | 1/4"            |
| NC-33    | 33          | ±15% | 50        | 1/4"            |
| NC-47    | 47          | ±15% | 50        | 1/4"            |
| NC-68    | 68          | ±15% | 50        | 1/4"            |
| NC-82    | 82          | ±15% | 50        | 1/4"            |
| NC-100   | 100         | ±20% | 50        | 1/4"            |
| NC-150   | 150         | ±20% | 50        | 1/4"            |
| NC-220   | 220         | ±20% | 50        | 1/4"            |
| NC-250   | 250         | ±20% | 50        | 1/4"            |
| NC-330   | 330         | ±20% | 50        | 1/4"            |
| NC-470   | 470         | ±20% | 50        | 1/4"            |
| NC-500   | 500         | ±20% | 50        | 1/4"            |
| NC-680   | 680         | ±20% | 50        | 1/4"            |
| NC-750   | 750         | ±20% | 50        | 1/4"            |
| NC-1000  | 1000        | ±20% | 50        | 5/16"           |
| NC-1500  | 1500        | ±25% | 25        | 5/16"           |
| NC-1500B | 1500        | ±20% | 25        | 5/16"           |
| NC-2000  | 2000        | ±25% | 25        | 5/16"           |
| NC-2000B | 2000        | ±20% | 25        | 5/16"           |
| NC-3000  | 3000        | ±30% | 25        | 5/16"           |
| NC-3000B | 3000        | ±20% | 25        | 5/16"           |
| NC-3000C | 3000        | ±25% | 25        | 5/16"           |
| NC-4000  | 4000        | ±30% | 25        | 5/16"           |
| NC-4000B | 4000        | ±20% | 25        | 5/16"           |
| NC-4000C | 4000        | ±25% | 25        | 5/16"           |
| NC-5000B | 5000        | ±20% | 25        | 5/16"           |
| NC-6500  | 6500        | ±20% | 25        | 5/16"           |
| NC-6500B | 6500        | ±20% | 25        | 5/16"           |
| NC-7500B | 7500        | ±20% | 25        | 5/16"           |
| NC-01    | 10000       | ±30% | 10        | 5/16"           |
| NC-01B   | 10000       | ±20% | 25        | 5/16"           |

**SLIM - CAPS**

.060" wide max. x .060" thick max. Working voltage 25 VDC. W.E.P.A. Spec. nickel leads available for welding.

**23 STOCK VALUES**

| Part No. | Capac. mmf. | Tol. | Max. Body Length |
|----------|-------------|------|------------------|
| SC-1     | 1.0         | ±25% | .100"            |
| SC-2.5   | 2.5         | ±25% | .100"            |
| SC-5     | 5.0         | ±25% | .100"            |
| SC-7.5   | 7.5         | ±25% | .100"            |
| SC-10    | 10          | ±25% | .100"            |
| SC-15    | 15          | ±25% | .100"            |
| SC-22    | 22          | ±25% | .100"            |
| SC-33    | 33          | ±25% | .100"            |
| SC-47    | 47          | ±25% | .100"            |
| SC-68    | 68          | ±25% | .100"            |
| SC-82    | 82          | ±25% | .100"            |
| SC-100   | 100         | ±25% | .100"            |
| SC-150   | 150         | ±25% | .100"            |
| SC-220   | 220         | ±25% | .200"            |
| SC-330   | 330         | ±25% | .200"            |
| SC-470   | 470         | ±25% | .200"            |
| SC-680   | 680         | ±25% | .200"            |
| SC-820   | 820         | ±25% | .200"            |
| SC-1000  | 1000        | ±25% | .200"            |
| SC-1500  | 1500        | ±25% | .200"            |
| SC-2500  | 2500        | ±25% | .250"            |
| SC-3300  | 3300        | ±25% | .250"            |
| SC-4000  | 4000        | ±25% | .250"            |

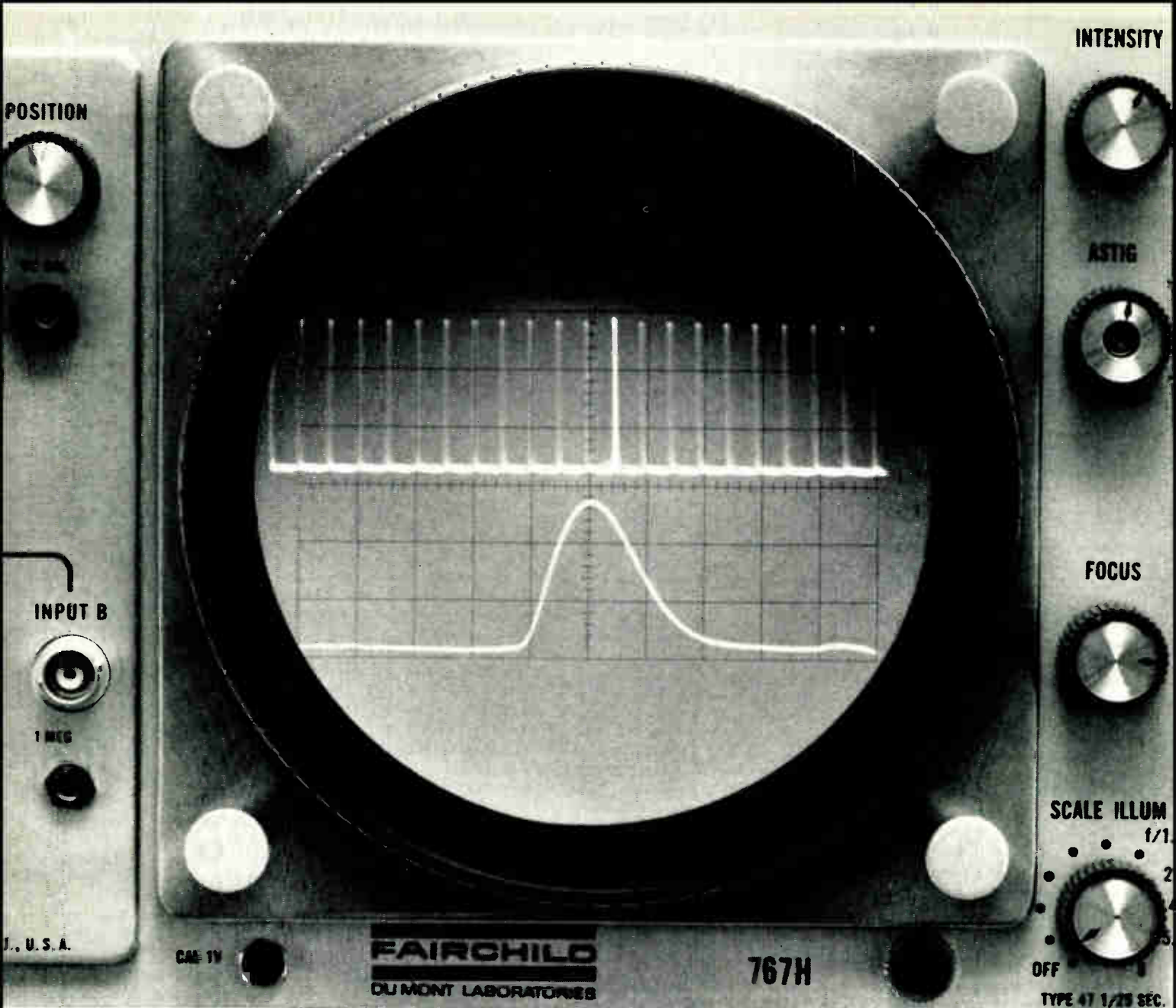
**MUCON CORPORATION**

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## What's the delay here?

The delay here is what happened to a 10-nano-second radar pulse on its way through a Fairchild Type 767H Oscilloscope. The trace is a multiple exposure of a strobed delaying sweep and the magnified delayed sweep. Its clear, "locked in" display was made with the Delaying Sweep Plug-In unit of this new Fairchild solid state scope.



The 50 mc Plug-In used to make this trace has a rise time of 7.5 nsec, sensitivity of 50 mv/cm. Other available plug-ins provide many other capabilities — enough to replace half a dozen or more special purpose scopes.

Investigate the new Fairchild line before you invest in another scope. Write for our Instruments Catalog. Better yet, call in a field sales engineer (offices in

39 principal cities) for a demonstration. Fairchild Scientific Instruments, 750 Bloomfield Avenue, Clifton, N. J.

# FAIRCHILD

## DU MONT LABORATORIES

DIVISIONS OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION  
750 BLOOMFIELD AVENUE CLIFTON, NEW JERSEY

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# SECTION **E**

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## **MEASUREMENT & TEST**

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- Where Ultrasonic Transducers Are Today E2  
Testing Without Direct Electrical Connections E6  
Electronic Measurement Standards E11  
New Designs in Panel Meters E18

Amplitudes of several thousandths of an inch are being achieved, with accelerations up to 100,000 g.

Among the newer developments are transducers using a depletion layer in a piezoelectric semiconductor as a resonant element.

The thickness of these layers is well below one micron and new types of transducers may well become possible.

AS EARLY AS 1847 JOULE OBSERVED that certain ferromagnetic materials changed their dimensions in a magnetic field. In 1880 the Curie brothers discovered that some crystals like quartz, tourmaline, etc., would produce an electrical charge, when squeezed. These effects, termed magnetostriction and piezoelectricity, as well as their inversions, piezomagnetism and electrostriction remained laboratory curiosities until the first World War, when it was realized that sound projectors and hydrophones could be made, using these principles. Thus a military application, submarine detection, caused the ultrasonic transducer to be born.

Sonics (a word coined by Hueter and Bolt as the title of a well-known textbook) comprises the generation and detection of vibration or elastic waves, their properties of propagation and their interaction with solid or fluid matter. Today uses of elastic waves range from subcycle frequencies (infrasonics) used in geological seismic prospecting through the audible range (acoustics) up to, say 15 kc. From

# WHERE ULTRASONIC TRANSDUCERS ARE TODAY

there on up, ultrasonics has pushed the frequency limit into the gc range with many applications.

In 1957 a German handbook<sup>1</sup> listed over 7,000 references on ultrasonics, with applications ranging from nondestructive testing to submarine detection systems, from TV-image projectors to liquid level sensors, from medical therapy to ultrasonic cleaners. Whether a device modulates a light beam or prevents deposit formation in steam boilers, it always contains one component—the ultrasonic transducer, the device converting electrical r-f power into vibratory mechanical energy or vice versa.

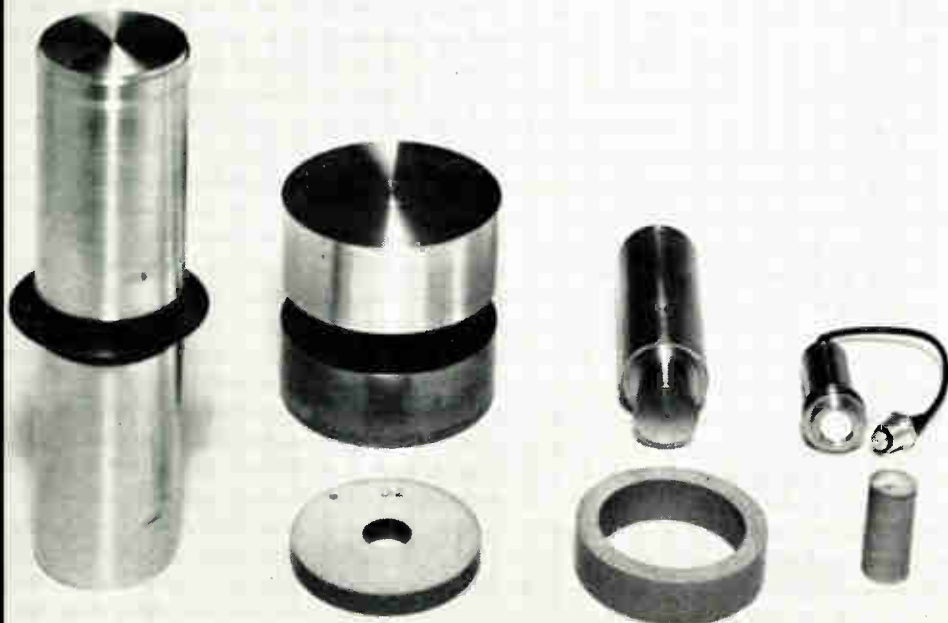
## Transducer Materials Today

An ideal transducer material should combine the following properties:

1. High piezoelectric or piezomagnetic constant
2. High electromechanical coupling factor
3. High electrical quality factor
4. High mechanical quality factor
5. Maximum time and environmental stability of properties
6. High tensile and compressive strength
7. Optimal economies and fabricability

Practical materials usually fall

Fig. 1: Several types of transducers are shown along with special items that are used in conjunction with some transducers for vibration pick-up or sonar.



## Dr. ERHARD SITTIG

Senior Physicist  
Durasonics  
Div. of Dura-Bond Bearing Co.  
P.O. Box 11085  
Palo Alto, Calif.

short in one or more of these listings and must be selected by the application.

Tables 1 and 2 list some data of materials representative of our general classes.<sup>2</sup>

### Piezoelectric Single Crystals

Several hundred substances with usable properties are known, but only a few are of importance. They are available as natural or artificially grown crystals from which plates of suitable orientation have to be cut or ground. Available shapes are, therefore, limited. Crystals combine high  $Q$  and high time stability with a low to moderate coupling factor and low permittivity. Their use as vibrators is only warranted at high frequencies where other materials are too lossy, and where they do not have to be driven with high voltages.

Quartz has low losses and a high maximum usable operating temperature. This makes it the choice for high stability resonators, vibrators at high frequencies (several thousand megacycles have been reached) or high environmental temperatures. At lower frequencies ( $< 1$  mc) and for high power vibrators, ferroelectric ceramics are much cheaper.

### Ferroelectric Electrostrictive Ceramics

Arbitrary shapes may be made from these materials by standard ceramic methods. They are rendered piezoelectric by a polarizing heat treatment in an electrical field. The remanent polarization can be lost by electrical overloading or overheating. Mechanical and dielectric losses are high to moderate and amplitude dependent, but coupling factor and permittivity are very high. Transducers made from these materials may be driven by low voltages. As receivers, they produce voltages from a low source impedance.

Until recently barium titanate compositions were the most used. Now they are being superseded by newer compositions based on lead zirconate. These offer higher usable operating temperatures and, therefore, better power handling. Their coupling factors are indeed high enough to contemplate their applications as static energy converters, e.g., in automotive ignition systems, photographic flash bulb triggers, etc.

### Magnetostrictive Metals

This group comprises nickel and alloys containing nickel, iron, and aluminum. Being conductors, they have to be used as thin walled tubes, strips, laminated stacks or scrolls, to avoid excessive eddy current losses, particularly at higher frequencies. Due to internal friction such structures exhibit high losses,

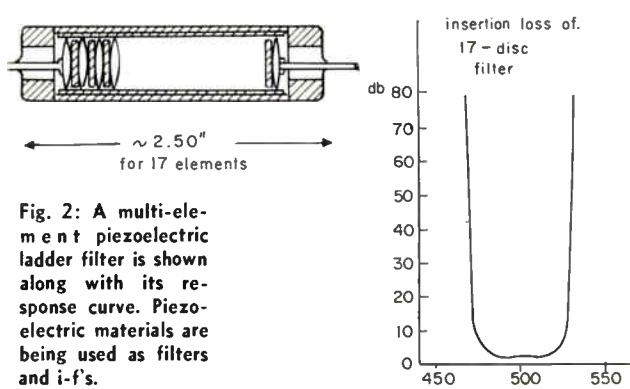


Fig. 2: A multi-element piezoelectric ladder filter is shown along with its response curve. Piezoelectric materials are being used as filters and i-f's.

although the basic metal has a mechanical  $Q$  of about 10,000. Because of low coercivity, power vibrators must be polarized by dc-current or permanent magnets to obtain a linear relation between driving field and deformation.

Their inherent ruggedness makes them well suited for high power applications in spite of their low efficiency. Eddy current and hysteresis losses restrict their application to frequencies below 50 kc.

These are nonconducting ceramics and need not be laminated. They combine a moderate coupling factor with a high  $Q$  and high usable temperature. Therefore, they can share in most applications with the ferroelectric ceramics, particularly where their higher temperature limit makes up for their somewhat higher price and the necessity for coil windings rather than simple plate electrodes.

### Applications of Ultrasonic Transducers

Ultrasonic transducers find their main use in the areas listed below.

*Electrical circuit components:* A transducer exhibits certain filter characteristics. Unloaded, it constitutes a 2-terminal network having an impedance minimum and maximum near its mechanical resonance frequency. It may also be used as an "adaptor" to connect mechanical structures to electrical circuits. These may have resonating properties. A much higher  $Q$  is available from mechanical resonators than from equivalent electrical networks consisting of capacitors and inductors. At frequencies below several mc spectacular space and weight savings may be had from, say, electromechanical i-f filters or multi-element ladder filters.

This also is true for sonic delay lines. These use the fact that the sound velocity is much smaller than the light velocity. By means of suitable transducers an electrical signal is converted into a sonic one, and reconverted into an electrical one after having traveled through a liquid or solid delay medium. Since such media typically produce delays of 0.2 to 3 microsec. per millimeter path length, fixed or con-



# TESTING WITHOUT DIRECT ELECTRICAL CONNECTIONS

Due to the number of connections which must be made, testing complex systems is both costly and time consuming. This situation can be rectified by using the methods described in this article. Sensors are used which respond to external fields — found in electronic components which have been energized. Optical fibers are used to transmit the data.

IN ELECTRONIC SYSTEMS which contain thousands of components failure should be expected which will impair system operation. Much has been said and done to reduce the number of failures. Even so, failures still exist, creating a severe problem. The larger the number of active components, the more severe the problem. Often the time consumed for testing greatly reduces the time left for useful operation. In a complex system this testing sometimes becomes a full time effort. Thus, the elusive goal of 100% reliability often is replaced by the nonelusive goal of 100% testing. To reduce the chance of this happening, test and repair time must be kept at a minimum.

## Automatic Test Equipment

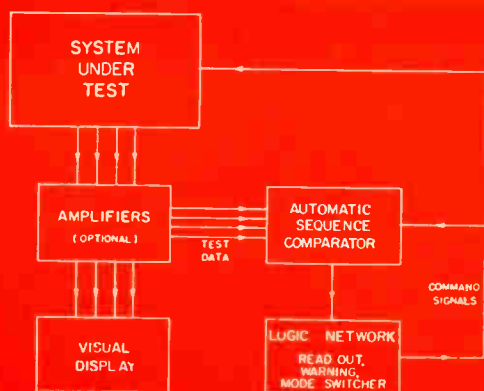
Automatic testing methods have been introduced in recent years. First there was the stepping-switch programmed, internally-wired, programmer-comparator. This method decreased test time but was inflexible with regard to changes in the system subject to test. To avoid this, and to make more flexible

the programming of test stimuli and the measurement of response, the punched-tape sequentially programmed device was introduced to replace the pre-wired stepping switch. This method of tape programming has improved the situation in certain cases but these devices are large and complex; and programming is difficult and costly. Now being introduced is the computer type of device using magnetic and delay line storage, rapid access and simultaneous test. This type of device increases the complexity of both the test equipment and the programming. The extent to which these methods have been used for maintenance purposes is evident from the literature.

These methods are useful in many applications, but they don't provide the simplicity of test that is desired in operational systems. The programmer-comparator, for example, needs stimuli generators and "adapter carts" before it can be connected to the equipment under test. This assembly of test equipment is complicated since a sequentially operated digital machine process is used to control and measure analog electrical quantities. Often, automation is relied upon to supply test data even though the underlying basic manual measurement methods are unknown. Also, few systems provide, in suitable form and number, the test points which are desired for this test arrangement. Thus, the areas have been limited in which this type of test equipment has proved successful.

Where the above types of test equipment have not proved effective is in the test of operational systems.

Fig. 1: Continuous monitoring of the system under test provides a visual display for detection of intermittent faults and for failure prediction based upon gradual component degradation.



By **DAVID M. GOODMAN**

Director of Project SETE  
Research Div., College of Engineering  
New York University  
New York, N.Y.

In these systems time needed to connect external stimuli and measurement devices often discourages the user. Equally important, test logic that is needed to trouble-shoot from the outside of a system is hard to work out and set forth. Programming needed to carry out a suitable test sequence is a major consideration. In effect, it is necessary to trouble-shoot the entire system in advance. This is done without benefit of the practical experience normally obtained on a given system. Then, to carry out the requisite tests much external equipment is needed which is complicated and costly. Finally, the logic, programming and external equipment must be reviewed whenever a change is made in the system under test. Net result is that usefulness of this method is doubted. It should have been anticipated that the external stimuli generation and the control and measurement sequence are not needed whenever these means are already contained in the equipment under test. By

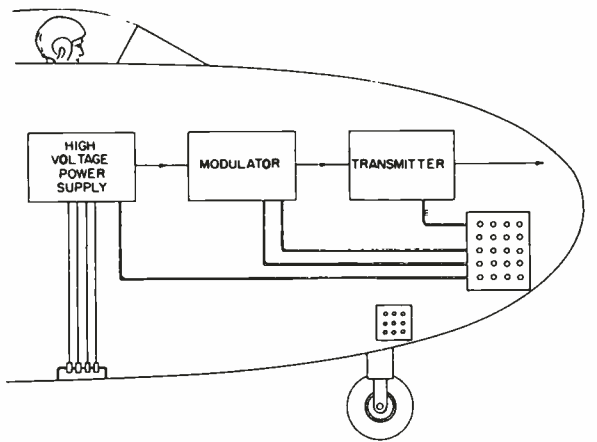


Fig. 2: Representation of three optical test point matrices which provide test data at the outer surfaces of an aircraft.

using these self-contained means for test purposes as well as for their main purpose, large savings can be achieved. Much confusion has arisen, nevertheless, at this time from all-too-frequent use of the external programmer-comparator for testing of operational systems.

### Continuous Monitoring

The disadvantages and uncertainties that exist in the above procedures can be overcome. This can be done by providing many sensors that use long-life, lightweight, and reliable probes made of magnetic materials, semi-conductors and phosphors, and which are used to continuously monitor the components in a system. Simple and reliable means are thus provided which respond to an action of an operative component so that an electrical signal, or preferably electromagnetic radiation, is generated which shows

the state of energization of the component. When the electromagnetic radiation is transmitted to provide a test signal, the method of transmission for reasonable distances is via thin, rugged, flexible optical fibers.

Since the sensors respond to external fields, it is not necessary to make circuit connections in the prime equipment, and retrofit of existing systems becomes practical. This method can also be applied to sub-miniature and microminiature building block assemblies, and to thin film and solid-state assemblies. To trouble-shoot these assemblies a single test set suffices. It is made of an optical probe, a detector, an amplifier, and an oscilloscope connected in tandem. Finally, by combining the foregoing features, large and complex systems can be tested so that the users will have a current and continuously updated display describing the complete status of the system.

To achieve these ends, use is made of the electric or magnetic field that electronic components have when energized. Often this field is intense and external of the component which makes it easy to measure. The field may be static, it may be alternating, or it may comprise electromagnetic radiation. These fields may be detected in many ways. For example, phosphors have the ability to emit light when they are excited by particle or by electromagnetic radiation. Electroluminescent materials and other semiconductors also have the ability to detect the presence of electric and magnetic fields. By placing sensors made of materials of this type at strategic positions, it is possible to trouble-shoot a complex system almost instantaneously. As noted this can be done without making direct electrical connections into the system. Optical fibers are then used to transmit "light" signals representative of the level of energization of the major units in a system under test to where these signals are examined. Checking of the "light" signals is done rapidly and need only locate failure to a replaceable unit or assembly. When desirable, however, the logic of test may be made to pin-point the component or subassembly which has failed. Continuous measurement of the external fields associated with the components within a system, and data transmission by rugged optical fibers, contains elements of simplicity and reliability which have been lacking in prior test arrangements.

### The Display and Computer

A hypothetical system under test, in Fig. 1, has many output signal test leads. Test signals contained on these leads are derived from various points within the system. They contain information that shows

## TESTING (Continued)

the level of energization of many components within the system. Amplifiers are used only when necessary in order to amplify the test signals. Although these signals may be electrical in nature, preferably they consist of electromagnetic radiation in the range from infrared (IR) to ultra-violet (UV) making it possible for them to be transmitted by optical fibers. Signals are split into two parts, with a first set going to a visual display device and a second set going to an automatic sequence-comparator. The visual display is for the benefit of an operator; the sequence-comparator is used for unattended or automatic operation, and for convenient transmission of the test data.

Output test signals which carry visible radiation are arranged in matrix form to provide the display. The visible signals are presented to the operator in a symmetrical pattern so that any change from normality may be noticed rapidly. When the leads carry electrical signals they may be converted to light for display purposes. Signals from the system are also fed into sequence-comparator so that rapid automatic comparison can be made. Signals into the comparator may be normalized so that a single reference may suffice for comparison purposes. Alternatively, a

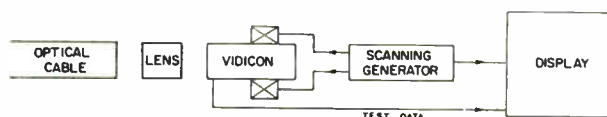


Fig. 3: Closed-circuit television chain for transmission and display of the test data which is provided by the optical cable.

number of different reference signals may be provided. Comparison of the input signals to the reference signal may be sequential, or parallel, or a combination thereof depending upon the system and purpose of test. Departures from normal system operation are detected and suitable corrective action is programmed. For example, when drastic failure is detected the system may revert to an alternate mode of operation. Under these circumstances the command signals to the system also instruct the sequence-comparator to make changes in the test sequence. Desirability of using an alternate mode of operation in this manner depends on system design and the operational needs placed on it. This alternate mode may or may not constitute a degraded mode of operation. Careful consideration of the intended method of operation of the system will dictate the choices available to the equipment designer. Logic networks

which are used can be thought of as the computer section of this test system.

### Sensors and Transmitters

Some of the test signals are provided by phosphor sensors. These phosphors are long lived and need no electrical connection for their operation. They are merely coated on the optical fibers. This coating provides light energy when excited by UV light or X-rays or by particle radiation. By means of internal reflections the light rays are transmitted for a long distance along the fiber.

Optical fibers may be routed and cabled in a manner akin to electrical wiring. At the termination, junction box, or test point the optical signal may be observed by a technician. Also, since these fibers can be made thin, can be flat or ribbon-like, and since they are chemically inert in most cases, they can be interspersed with assemblies having a high packing density. The analogy with electrical wiring continues since a series of optical test points can be provided in a module much like an electrical connector. Possibilities in this regard are endless.

### A Radar Transmitter

In Fig. 2 a typical chain of high-power electronic assemblies is outlined by a power supply, a modulator, and a transmitter such as may be used in an airborne radar set. Each of these packages is sensed by a different phosphor which may be inside or outside the package. During normal operation a certain level of radiation, often in the form of X-rays, will impinge upon each of the phosphors. This radiation will be converted to light by the phosphor. This light will be transmitted through the optical light pipes or fibers and the brightness will be proportional to the radiation intensity. In an aircraft environment the attenuation in the optical fiber will be kept low due to the short cable runs.

Consider the situation where the transmitter contains a klystron amplifier designed to operate at 60kv. with a power output of 1Mw, a pulse width of 0.1μsec., and a duty cycle of 0.001. One sensor monitors average X-ray activity while a second monitors peak X-ray activity. For the first sensor, a phosphor is chosen with a decay time which exceeds 1 msec. so that the X-ray averaging process takes place in the phosphor. For the second sensor, a phosphor is chosen with a decay time which is much less than 0.1 sec. so that the shape of the output pulse may be examined. Many phosphors or scintillators are available which can be used. They are listed and described in standard texts. More recently introduced are the plastic scintillators which offer high conversion effi-



ciency, have a large dynamic range, and are unlimited in size and physical shape. They have decay times as short as  $5 \times 10^{-9}$  sec., are rugged, easily machined, and have a long shelf life. Also, the optical fiber itself may comprise the scintillator.

Exact location of these phosphor sensors is not critical since they are small in size, need no electrical connections; and are easily shielded from undesirable radiation. Spatial or directive filtering may be obtained by physical placement, and by surrounding the sensor with simple collimating devices. Wavelength or frequency filtering may be obtained by coating the phosphors to enhance the transmission of particular radiations and to attenuate others. Since the sensors are small and the light pipes flexible, a large number of detectors can be used simultaneously making it possible to monitor each major component within a high voltage assembly. The various test signals can be routed so that each fiber of the cable thus formed carries a signal representative of the level of energization of a different component. These fibers are brought out to a panel in the form of an optical termination where the operator may make observations or measurements. The panel may conform to or be contiguous with the flush surface of the aircraft.

Many such panels may be provided, each supplying test data from a different section of electronics within the aircraft. These panels are best located on the aircraft surface so that tests on each panel can be made simultaneously and independently, a most important consideration. Further, since space often is at a premium it is possible to arrange these panels so that the test signals may be transmitted to a remote location. This may be done for short distances via optical cables, or for greater distances by using optical transmission of the data to a receiving device such as an image-orthicon or a vidicon or to a coherent light receiver. Thus, it is possible to speed up the test procedures by having a number of optical test panels, and the testing may be done at a remote location without undue concern for electrical interference and without being subject to electronic countermeasures.

### Use of TV Techniques

One method of transmitting and displaying the optical test data is shown in Fig. 3. The optical cable has outside dimensions of 1 x 1 in. Individual fibers

contained therein have a diameter of 0.033 in. so that an array, or matrix, is formed made of  $30 \times 30$  optical fibers, or 900 test leads. The optical cable is coupled to a vidicon via a conventional lens, a flat Fresnel lens, or a short optical fiber section. Also, the cable can be placed directly against the vidicon face. The 900 signals are stored on the target within the vidicon on a target which is about  $1^2$  in. Stored signals are released when the electron beam of the vidicon scans the target. A scanning generator, a deflection assembly, and a display device complete a closed circuit TV chain. The display is arranged to reproduce the  $30 \times 30$  matrix of test points. For a normal system the 900 points cast a uniform pattern. For an abnormal system with a single fault,

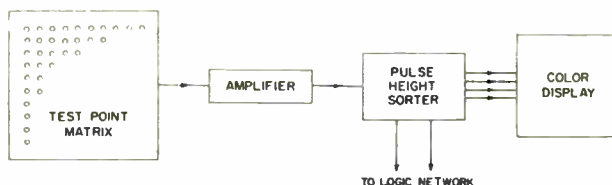


Fig. 4: The pulse height sorter receives the data derived from scanning the test point matrix and also furnishes signals both for the visual color display and for the logic networks.

one point on the matrix will differ from the rest. This point will show on the display. Thus, a maintenance tool is introduced which uses methods of the TV industry. The test data, as well as the analysis thereof, can be collected and displayed at a rapid rate. The data can be viewed directly, transmitted to remote locations, stored and photographed.

To illustrate this point with another example, the target screen of the vidicon in Fig. 4 is illuminated by an optical cable with a  $10 \times 10$  matrix. Using TV scanning practice of 525 lines and  $62.5 \mu\text{sec./line}$ , it takes only 0.033 sec to trace out a complete raster. This means that the 100 points of test data are re-scanned 30 times/sec. Pulses thus derived are amplified and are sorted so that signals of normal amplitude are displayed in white on a CRT. Signals above a certain tolerance are displayed in red. Signals below this are displayed in green. This color coding assists the observer in interpreting the display. Intermittent faults, for example, which ordinarily are most difficult to recognize and analyze will show up as a red and green flicker in a normally white test point.

No doubt the reader can imagine many variations of the foregoing test setup. Two such variations merit consideration. First: instead of, or in addition to, relaying the data to a remote location these data can be displayed on a CRT already contained in the system under test. A weather radar, for example,

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## TESTING (Continued)

can be time shared to present both cloud formation and the test matrix. Second: storage features of the vidicon, or of the display tube, can be used effectively for the test of systems which are energized only for a short period of time. In these cases, the data is obtained during the brief interval of system energization. The data is stored and the analysis continues after the system is de-energized.

### Status Display

Another form of a central display arrangement is shown in Fig. 5. Here a test or status display is provided by optical fibers to yield an output for viewing. The display is arranged to match colors, intensities, flicker rates, etc., as is best decided by a study of the entire system from a human-engineering viewpoint. In this case, however, a test may be made of individual wave shapes. An oscilloscope is provided for this purpose. For each sensing position, a detector is used with response time and decay characteristics suitably matched to the purpose of measurement. For example, high-speed phosphors may be used to transmit video pulses in the microsecond range. They are suitable also for transmitting other signals provided the frequency of the signals is not excessive. Phosphors with a slower decay may be

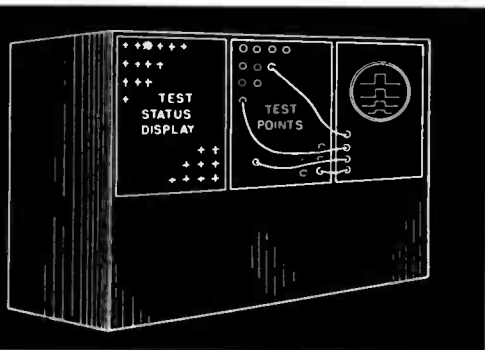


Fig. 5: Central monitoring and status display. An oscilloscope is provided for analyzing a plurality of individual waveshapes.

used to average sinusoids, or pulses, and, therefore, may respond to the envelope thereof. Following considerations of this nature, the test point panel is set up so that the wave shapes of signals may be selected for viewing on the scope. The test point section may be composed of both electrical and optical test points. Waveshape measurements of signals at the electrical test points are made conventionally. The description of Fig. 6 will describe the use of the optical test points for waveshape measurements. It should be appreciated, however, that even without making waveshape measurements, the central monitoring position provides a complete and continuously updated display which gives the operator a rapid view of the status

of the entire system. He can determine readiness of the system at a glance.

### General Purpose Test Set

In Fig. 6, the optical cable provides a matrix of test points. The sealed unit also provides a matrix of

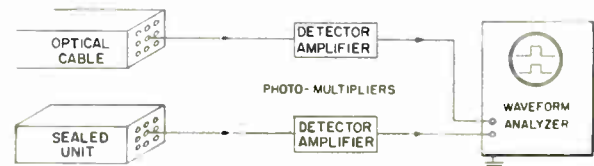


Fig. 6: Flexible optical probes are used to pick up individual test signals in a matrix. These signals are detected and amplified in the photomultipliers for presentation on an oscilloscope.

optical test points. Signals are present at these points which reveal the different levels of component energization. The sealed unit may represent an assembly which is hermetically or vacuum sealed, or it may represent a micromodule or other subminiature circuit. The flexibility, chemical stability, and thinness of the optical fibers allow them to be packaged in many ways. In any event the optical signals represent instantaneous energy levels in some cases. In other instances the optical signals represent time averaged values of energization. To examine the waveshapes of these signals two optical probes are provided. These probes, akin to electrical test prods, are flexible shielded optical fibers and have an exposed optical contact area which is to be positioned against the various test points. The data thus picked up are transmitted along the fiber to detector-amplifiers which provide an electrical output corresponding to the optical signals. These electrical signals are portrayed on the scope. Advantages of this arrangement are numerous. The atmosphere, or lack of it, surrounding the sealed unit will not interfere with the measurements. The optical signals are easier to handle than their electrical counterpart from the point of view of voltage breakdown, electrical interference and countermeasure, and are safer to handle in a hazardous environment. More important though, this arrangement of basic elements provides a versatile wide-band test combination. The optical fibers have an almost unlimited bandwidth. The plastic phosphors are very fast. The detector-amplifier, shown as a photomultiplier, has a wide bandwidth. Suitable scopes are readily available and for the few occasions where these might be inadequate a sampling attachment may be used. Thus, without loading any of the circuits, measurements from dc to 50 mc can be made with a single instrument, and hundreds of optical test points which may be provided in a complex system may be diagnosed.

*(continued on bottom of page E14)*

Fundamental to all technological progress is the ability to make precise, accurate measurements. This in turn depends on the availability of accurate stable standards. Here is a quick discourse on the current state of electronic measurement standards.

# ELECTRONIC MEASUREMENT STANDARDS

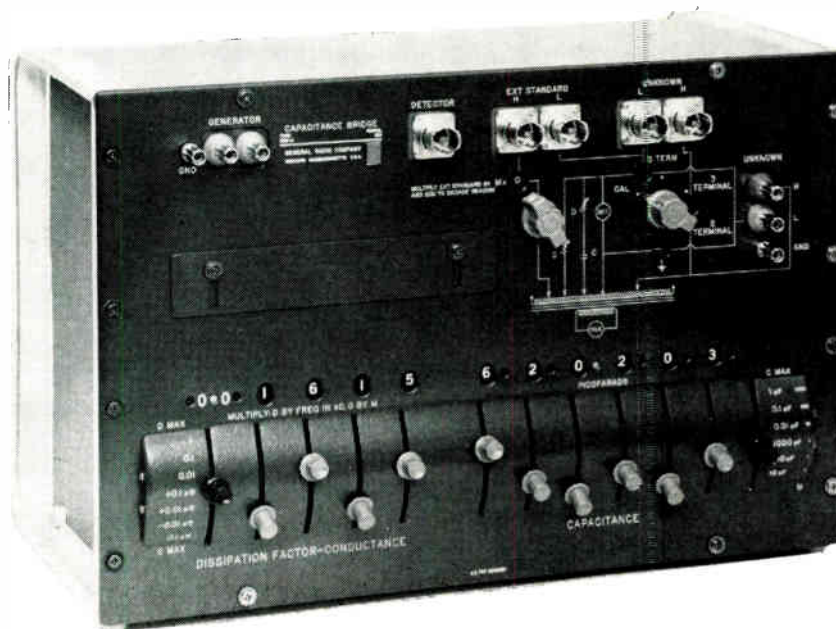
OF ALL BASIC PARAMETERS used in science and engineering, frequency continues to be the one that can be measured to the greatest precision and accuracy (see Fig. 1). So fast, in fact, have improvements been made in stability of frequency standards, that the very definition of frequency needs modification. Frequency was originally defined by international agreement as the reciprocal of time, which in turn was based on astronomical observations. But today, modern molecular oscillators are better timekeepers than the astronomical movements. International intercomparisons of frequency and time have in fact been carried out since 1959 in terms of an atomic time scale based on an atomic cesium resonance. Although the fundamental unit of time has been defined since 1956 in terms of the tropical year 1900, it now seems likely that a new definition of the second, based on some selected atomic transition, will be adopted at the 1966 General Conference on Weights and Measures. Such action would "formally recognize the

To try to discuss the complete state-of-the-art in electromagnetic measurements and standards in a few thousand words would be quite futile, as is well illustrated by the IRE Transactions on Instrumentation, Dec. 1962. This volume consists of the papers given at the International Conference on Precision Electromagnetic Measurements in August 1962. It thus represents some of the highlights of recent advances in the "electronic" measurements art. Even so, the 300-odd pages and 1/4 of a million words do not even touch on vast areas of the modern technology. In particular, they give no clue to the enormous outpouring of commercial instruments for the measurement of every imaginable electrical and physical quantity. These comments merely touch on a few highlights of the present and recent art.—I.G.E.

situation that already exists, namely, that atomic clocks are used to provide the unit of time interval where very high precision is needed."<sup>1</sup>

Production of commercial equipment has followed closely behind the advanced development. Frequency standards based on cesium beams and on rubidium vapor are available, as are a host of good quartz

1. Markowitz W., "The Atomic Time Scale," IRE Transactions on Instrumentation, Volume I-11, Dec., 1962, p. 239.



The General Radio Type 1615-A capacitance bridge seen here offers capacitance measurement accuracy of 0.01% routine direct reading, with intercomparison to better than 1 ppm.



**By IVAN G. EASTON**  
Vice-Pres. for Engineering  
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West Concord, Mass.



## MEASUREMENT STANDARDS (Continued)

crystal oscillators. These provide the working standards of frequency, but need to be maintained in terms of the accepted standard. By use of standard frequency transmissions on VLF and of time signals on Loran C, a standards lab. anywhere in the country can find the frequency of local standard oscillators to an accuracy of a few parts in  $10^{11}$ .

Techniques have long been known and used for subdividing the precisely known frequency of a quartz oscillator by powers of 10 or successively by various integral numbers. Recently there has been intensive development of synthesis techniques for generating any arbitrary frequency from a single standard frequency. Instruments based on such methods have become available, and they may well have the same impact on the art of frequency generation that the electronic counter did on the art of frequency measurement.

### Capacitance

In the field of capacitance standards and measurements, progress has been comparable to the strides made in the field of frequency and time. The advances made are based on 1. the discovery of a fundamental new theorem in electrostatics and 2. a recognition of and the exploitation of the advantages of bridge circuits using inductively coupled ratio arms (popularly referred to as "transformer bridges").

The basic work for an order-of-magnitude improvement in the determination of the absolute unit of capacitance was contributed by Thompson and Lampard<sup>2</sup> and their co-workers, in Australia. In their search for an accurately computable capacitor, they recognized a form whose capacitance depends solely

Fig. 1: The improvement in accuracy of the U. S. frequency standard over a period of 4 decades. The sharp break in slope was the result of introduction of atomic standards.

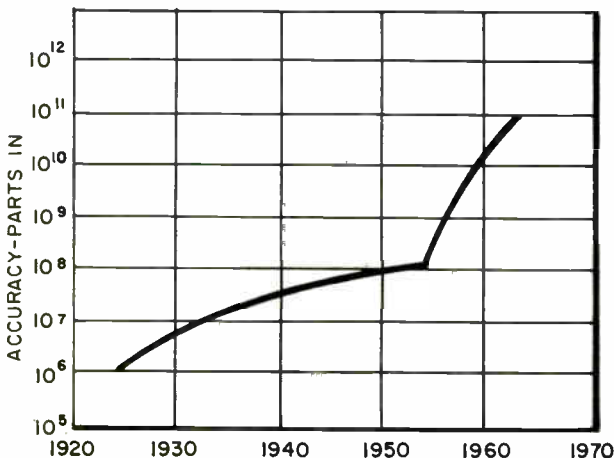
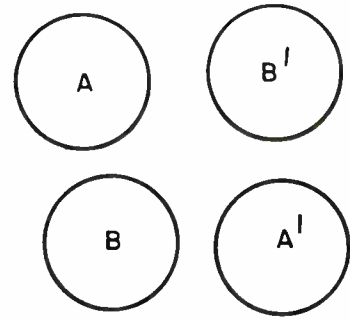


Fig. 2: A cylindrical capacitor with the cross-section shown is accurately computable since it depends solely on a single dimension.



upon a single dimension of length. Referring to Fig. 2, the 3-terminal capacitance per unit of length between A and A', with B-B' connected to ground, is independent of the form, provided only that certain simple conditions of symmetry are met.

Reference standards, based on this principle, have been built in several labs., and the pf. ( $10^{-12}$  farad) is now believed to be known to within a very few parts per million. Continuing work may soon lead to accuracy expressed in parts per 10 million.

The capacitors constructed on the new principle have a capacitance of less than a pf., but the transfer from this low value of reference standard upward to the  $\mu$ f. range is done with very little loss of accuracy using newly developed transformer bridges.

The transfer of capacitance values from the national standardizing labs. to "lower echelon" labs. and, in turn, to the production line can be done with remarkably little loss of accuracy with the newest bridges and standard capacitors. The "transformer bridge" shown in the photograph permits capacitance comparisons to better than 1.0 ppm and routine direct-reading measurements to 0.01%. Fixed, sealed, nitrogen-filled capacitors similar to those used in this bridge show promise of long-term stabilities of the order of 10 ppm.

Whereas a few years ago, the standards laboratory that could be confident of capacitance values to a few hundredths of 1.0% was doing well, accuracies in the order of 50 ppm are now possible.

### Resistance

One of the oldest and perhaps most intensively cultivated of the electrical measurement arts is that of resistance. In this mature field, progress tends naturally to be slower, but recent years have seen intensive commercial development work on improved resistors, on highly refined ratio-sets, and on guarded bridges for high-resistance measurements.

On the frontiers of the art, the absolute value of the ohm has been redetermined by new methods. The

2. Thompson, A. M., and Lampard, D. G., *Nature*, Vol. 177, p. 888, May, 1956.

new computable capacitor described above has been the basis for a new evaluation in terms of fundamental units of length and time. The impedance of a capacitor (evaluated in terms of length) is calculated for a given frequency (time) and compared with a resistor. The value obtained in this way checks very well with older findings based on inductance and time, and the ohm is now known with confidence to better than 5 ppm. Available resistance standards are sufficiently stable that the ohm can be known in a well equipped lab. to within a few parts per million of the value maintained by the National Bureau of Standards.

### Inductance

No great progress in inductance standards has come to my attention in recent years. Interest in and, presumably, need for better inductance standards and measurement methods do not appear to be very strong. Standard inductors that have been available for a number of years consistently demonstrate long-term stabilities of about 0.01%, and available bridges are more than adequate for intercomparison and maintenance purposes. Conversely, the standards are adequate for the maintenance of the accuracy of the bridges. In the advanced development area, research is under way to find a configuration whose inductance can be found simply and accurately from a single dimension in the manner of the Thompson-Lampard capacitor. As a matter of general scientific interest, if this can be done, it will be possible to determine the speed of light very accurately from the ratio of electrostatic to electromagnetic units. Some interest has developed in the use of commercially available decade ratio-transformers for the intercomparison (or measurement) of inductance, but the extent to which such methods may replace conventional bridge methods is not yet clear.

### Voltage Ratio

A very significant development has been the growing use of the decade ratio-transformer. This device can subdivide an audio-frequency voltage with very high accuracy. One ppm (of the input voltage) is quite common, a few parts in 10 million less readily, and parts in  $10^8$  seem within the reach of most advanced techniques.

### Voltage and Current

The saturated cell remains the preferred device for the unit of electromotive force. Highly refined and thoroughly understood after many years of use and development, such cells provide the standardizing

lab. with a reference voltage known in the order of 10 ppm.

The Zener diode is coming into its own as a voltage reference in measuring instruments, but does not yet seem to threaten the "standard cell" as a primary reference.

Current-regulated power supplies have been developed to the point where they can be treated as standard current sources, with accuracies of at least a few hundredths of 1.0%. This is an interesting development, since current, being a transitory quantity, has not heretofore been considered as being transportable.

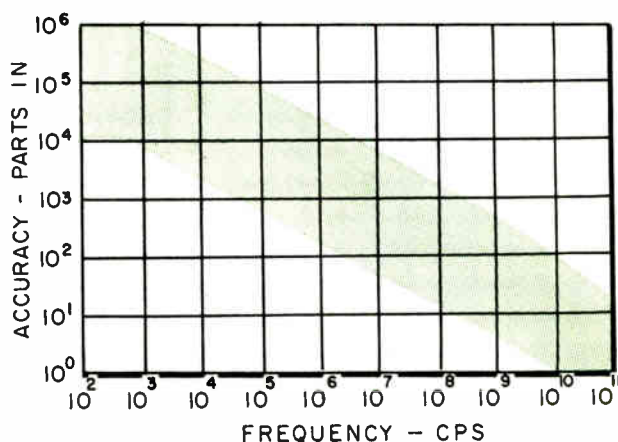
Techniques of transfer from dc to ac have been greatly improved, and ac current and voltage through at least the audio-frequency range can be found from the established dc values without major loss of accuracy.

For the basic parameters of voltage, current, resistance, capacitance, inductance, and their ratios, which characterize electric-circuit performance at low frequencies, there has been developed a well integrated, highly consistent, and mutually compatible system of units, reproducible standards, and measurement techniques. Accuracies ranging from a few parts per million to a few hundred parts per million can now be maintained by a well equipped, conscientiously operated standards laboratory in these basic areas of electrical measurement.

### Microwave Standards

At higher frequencies, as circuit dimensions become comparable to wavelength, the emphasis gradually shifts from circuit analysis to wave and field concepts, and the parameters of primary interest also  
(Continued on page E14)

Fig. 3: The graph shows how precision in the measurement of most electrical parameters falls off with increasing frequency.



## MEASUREMENT STANDARDS (Concluded)

shift. Voltage, current, inductance, and capacitance give way to characteristic impedance, attenuation, reflection coefficient, and phase shift, for example. Attainable accuracies vary considerably with frequency, but in general we are now dealing in terms of parts per thousand rather than parts per million.

The chart in Fig. 3 indicates the general nature of the degradation of accuracy of electrical measurement with frequency. To supplement this chart, the following examples will indicate the approximate state of the art as realizable in a competent laboratory with commercial equipment.

### Microwave Power

In the microwave range of current interest one encounters power levels from microwatts to megawatts. Over the frequency range from a few thousand  $\mu\text{c}$  to about 30,000  $\mu\text{c}$ , power levels from 100  $\mu\text{w}$ . to 100 w. can be measured to within 1%. At higher and lower power levels, accuracy falls off sharply. Over the frequency range in which coaxial systems are used (roughly 1  $\mu\text{c}$  to 10,000  $\mu\text{c}$ ), 1%

accuracy can be achieved for power levels from 1  $\mu\text{w}$ . to 1 kw.

Over the coaxial frequency range just mentioned, attenuation values from 0 to 60 db can be measured to less than 1%.

### Voltage

The accuracy of voltage measurement in the range between a few tenths of a volt and a few hundred volts approaches 0.1% at frequencies in the tens of  $\mu\text{c}$ , falls to 1% or poorer in the hundreds of  $\mu\text{c}$ , and is not much better than 10% at a few thousand  $\mu\text{c}$ .

Attention is being directed by many labs. to the problems of improving measurement accuracy in the microwave region. The next few years will undoubtedly see significant improvement in many areas, but the erosion of accuracy at higher frequencies is probably fundamental. Very likely, accuracies at low frequencies will continue to improve and the general relationship between accuracy and frequency of measurement may remain almost as suggested in Fig. 3.

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## TESTING (Concluded)

### Conclusions

At this point it is clear that a sizeable number and variety of sensors are needed for and serve as the basis of this new test method. For high-energy fields, the phosphor detectors are ideal and the examples were restricted to this type of sensor. It is noted, however, that low-energy detectors are available and that often the direct visible radiation, as from heater filaments and cathodes, and from corona, and from arcs in waveguides, etc., are useful in providing the optical test signals. Many radiation sources and sensors are now available, and more can be anticipated, that will respond to or be indicative of the level of energization of the components in an operative system. These sensors provide signals in the optical frequency range which are displayed and analyzed so that a complete picture is presented of the manner in which the system is behaving. By incorporating these sensing devices into the system, and its subassemblies, in the design stage it is almost a necessity that the system be properly instrumented. The function to be performed by the system, the operational environment, the logistic support plan,

the predicted failure rates, the anticipated life expectancy of the components, the skill level of the operators and of the maintenance people, are considerations which will all have a bearing on the design of the system and the selection of sensing devices to be provided therein. Likewise, these considerations will determine the method of choice for the collection, analysis, and display of the test data.

It is my belief that a major breakthrough will be achieved in the electronics art if the considerations of the above teachings are made mandatory in the design of new components and systems. The designer then will be forced to include in his equipment suitable test features and test points which have been so noticeably lacking. It will then be possible to test a complex system rapidly and reliably so that its operational status may be determined with a degree of certainty not now available.

The author appreciates the encouragement given to him by the entire Project SETE Steering Group to release the contents of the article. Also, special credit is extended to V. A. Parks, Bureau of Ships; A. R. Glorioso, Bureau of Weapons; H. Mulkey, Hq. USAF; and W. J. Schlotterbeck of the Electronic Systems Div., Bedford, Mass.



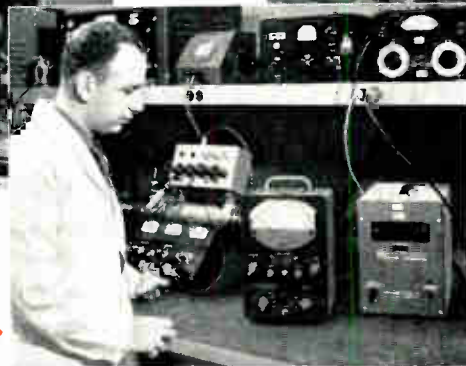
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 (Toronto) 247-2171

# FIRST TRULY UNIVERSAL

## Panoramic\* solid-state TA-2 goes anywhere, does many jobs!

The TA-2 is the first truly all-purpose spectrum analyzer. Utilizing plug-in modules — 20 cps to 25 mc — it is transistorized, miniaturized, portable (30 lbs.), and battery-operated.

Its operation is "optimized" for universal application. Operable for over four hours on rechargeable silver-cadmium batteries, it is capable of normal operation, while charging, on any line 95-130 and 190-260 volts, 50 to 1000 cps.

With minimum space, installation, power, setup, and adjustment problems, the TA-2 can be taken anywhere in the laboratory, production line, or field. Finding great usefulness on board small ships and aircraft, it brings swept-band convenience to areas where, because of equipment bulk, less satisfactory instruments have been used.

Four modules give the TA-2 wide frequency versatility:

The AR-1 sonic module covers 20 to 35,000 cps. Center frequency is adjustable 0-25 kc. A 20 kc scan permits quick surveillance of the entire sonic spectrum at a glance, and detailed high-resolution analyses are made by the stable narrow-band scans of 5000, 1000, and 200 cps. Preset resolution is automatically at optimum. Internal crystal-controlled markers every 2.5 kc verify frequency calibration. A unique input switching and CRT calibration permits use of the TA-2/AR-1 as a sensitive (30  $\mu$ v full scale) direct-reading dbm and voltmeter. CRT is calibrated for linear (voltage) and log (40 db) scales.

TA-2/AR-1 applications include vibration and acoustic waveform analysis, filter and transmission line checking, digital and other pulsed signal analysis, distortion measurements, dynamic analysis of digital, speech, and music for channel bandwidth and other studies, geophysical and seismic studies, and a host of others.

The AL-2 module has the features of the AR-1 plus a logarithmic frequency scan. The UR-3 covers the 100-

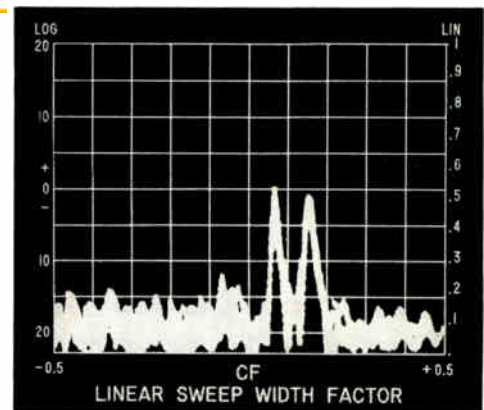
600,000 cps sonic, ultrasonic, and low rf range, useful for telemetry subcarrier, VLF and wire carrier communications, sonar, and ultrasonic equipment analyses. The VR-4 analyzes 1 kc-25 mc. and is valuable for a wide variety of analyses of communications, including telephone carrier systems for rapid detection and measurement of noise or malfunctioning message channels, and for monitoring and trouble-shooting television video modulation. Other modules covering higher frequencies will be available soon.

The upper right hand space on the front of the TA-2 contains a removable cable and accessory compartment that may also be used for future plug-in accessory modules to even further extend the universality of the TA-2.

Vibration of a motor viewed with 0 to 5 kc sweep, log amplitude scale.

Note resonances and amplitudes are easily read.

Narrow band scans permit detailed observations.



### TA-2/AR-1 SPECIFICATIONS

**FREQUENCY:** Range: 20 (usable to 15) to 35,000 cps./Center Frequency: expanded calibration control 0-20 kc. / Sweep Width: preset scans of 200, 1000, 5000, 20,000 cps. / Resolution: automatic optimum, 25 cps min. / Scale: linear frequency sweep. / Markers: zero and 2.5 kc intervals (built-in). ■ **SCAN RATE:** 1 cps, other rates available. ■ **SENSITIVITY:** 30  $\mu$ v full LIN scale, -90 dbm full LOG scale. ■ **DYNAMIC RANGE:** harmonic and IM products down 60 db. ■ **CRT:** Size: 3½" square. / Amplitude Scales: linear voltage (accuracy  $\pm$ 10%); linear direct-reading 40 db ( $\pm$ 1 db). ■ **POWER:** internal battery, or 95-130 or 190-260 volt 50-1000 cps line. ■ **DIMENSIONS:** TA-2: 8¾" w x 11" h x 18" d. / AR-1 module 8½" w x 6¼" h x 8¾" d. ■ **WEIGHT:** Approximately 30 pounds.

PAN-40-1

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The measure of progress...



SINGER METRICS DIVISION

THE SINGER COMPANY

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# SPECTRUM ANALYZER !

The TA-2 with AR-1 sonic module. Display on TA-2 screen shows internal markers at 2.5 kc intervals for checking frequency calibration of 20 kc sweep width.





## NEW DESIGNS IN PANEL METERS

A few years ago panel meters came only in a few shapes, and a limited number of colors—all black. Today, along with accuracy, a prominent factor in meter selection is the human engineering considerations. The newer designs also offer more rugged movements, increased sensitivity and improved accuracy.

A CLASSIC EXAMPLE OF THE TRANSITION which takes place in a product as design considerations become more critical lies in the history of the electrical indicating panel instrument. This transition has been far from a "blockbusting" imposition of new ideas and approaches. Rather, within the last few years a quiet revolution has been going on in the field of panel meters.

As is usually the case with an item that is with us for many years, their functions and their importance are taken for granted. In fact, a casual examination might lead one to conclude that nothing much has happened in the panel meter field since it started.

This is far from the case. The quiet revolution has completely upset the classical relationship between manufacturer and user of panel meters.

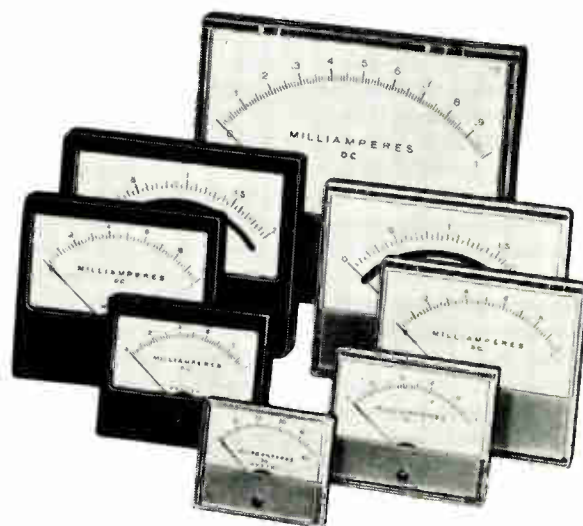
Historically, a user demanding better than 1% accuracies was pretty much limited to a large bulky design intended for switchboards. For reasonable performance and good reliability, there was an automatic restriction to bakelite case construction. For sensitivities less than 20  $\mu$ a., it was vital to mount the meter in a horizontal position to assure repeatability.

And now, let's look at the changes that have taken place.



### By EMIL G. NICHOLS

Mgr. New Product & Market Dev.  
Weston Instruments & Electronics Div.  
Daystrom, Inc.  
614 Frelinhuysen Ave.  
Newark 14, N.J.



Weston 1900 Series Panel Meters above have design options in sizes ranging from 2½ to 7½ inches.

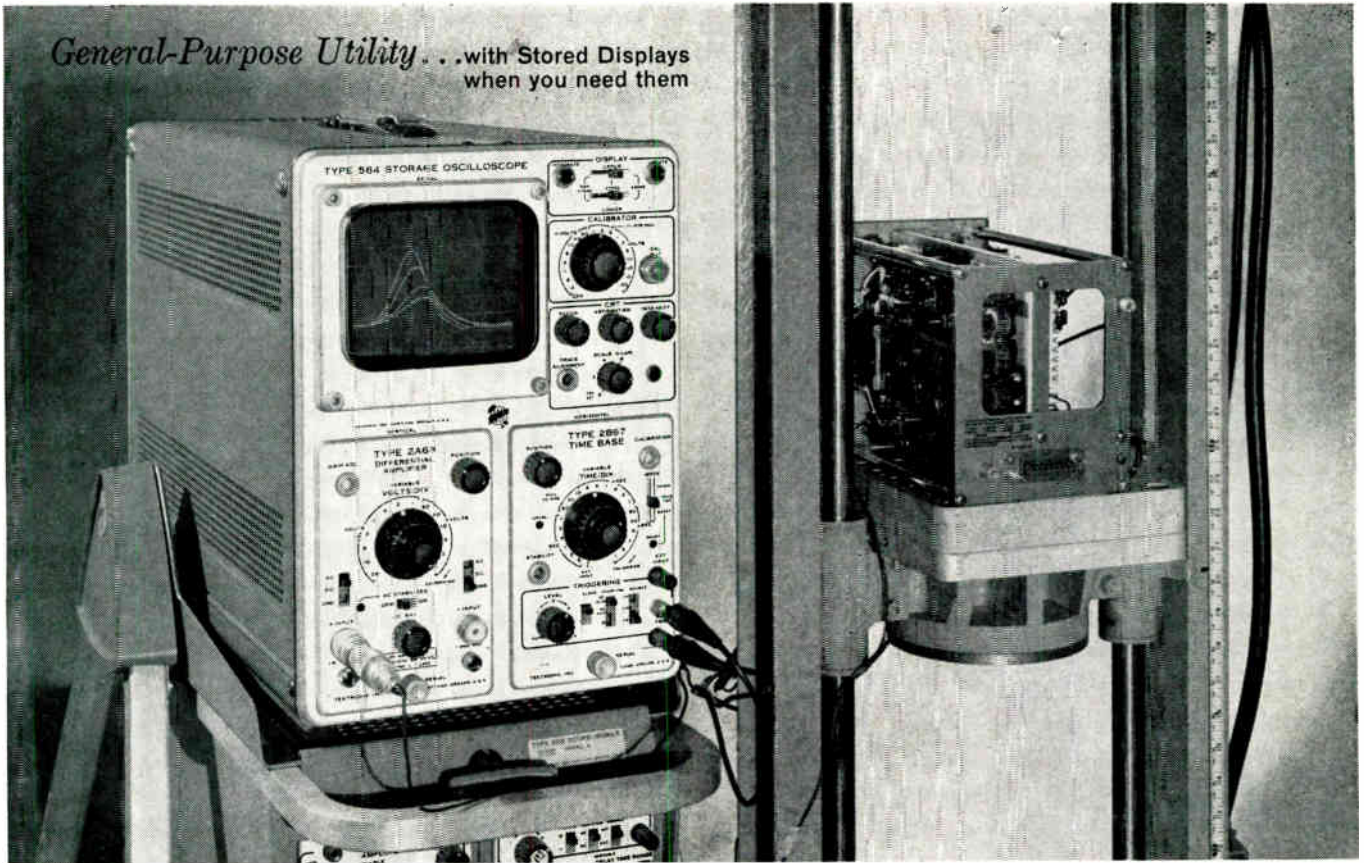
First and basic was the meter manufacturer's recognition that designs of panel meters should be subservient to the overall design of the product in which meters are used.

Second, the development of taut-band or ribbon suspension in place of the classical pivots and jewels. This obviated the need for any restrictive mounting positions or the need for bulky construction to obtain high accuracy or good repeatability.

Third, the development of anti-static treatments for thermoplastics. This eliminated the collection of electrostatic charges on such plastics. Better grades of thermoplastic materials permitted construction of meters to very close mechanical tolerances and to dimensional stabilities against age, temperature, humidity and other environments.

Fourth, the development of an integrated functional series of panel meters offered greater flexi-

*General-Purpose Utility* . . . with Stored Displays  
when you need them



## THE NEW TEKTRONIX TYPE 564

### *... As a General-Purpose Oscilloscope*

When you don't need stored displays, the Type 564 operates for you as a conventional oscilloscope, with all the versatility afforded by interchangeable vertical-deflection amplifiers and time-base generators.

#### Vertical Plug-In Units Offer:

|  |        |
|--|--------|
| DC to 1 Mc at 50 mv/cm—Type 2A60 . . . . .                                 | \$ 105 |
| DC to 4 Mc at 50 mv/cm—Type 3A75 . . . . .                                 | \$ 175 |
| 0.06 cps to 300 kc at 10 $\mu$ v/cm—differential input—Type 2A61 . . . . . | \$ 385 |
| DC to 300 kc at 1 mv/cm—differential input—Type 2A63 . . . . .             | \$ 130 |
| Dual-Trace, DC to 650 kc at 10 mv/cm—Type 3A72 . . . . .                   | \$ 250 |
| Dual-Trace, DC to 10 Mc at 10 mv/cm—Type 3A1 . . . . .                     | \$ 410 |
| Four Trace, DC to 2 Mc at 20 mv/cm—Type 3A74 . . . . .                     | \$ 550 |
| 0.4-nsec risetime at 2 mv/cm, sampling—Type 3S76 . . . . .                 | \$1100 |

#### Time Base Plug-In Units Offer:

|   |        |
|---|--------|
| 1 $\mu$ sec/cm to 5 sec/cm, 5x magnifier, single sweep—Type 2B67 . . . . .  | \$ 175 |
| Normal and Delayed Sweeps, 0.5 $\mu$ sec/cm to 1 sec/cm, calibrated delay from 0.5 $\mu$ sec to 10 sec, single sweep—Type 3B3 . . . . . | \$ 525 |
| Same as Type 3B3 except delay not continuously calibrated and no single sweep—Type 3B1 . . . . .  | \$ 475 |
| 0.2-nsec/cm to 10 $\mu$ sec/cm equivalent, for sampling—Type 3T77 . . . . .   | \$ 650 |

### *... As a Storage Oscilloscope*

Single traces at low and medium speeds are stored for at least one hour, and erased in  $\frac{1}{4}$  second. A unique split screen permits storage or conventional operation over the whole screen, or storage on either half with conventional operation on the other half.

Type 564 (without plug-in units) . . . . . \$950

U.S. Sales Prices f.o.b. Beaverton, Oregon

The Type 564 in a typical mechanical measurement. Waveforms on screen represent shock imparted on the device under test when dropped from successively increasing heights. Trace is calibrated vertically at 8.6 g/cm and horizontally at 2 msec/cm. Storage facility permits easy analysis of shock data without need for multiple exposure photography.

For a demonstration and/or complete information, please call your Tektronix Field Engineer.

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Tektronix Canada Ltd: Montreal, Quebec • Toronto (Willowdale) Ontario • Tektronix Ltd., Guernsey, Channel Islands



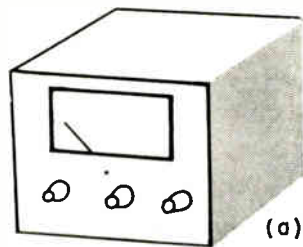
## PANEL METER (Continued)

bility as to size, choice of construction materials, colors, mounting methods and operating characteristics.

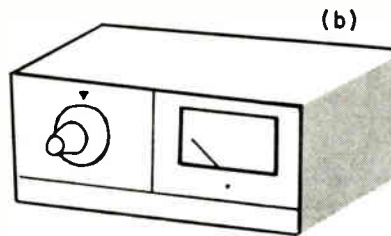
With the capabilities of present day meters many of the engineering considerations do not have to be compromised to suit the human engineering aspects of the equipment. Nor do the human engineering aspects of the equipment design have to be compromised for the sake of performance dictated by the equipment developer.

### Selection of Meter Size

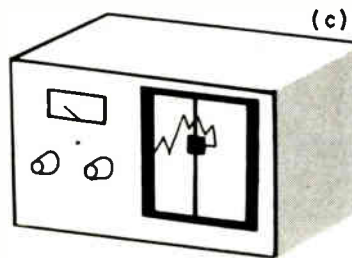
In a given situation, the size of the indicating meter may be unrelated to its technical needs of accuracy, resolution, visibility from a distance, etc. In such a case, the human engineering considerations could be the governing factor. The designer may choose a large size of meter to create a center of interest.



(a)



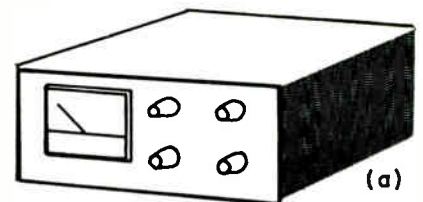
(b)



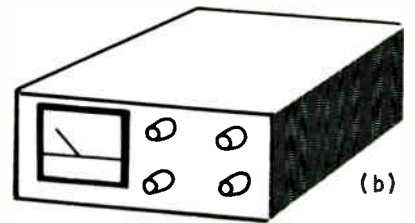
(c)

Fig. 1: The size of a meter has, as shown, in (a) more, (b) equal, and (c) less importance due to its function.

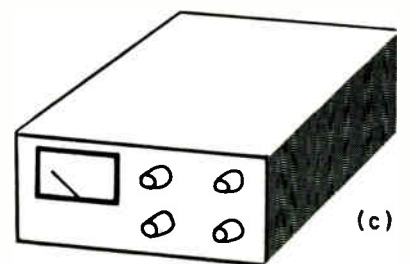
See Fig. 1a. This might be especially true in such devices as vacuum tube voltmeters. Here, the range and function selector switches might be



(a)



(b)

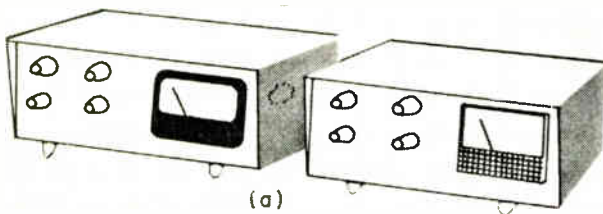


(c)

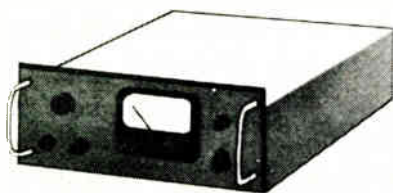
Fig. 2: A meter is usually on the surface as in (a), but, looks larger with a bezel (b) and smaller recessed (c).

quite incidental and subservient to the meter itself since in indication of the meter is the important factor.

(Continued on page E22)



(a)



(b)

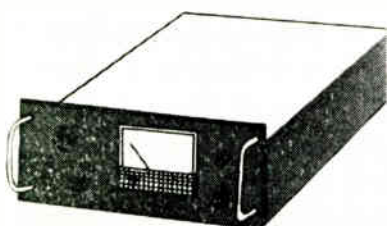
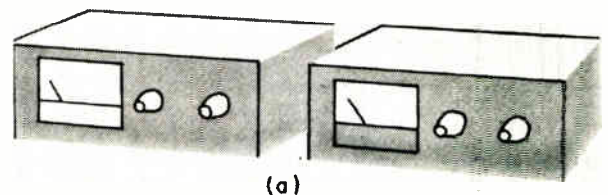
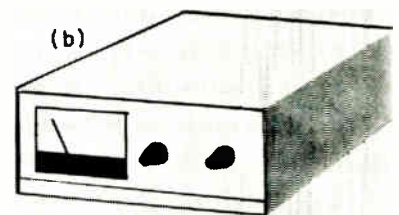


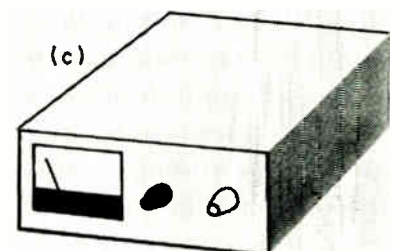
Fig. 3: Thermoplastic is better-looking on panel with light finish, as in (a) but, bakelite is more appropriate for equipment treated roughly, as in (b).



(a)



(b)



(c)

Fig. 4: Use of color in panel meters is meant to (a) change aspect ratio, (b) harmonize with a panel's detail, and (c) associate with a control knob.



*Quite a package!*



Fluke-manufactured, precision wirewound resistors, aged and matched both for resistance and temperature coefficient, guarantee the long term DC accuracy of the voltmeter to be better than 0.01%. Resistors used in critical portions of the Kelvin-Varley divider have temperature coefficients of less than one part per million per degree Centigrade.



## Accuracy of 0.01% DC, 0.1% AC *a uniquely useful measuring instrument*

The new Fluke Model 823A differential voltmeter provides the highest accuracy obtainable in a portable instrument. In addition, it provides infinite DC input resistance at null (0-500V), divider terminal linearity of 2-20 ppm, DC polarity switch, recorder output, and no zero controls.

Model 823A is designed to perform under severe environmental conditions. It is guaranteed to withstand the shock and vibration requirements of Mil-T-945A. It is guaranteed to perform within specifications from 0-80% humidity and from 55° to 95°F. It's quite a package.

Ask your Fluke representative for a demonstration, or request complete data from John Fluke Mfg. Company, Inc., P.O. Box 7428, Seattle 33, Wash. Tel. PR 6-1171; TWX 206-879-1864, TLX 852.

# FLUKE

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World Radio History

Brief Specifications:

### MODEL 823A

#### DC ACCURACY

± 0.01% from 0.5V to 500V  
± (0.01% + 10 uv) below 0.5V

#### AC ACCURACY

± 0.1% from 30 cps to 5 KC  
± 0.15% from 20 cps to 10 KC  
overall frequency range 5 cps - 100 KC

#### CALIBRATION

500V internal reference supply calibrated to better than 20 ppm against built-in standard cell

#### INPUT POWER

115/230V AC ± 10%, 50-400 cps, 80 watts

#### CABINET

SIZE: 13" high x 9 3/4" wide x 16" deep

#### WT.:

28 pounds

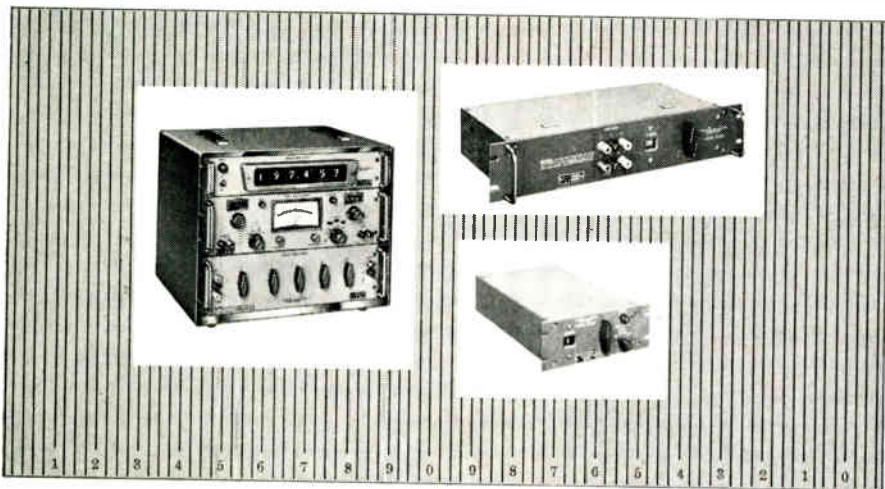
#### PRICE:

\$1300.00

### MODEL 803D

New Model 803D, available in either rack or cabinet configuration, offers many of the features of Model 823A. Accuracy—AC, 0.1%; DC, 0.02%. Price—cabinet, \$1100.00; rack, \$1120.00.

# NOW... high accuracy synchro/resolver testing



## —GERTSCH STANDARDS AND BRIDGES REPLACE COSTLY ELECTRO-MECHANICAL METHODS

There is a Gertsch synchro or resolver instrument to meet virtually all requirements. Whether testing simple components or complete systems, you get accuracies up to 2 seconds-of-arc — accuracies maintained without constant checking and recalibration. These versatile units employ the same time-proven design techniques as Gertsch RatioTrans,<sup>®</sup> assuring high input impedance, low output impedance, and very low phase shift.

**Minimum operator error.** Angles are selected with positive detent knob — requires no critical adjustments. Direct-reading digital display reduces readout error.

**Simplified circuitry** — least susceptible to the effects of stray capacitance, pickup, loading.

**Fewer accessories needed,** hence less error from associated equipment.

**Over 100 synchro/resolver test instruments** are available from Gertsch — synchro standards, resolver standards, synchro bridges, resolver bridges. In addition to conventional, manually-operated units, all standards and bridges can be supplied as rotary solenoid, relay (programmable), and decade (.001° resolution) instruments.



**Gertsch dividing heads** (both manual and automatic), in combination with Gertsch phase angle voltmeters, provide complete checkout capabilities for AC rotating components.



**Complete information** on all Gertsch synchro/resolver test instruments in catalog #11 — 40 pages of technical information, specifications, theory, application data and engineering bulletins. A valuable reference source for design and test engineers.

# Gertsch

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## PANEL METER

(Continued from page E20)

On the other hand, another piece of equipment might have a calibration or tuning dial whose functional importance is equal to that of the indicating meter associated with such a dial (Fig. 1b). In this case, the human engineering considerations might well dictate an intermediate size of panel meter and a larger sized tuning dial or knob. In still other cases, (Fig. 1c) a meter may be necessary but completely incidental to the main function of the device. Again, this can be implied by choosing a very small panel meter; thereby indicating its lack of relative importance in the overall function of the device.

Of course, the shape and location of the meter in each of the 3 situations above would also have a very profound effect on the human engineering aspects, but of the 3 parameters involved, size is the most important.

### Mounting Methods

In certain uses, the scale length may dictate a large meter size, but the human engineering aspects may call for a relatively small meter. To a very real degree, these seemingly incompatible factors can be resolved by mounting the meter behind the panel with a half-bezel (Fig. 2c). This technique will frame only the scale-plate area and produce the double advantage of a seemingly small meter and the illusion of an even longer scale.

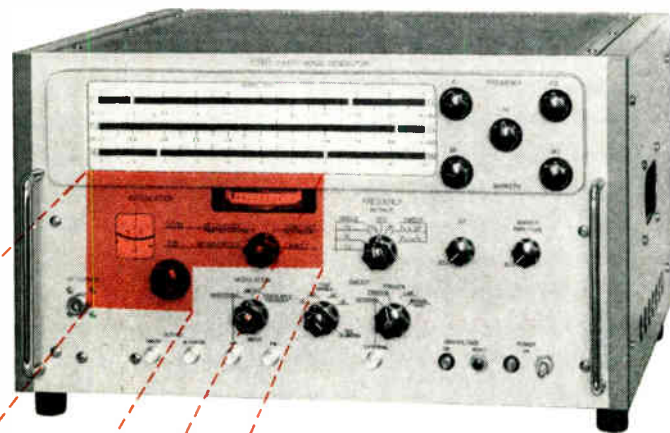
The opposite may also be true. Economics might dictate a very small meter for minimum cost, but human engineering aspects dictate a larger meter for increased prominence. In this case the smaller meter can be flush-mounted with a bezel (Fig. 2b) which completely surrounds it and thereby adds to its apparent size.

(Continued on page E24)

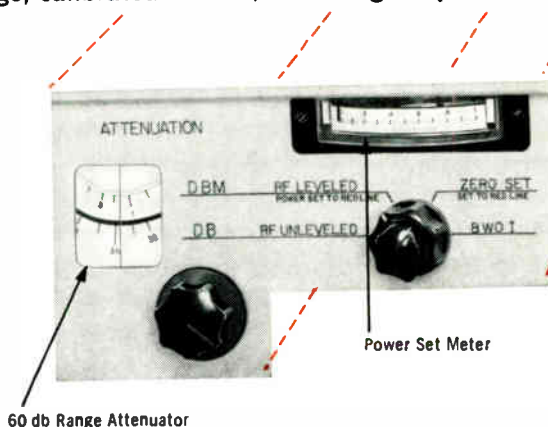


# This is not a microwave sweep oscillator

# This is the first microwave sweep signal generator



HERE, IN ONE COMPACT PACKAGE, is the microwave industry's first electronically swept signal generator. Alfred's new 630 Series now provides precise frequency tuning PLUS known absolute power output over a 60 db range, calibrated in dbm, all during swept or CW operation. Note these special features:



**FLAT OUTPUT**—Feedback leveler holds power variation to less than  $\pm 0.5$  db at rated output over each range. Variation in any 100 Mc range is less than  $\pm 0.1$  db. Accuracy  $\pm 1$  db at rated power output.

**TRANSISTORIZED**— $10\frac{1}{2}$ " panel height—lightweight—low power consumption—only five vacuum tubes used.

**STABILIZED POWER OUTPUT**—Balanced bolometer assures constant power output over wide temperature range.

**AVAILABLE IN THREE RANGES**—1 to 2, 2 to 4 and 4 to 8 Gc. Frequency is continuously adjustable over entire range with direct calibrated dial (1% accuracy).

**ADJUSTABLE FREQUENCY MARKERS**—Each unit has two time-saving indicators of band limits and two additional frequency markers.

**KEY SPECIFICATIONS** FREQUENCY RANGE: Model 631, 1 to 2 Gc; Model 632, 2 to 4 Gc; Model 633, 4 to 8 Gc. RF POWER: At least 1.0 mw. Continuously variable over 60 db range. Greater power output available unlevelled. RESIDUAL FM: Less than 0.003% peak of highest frequency. DRIFT:  $\pm 0.01\%$  per hour. SWEEP WIDTH: Continuously adjustable from 0 to any part of the entire frequency range. Symmetrical Sweep: 0 to  $\pm 5\%$  of range about any center frequency. SWEEP TIME: CW operation, 100 to 0.01 second. Square Wave Operation, 100 to 0.5 second. AMPLITUDE MODULATION: CW, square wave or external.

COMPLETE DATA AVAILABLE—Alfred's policy is to publish complete specifications and guarantee them as stated. For detailed information on Series 630 Sweep Signal Generators, contact your Alfred engineering representative or write to:

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## PANEL METER

(Continued from page E22)

Of course, the intermediate condition would be the case in which the selected size of meter, mounted in the typical fashion on the surface of the panel as in Fig. 2a, provides the best solution to the technical and human engineering needs.

### Case Materials

As mentioned, the current availability of good plastics have contributed to the equipment designer's freedom of choice. Bakelite cases or thermoplastic cases now are simply a matter of preference rather than any technical necessity.

Many of the current designs of lab. instruments are modernistic in appearance and use light pastel colors on their panels and cabinets. In such cases, meters with thermoplastic covers better looking, while meters with bakelite cases might tend to become overwhelming by their prominence. See Fig. 3a.

Conversely, certain types of equipment which are designed or built to rugged military specs may look much more homogeneous in overall design when meters with bakelite covers are used (Fig. 3b). Such bakelite-cased meters would enhance the feeling of utility and ruggedness, while meters with thermoplastic covers, even though just as rugged, durable and well sealed, might give the appearance of delicacy which could be out of place. Panel meter designs which provide for complete interchangeability of covers eliminate the need to compromise in either direction.

### Use of Color

Certain equipment designs deal almost entirely with human engineering aspects rather than technical aspects. Among such factors are the use of color in panel meters.

(Continued on page E26)

## ULTRA-PRECISE TEMPERATURE TESTING

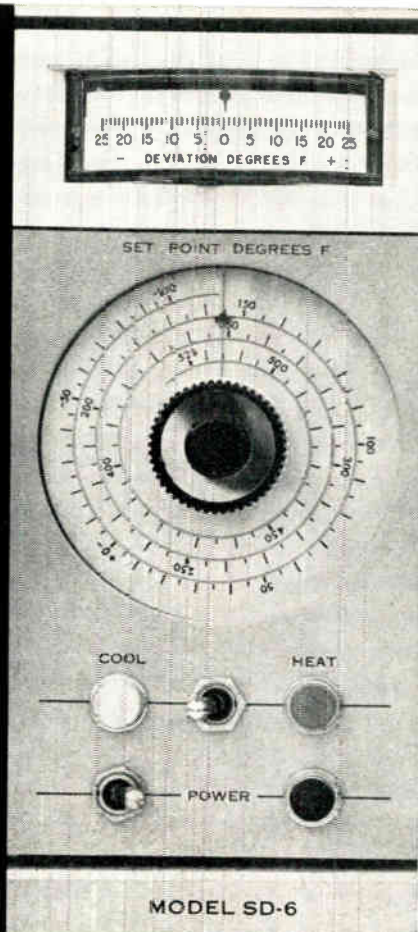
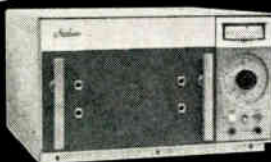
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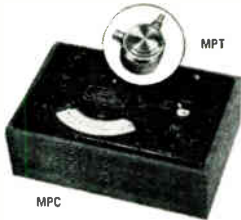


Statham Instruments, Inc.  
12401 West Olympic Blvd.  
Los Angeles 64, Calif.



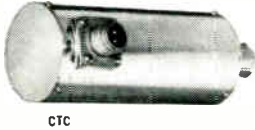
MODEL SD-6

## RF STANDARDS



### MODEL MPT MICROPOTENTIOMETER

DC — RF calibration standard provides true rms voltages from 1  $\mu$ v to 660,000  $\mu$ v. Interchangeable radial resistors supplied in type N connectors. Certifiable by NBS to  $\pm 2\%$  up to 100 mc;  $\pm 3\%$  to 500 mc;  $\pm 5\%$  to 900 mc. Model MPC, Micropot Calibrator, is an instrument for the rapid readout of micropotentiometers and their calibration at time of use.



### MODEL CTC COAXIAL THERMAL CONVERTER

DC — RF voltage transfer standards for true rms measurement or calibration. Ranges: 0.5, 1, 2, 5, 10, 20, 50 and 100 volts; usable from 20% to 135% of nominal value. Certifiable by NBS at  $\pm 0.02\%$  to 50 kc  $\pm 0.1\%$  to 10 mc;  $\pm 0.2\%$  to 30 mc;  $\pm 1.0\%$  to 100 mc.



### MODEL ATV A-T VOLTMETER

RF voltage standard having true rms response. Ranges and frequency: from 0.2 to 20 volts up to 1000 mc; 1 to 300 volts up to 100 mc; 10 to 500 volts up to 10 mc. Accuracy 1%  $\pm$  of NBS calibration. Features  $1\frac{3}{4}$ " diameter micrometer readout with direct resolution of 0.0001" per division.

The comprehensive array of **Sensitive Research\*** high accuracy AC/DC electrical instrumentation ranges from portable and panel type indicating instruments to the most sophisticated laboratory standards. The calibration of all Sensitive Research instruments is traceable to the National Bureau of Standards.

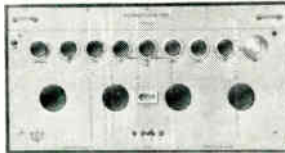
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 CORROSION INSTRUMENTS  
 CONSTANT TEMPERATURE ENCLOSURES  
 CURRENT CONTROLLERS  
 DIFFERENTIAL INSTRUMENTS  
 DUAL CONTACT SWITCHES  
 ELECTROSTATIC VOLTMETERS  
 FLUXMETERS  
 FLUXMETER CALIBRATORS  
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 FREQUENCY METERS  
 GALVANOMETERS  
 GAUSSMETERS  
 HIGH VOLTAGE DIVIDERS  
 HIGH VOLTAGE PROBES  
 INCREMENTERS  
 INDUCTORS  
 ISOLATING POTENTIAL COMPARATORS  
 KILOVOLTMETERS  
 LINDECK MICROVOLT SOURCES  
 LOW THERMAL NOISE SWITCHES  
 MAGNETIC TEST INSTRUMENTS  
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 POWER FACTOR INSTRUMENTS  
 POWER SUPPLIES  
 RATIO METERS  
 REVERSING SWITCHES  
 SHUNTS  
 STANDARD CELL ENCLOSURES  
 STANDARD RESISTORS  
 TEMPERATURE MEASURING EQUIPMENT  
 TEST CONSOLES  
 THERMOCOUPLES  
 THERMOMETER BRIDGES  
 THERMAL RESISTORS  
 TRANSFORMERS  
 THERMAL COMPENSATORS  
 VOLT-AMP-MILLIAMMETERS  
 VOLT-AMP-WATTMETERS  
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# Sensitive Research\*

## ELECTRICAL MEASURING STANDARDS



915 PEMBROKE ST., BRIDGEPORT 8, CONN.  
 (203) FO 6-3201 • TWX 710-453-3483



### COMMANDER TYPE 9120 POTENTIOMETER

Features 7 figure, single window readout from only 4 dials. Accuracy  $\pm (0.0015\% + 0.1 \mu$ v). Range: zero to 2,099,999.9 volts. Resolution: 1 part in 20 million (0.1  $\mu$ v per step). No current is carried through measuring dial switches so contact resistance is not a factor. Thermal emfs 0.1  $\mu$ v max.



### MODEL PARK HIGH VOLTAGE DIVIDER

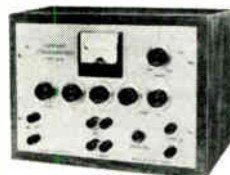
Precision high voltage measuring or calibration standard. Constructed to a design by Howard Park of the National Bureau of Standards. Total resistance: 100 megohms.

DC ratio accuracy: 100 kv to 1 v  $\pm .05\%$   
 AC ratio accuracy (60 cps): 50 kv to 500 v  $\pm .5\%$ .  
 Units may be stacked for higher voltage measurements.



### COMMANDER TYPE 9800 COMPARATOR

A DC resistance and voltage comparator employing an isolating potential circuit. Thermal noise less than 0.01  $\mu$ v. Voltages compared to 1 part in  $10^7$ ; resistors to 1 part in  $10^6$ . May be used with Dauphinee potentiometer and platinum resistance thermometer for temperature measurements. Resolution 0.0005°C. Ideal for comparison of two thermocouples. Measurements are independent of lead length and current stability.



### CONSTANT CURRENT SOURCE

Type 9770A supplies currents from 10 to 100 ma DC that are stable to  $\pm 1$  ppm when referenced against an external saturated cell ( $\pm 10$  ppm when using internal reference). Output is approx: 10 v into 1000  $\Omega$  (max.) load. Application is for use with DC potentiometers, accelerometers and all circuits requiring highly stable currents within its output range.

WRITE FOR DETAILED SPECIFICATIONS OR CATALOG



## Analyze high voltage spikes easily

Now you can quickly analyze the amplitude and duration of random high voltage spikes, without going blind over a scope. Leland's Voltage Spike Analyzer is a versatile piece of test equipment that lets you explore spikes from 10 to 990 volts with durations from 1 to 10 microseconds. Heart of the analyzer is a set of four adjustable solid-state gate circuits which may be digital dial-set for four different voltages in increments as narrow as ten volts. The time matrix is built-in, with indicators for 1, 3, 6, and 10 microseconds. An incoming spike is thus "trapped" and its profile is retained in lighted indicators as long as desired, then instantly erased at the touch of a button.

Uses are in optimizing circuit design and filtering and thereby increasing reliability, determining actual filtering requirements, locating sources of spikes, and in field-checking to isolate spike-producing elements. Unit operates from 110 volts, 60 or 400 cycle line, or has provision for self-contained batteries for remote use. Request Bulletin SA-100 from Leland Airborne Products Division of American Machine & Foundry Co., Vandalia, Ohio.

# LELAND



Circle 104 on Inquiry Card

## PANEL METER

(Continued from page E24)

One way of obtaining such color is by the use of very low-cost colored plastic inserts (Fig. 4a). These inserts are mounted between the scale plate of the meter and the transparent thermoplastic cover. This permits the user to have very wide selection of color. At the same time he avoids the need and added cost of having the meter manufacturer to custom-paint such covers.

In certain equipment designs, human engineering may dictate a horizontal/rectangular aspect ratio for a meter, while the available meter may be more nearly a square. In such a case, the use of a plastic strip insert in the lower portion of the meter, in a color matching the mounting panel, helps to create the illusion of a rectangular meter.

At times, the panel of the equipment may be finished with an accent

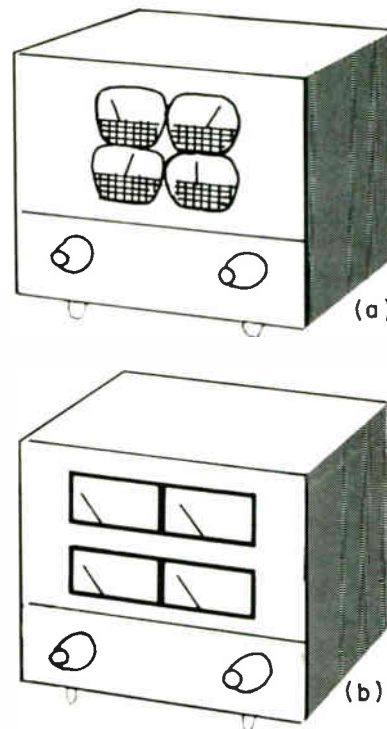
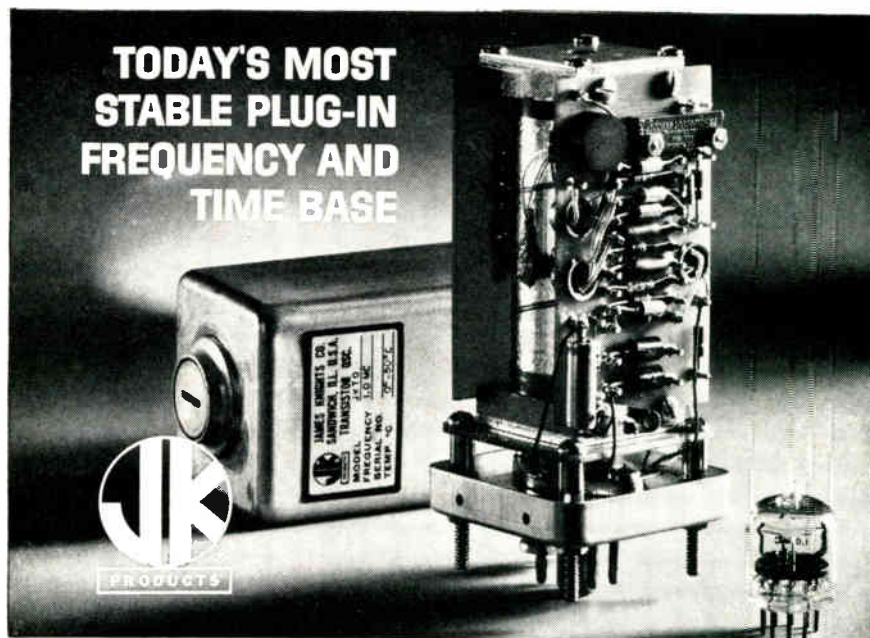


Fig. 5: Odd design shapes, as in (a), which are not square-cornered as in (b) are more pleasing if used singly.

color used as a design element (Fig. (Continued on page E29))



### SPECIFICATIONS

**Stability:**  $5 \times 10^{-9}$ /Day. **Frequency:** 1 mc to 5 mc normal range; 31.25 kc to 50 mc extended range. **Oven:** DC type proportional control. **Power:** 28 volt input. **Output:** 1.25 volts into 5 K ohm load. **Dimensions:** 2" x 2" x 4.5" seated height. Write for data sheet. James Knights Company, Sandwich, Ill.

## JKTO-43 Transistorized FREQUENCY STANDARD

Designed for both laboratory and field service

Circle 105 on Inquiry Card



## ANCIENT HISTORY



### **MINCOM CM-100 1.5 MC RECORDER / REPRODUCER**

Only the Mincom CM-100 has a field-proven record of predetection performance. Mincom's leadership in this highly complex telemetry technique stems from the CM-100's long-standing and reliable 1.5-mc response. CM-100's versatility and extreme wideband capability have made it the industry's instrumentation standard: 1, 1.2 or 1.5 mc at 120 ips in analog recording/reproducing, or simultaneous post- and pre-detection recording in FM/FM mod, PCM, PCM/FM, PAM/FM, PACM/FM and other FM-type carrier systems. Superior fixed heads and phase-compensating electronics produce better rise time, correcting for phase shift and overshoot. Write today for specifications.

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COMPANY

2049 South Barrington Avenue, Los Angeles 25  
425 13th Street N.W., Washington 4, D.C.



SHOWN WITH DATAFLASH

## This man is looking at a perfect oscillograph record

... and you can, too ... with CEC's direct-writing 5-123

You can't buy an oscillograph that produces better records than CEC's 5-123. It's made by the company with the greatest experience and know-how in the field of oscillography.

The versatile 5-123 can be used in any laboratory environment installation, fitting into a standard RETMA rack. 36- or 52-individual channels of recorded data on 12-inch-wide recording paper are produced without chemical processing of any kind... at 12 discrete speeds from .1 to

160 ips — and with trace numbering.

Instant record speed select on is made by pushbuttons. There's complete front access for operation and routine maintenance. All major modules of the 5-123 can be easily removed, replaced or exchanged.

For ultrafast access to data traces, the optional DATAFLASH module is available, providing access time that is up to 60 times faster than any other print-out process.

Need more information? Call CEC, or write for Bulletin CEC 5123-X14.

Circle 107 on Inquiry Card



**CEC**  
Data Recorder Division

**CONSOLIDATED ELECTRODYNAMICS**

A Subsidiary of Bell & Howell • Pasadena, California



## Three more ways to measure with CEC



Here are 3 other oscillographs made by CEC: The 5-119V "universal" oscillograph makes conventional, DATARITE® (Flash Developing Process), or print-out records; 36-50 channels, a-c or d-c models with 12" wide oscillograms. Speed: 0.1 to 160 ips. CEC's portable, direct-writing 5-124 weighs only 40 pounds, is low-cost and easy loading. Up to 18 traces, 7" wide records. CEC's 5-118A miniature unit is a compact, rugged high environment oscillograph that records to 12 channels of static or dynamic data at accelerations up to 20g, altitudes to 50,000 ft., and temperatures from -65°F to +135°F. Further data? Call CEC, or write for bulletins in CEC Kit #3413-X5.



# CEC

Data Recorders Division

**CONSOLIDATED ELECTRODYNAMICS**

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## PANEL METER (Concluded)

4b). To be compatible with such a panel design, plastic strip insert on the meter can repeat this color accent.

Sometimes a specific control knob may be related to a meter (see Fig. 4c). Here, the color used on the knob can be repeated, by means of the colored insert in the meter, and thus imply the necessary relationship.

### Group Mounting of Panel Meters

When several meters are mounted in close proximity, another factor becomes apparent—the shape of the meter selected. Panel meter designs which use shapes other than square or rectangular may look very pleasing when used singly. However, when they are grouped or clustered, such odd shapes may not be compatible with the rectangular aspect of a typical instrument panel (Fig. 5a). Furthermore, when meters having the shapes of shields, circles, trapezoids, or other non-rectangular areas are clustered, the odd-shaped areas remaining between the meters are natural dust collectors.

### Summary

Increased sensitivities now permit the development engineer to simplify circuitry and in many instances eliminate amplifiers that might have been previously needed. Compatibility of appearance in various instrument sizes and functions enhances the freedom of choice of the designer.

One might well say that the design engineer can now "eat his cake and have it, too." He can design his equipment to be technically superior to anything that was possible previously, and still avoid any compromise that human engineering might have otherwise imposed.

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### Model 900B Super Sweep Generator

Wide plus narrow band in one versatile instrument. Handles all IF, VHF, UHF sweep requirements. Sweep widths from 10kc to 400mc. Frequency range from 500kc to 1,200mc. Built-in crystal-controlled harmonic markers, dc or ac scope preamplifier, precision attenuator. **\$1,980.00**



### Model LA-5100 rf Log Amplifier

Accurate within  $\pm 1$ db over 80db dynamic range. Frequency range 500kc to 100mc. Lets you make exact measurements of attenuation in networks, filters, amplifiers with dynamic ranges down to 85 db. Total rf response displayed in precise log ratio on standard dc-coupled scope. **\$795.00**

### Model 900A Wide-Band Sweeper

Sweep widths from 100kc to 400mc. Frequency range from 500kc to 1,200mc. **\$1,260.00**

### Model 707 Ultra-Flat Sweeper

Flatness of  $\pm 0.05$ db in highest single octave. Plug-in oscillator heads. **\$840.00**

All for immediate delivery. Prices f.o.b. Philadelphia. Write for complete technical data on these and other Jerrold rf test instruments.

**JERROLD**  
ELECTRONICS

Industrial Products  
Division,  
Philadelphia 32, Pa.



A subsidiary of THE JERROLD CORPORATION

Circle 108 on Inquiry Card



# NEW TECH DATA

for Engineers.

## Aerosol Photometer

Data on Royco Model 230 Aerosol Photometer, which monitors aerosol concentration in monodisperse aerosols or aerosols with constant size spectra, is available from Royco Instruments, Inc., 440 Olive St., Palo Alto 6, Calif. Photometer measures and indicates total average logarithm of light scattered by large numbers of particles in a sample stream.

Circle 339 on Inquiry Card

## High-Resolution CRT

Information on a new 5 in. dia. CRT, SC-3168, for high-resolution photographic recording is available from Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

Circle 340 on Inquiry Card

## Contact Test Set

Details on the Miss Tester®, automatic contact and component test set, are available from Hi-G, Inc., Bradley Field, Windsor Locks, Conn. System is suitable for relay manufacturers and incoming inspection departments.

Circle 341 on Inquiry Card

## Instrument Catalog

This 100-page, 2-color catalog lists data on sweeping oscillators, audio spectrum analyzers, noise generators, attenuators, oscillators and other instruments. Illustrations, specs. and characteristics are given in the cross-indexed publication. Kay Electric Co., Dept. E. I., Maple Ave., Pine Brook, Morris County, N. J.

Circle 342 on Inquiry Card

## Digital Voltmeter

Bulletin 107 describes a transistorized reed-relay type digital voltmeter which features automatic ranging, manual control selection (if desired), automatic polarity, and 10 megohm input impedance. Sensitivity is 1mv. Princeton Applied Research Corp., Box 565, Princeton, N. J.

Circle 343 on Inquiry Card

## Electric Utility Controls

GEA-7571, 16-page brochure, lists instruments available for the electric utility industry. Included are indicators, recorders, sensors, controllers, test instruments, and many other instruments and systems. General Electric Co., Schenectady 5, N. Y.

Circle 344 on Inquiry Card

## Tachometer Transducer

Bulletin F-111-1 describes TDS6 self-generating magnetic transducer, which has a linear signal proportional to rotation speed of shaft. Output signal is fed to Tach-Pak which changes frequency to dc for metering, recording or controlling. Seminole Div., Aripax Electronics Inc., Ft. Lauderdale, Fla.

Circle 345 on Inquiry Card

## Micro-Manipulators

A 12-page color catalog includes drawings, specs. and photos of micro-manipulators not previously offered. Accessories table is also included. Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

Circle 346 on Inquiry Card

## Oscilloscope Catalog

The illustrated 15-page "1963 Abridged Catalog," in color, gives complete specs. in tabular form for oscilloscopes and companion instruments. Characteristics, uses, prices and other sales data are included. Tektronix, Inc., P. O. Box 500, Beaverton, Ore.

Circle 347 on Inquiry Card

## Test Equipment Cart Model 30-1

The Model 30-1 Basic Cart was designed for easy handling of counters. It is large enough to handle single large or several small test units. The base provides storage for test leads and auxiliary equipment. To provide maximum utility, various alternative modifications have been developed. Shipped knocked down.



BASIC MODEL \$59.50

### Specifications

- Color . . . . . Dark Brown
- Handles . . . . . Nickel Plated
- Hardware . . . . . Nickel Plated
- Cushion . . . . . 3/16" Felt
- Construction . . . . . Heavy Gauge
- Size . . . . . 23" x 23" x 36 1/2"
- Weight . . . . . 90 Pounds (basic cart)
- Deluxe Model (with drawers) . . . . . \$131.50

## NORTHEASTERN

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**Measures resistance to 10,000,000 megohms**

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- versatile-accurate-reliable**
- dual test voltage . . . 500 vdc and 50 vdc
  - 24" total scale length . . . 1 to 10,000,000 megohms in 6 decades
  - measures resistance on printed circuits, transistor and miniaturized circuit components, cables, motors, etc.
  - measures leakage resistance of capacitors
  - measures grounded and ungrounded sections of three-terminal resistors
- advanced features**
- constant test voltage over full range
  - no overload damage
  - positive line voltage control
  - maximum guarding flexibility
  - latest tube-miniaturization techniques

2-35.7

Get all facts . . . write for Bulletin 2-1.4

**Associated Research, Inc.**  
Manufacturers of Electrical Testing Instruments since 1936  
3787 W Belmont Avenue Chicago 18 Illinois

Circle 113 on Inquiry Card



## Sweetest choice in miniatures

Today, you needn't look any further than Honeywell in your move to miniature meters. Honeywell's popular line, broadest in the industry, offers many shapes and models to choose from. Catching on fast is the brand-new, modern-styled MS-1 Square Meter. It has longer scale length, a clean, uncluttered dial and concave cover, stacks flush vertically and horizontally. In addition, there's the HS-1 Ruggedized Meter that shrugs off vibration, is immune to

dust and moisture; the MCE-1 Edgewise Meter, for use in cramped areas; and the contemporary-looking MM-1 Medalist®. All Honeywell miniatures are produced in quantity, so you can get immediate delivery. For further information, just write to us at Honeywell, Precision Meter Division, Manchester, New Hampshire. In Canada, Honeywell Controls Ltd., Toronto 17, Ontario.

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# STATE OF THE ART



**MODEL 242 Resistance MEASURING SYSTEM**

High accuracy, matched instrumentation for wide-range, direct resistance measurement and part per million resistance comparison. Measures direct resistance to a guaranteed accuracy of  $\pm 0.01\%$  with clip lead simplicity and without external standards. Makes resistance comparisons to an accuracy of 1 part per million. Bridge range—100 microhms through 120 megohms. Typical applications: calibration of laboratory and working standards; expected life, temperature and voltage coefficient studies; traceability proof; resistor check-in or quality control; stability studies. Complete system in metal cabinet—Model 240 double guarded Kelvin ratio bridge; Model 800 dc generator-detector; Model RS 925 nine-dial, adjustable, four-terminal decade resistance standard; Kelvin Klip™ four-terminal clips—\$3400 f.o.b. Portland, Oregon.



For detailed information, request Catalog Sheet C-27; "Design Ideas", Volumes I, II and III; Engineering Bulletin No. 30, "Traceability of Resistance Measurement."

**Electro Scientific Industries**  
7524 S.W. Macadam Ave. • Portland 19, Ore

Circle 115 on Inquiry Card

## NEW TECH DATA

### Atomic Frequency Standard

A solid-state, optically pumped rubidium freq. standard is described in Product Spec. Sheet No. 70. The 4-page brochure keys the theory of operation to a block diagram of the instrument. Performance data at the National Bureau of Standards is plotted to document stated stability. Uses of the standard described include navigation systems, communication systems, and its use for laboratory calibration. STL Products, 139 Illinois St., El Segundo, Calif.

Circle 348 on Inquiry Card

### Intervalometer Catalog

A 46-page catalog, AIC 1017, describes standard models of time delay relays, intervalometers and program controls, plus basic units for custom modification. Technical data, outline dimensions and environmental characteristics are given. Abrams Instrument Corp., Dept. 107, 606 E. Shiawassee St., Lansing 1, Mich.

Circle 349 on Inquiry Card

### Shock Machine

Data is available on a new shock tower for environmental testing of components under shock or impact. The 15-ft. tower is a vertical drop shock machine, designed to meet the need for a method of testing manufactured units at high "g" levels. Dept. 2A, Livingston Electronic Corp. Montgomeryville, Pa.

Circle 350 on Inquiry Card

### Semiconductor Tester

Data is available on a Go/No-go multi-parameter tester, Series 250, which conducts tests at the rate of 900 units/hr. This equipment features 16 variable go/no-go tests per unit, is easy to operate. Fairchild Semiconductor Corp., 545 Whisman Rd., Mountain View, Calif.

Circle 351 on Inquiry Card

### Magnetic Modulators

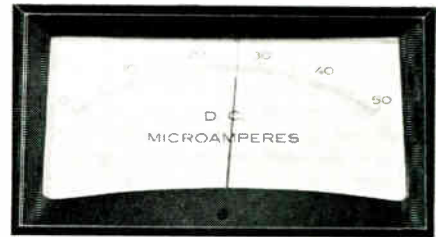
Specs. for magnetic and electronic modulators, analog multipliers, solid-state control relays, and dc and ac current sensors are detailed in a 6-page catalog. Theory of magnetic modulator operation is also covered. Transmagnetics, Inc., 134-08 36th Rd., Flushing 54, N. Y.

Circle 352 on Inquiry Card

### Underwater Camera Control

A 2-color data sheet gives complete specs. on small pan and tilt control for underwater cameras. Unit features open-frame design which requires no sealing or bulky housings. Also described are its underwater motors and components. Unit, Model #8700-1, is designed for operation in seawater, radioactive liquids and other environmental fluids. Electro-Kinetics Corp., 909 Border Ave., Torrance, Calif.

Circle 353 on Inquiry Card



**New low prices**



**for taut-band meters...**



**fresh new styling, too**

Now you can get taut-band performance, a variety of newly designed case styles and sizes, and a new type of meter-movement construction—all at lower prices than ever before—in API's Stylist/Panelist meter line.

The internal-magnet movement is self shielding, and the taut-band suspension offers a number of advantages. For one thing, it is virtually frictionless in operation; this gives the meter exceptional sensitivity (as low as 0.3 ua or 0.2 mv, full scale) and excellent accuracy (as close as  $\pm 0.5\%$ ). And for another, it is extremely rugged, inherently resistant to shock.

API's new Stylist/Panelist series is available in a wide choice of sizes from 2 1/4" to 6" in the three basic models shown above. The top photo shows the Stylist, the distinctive meter design that started an industry trend. Next is the Panelist, which is available in an all-clear plastic case or, optionally, with a color lower section. Shown at the bottom is the one model offered in a black phenolic case, in the widely used 4 1/2" size. All models can be supplied as pyrometers and some as contacting or contactless optical meter-relays.

For complete specifications and prices, write for Bulletin 34.



**ASSEMBLY PRODUCTS, INC.**  
CHESTERLAND 92, OHIO

Circle 116 on Inquiry Card SA 2795



# NEW TECH DATA

for Engineers.

## Direct Writing Brochure

This brochure gives a brief description of the high-speed, direct-writing recording instruments. Illustrated and described are Techni-Rite Analog Recorders, and Ana-Vent Recorders. Militarized adaptations of these recorders are available which comply with Mil-E-4158 and Mil-1-6181. Techni-Rite Electronics, Inc., 65 Centerville Rd., Warwick, R. I.

Circle 354 on Inquiry Card

## Precision Phase Detectors

Data sheets available from Ad-Yu Electronics, Inc., 249-259 Terhune Ave., Passaic, N. J., include one on millimicrosecond phase detectors. Several types are listed with specs., illustrations, schematics, characteristics, uses and accessories.

Circle 355 on Inquiry Card

## Epoxy Spray Tests

A test service to aid electric motor manufacturers in evaluating 1-part epoxy insulation on stators and armatures has been established. Details are available from Dept. W3-201, 3M Co., 2501 Hudson Rd., St. Paul 19, Minn.

Circle 356 on Inquiry Card

## Fault Counter

The PHYWE Fault Counter, Model IV, tests defects in enamelled wires. The wires to be tested are run through a solution of NaCl or Hg. The device detects a defect when insulation resistance is  $10K\Omega$  or less. Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, L. I., N. Y.

Circle 357 on Inquiry Card

## Strip-Chart Recorders

Bulletin on strip-chart recorders describes linear/log recorder and high-sensitivity recorder with sensitivity of  $1\mu v$ . in the 0.5mv. range. An automatic integrator is also described and illustrated. LaPine Scientific Co., 6001 S. Knox Ave., Chicago 29, Ill.

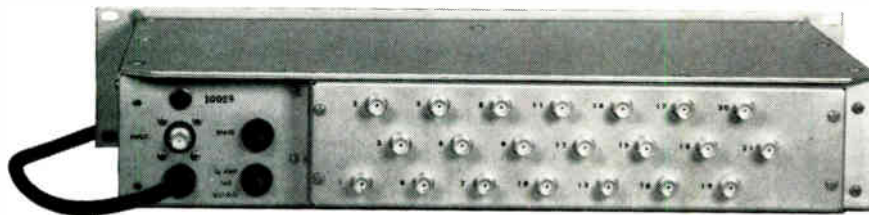
Circle 358 on Inquiry Card

## High-Voltage Testing

The 12-page short-form catalog No. 63 on high-voltage test sets and power supplies covers instruments for lab and production tests and industrial processes. Peschel Instruments, Inc., Route 216, Towners, Patterson, N. Y.

Circle 359 on Inquiry Card

**NOW... MULTIPLY YOUR  
LAB FREQUENCY STANDARD  
BY 21!**



### Montronics Model 202 • Standard Frequency Distribution Amplifier

- Up to 21 independent amplifiers available in a 3 1/4" panel
- Solid state circuitry with silicon transistor reliability
- Very low phase shift with temperature
- Supplied for 100 kc, 1 mc, or 5 mc frequencies
- Maximum isolation between outputs



*Application:* Ability to supply precision frequency standard to 21 remote locations for instrument calibration, frequency and time counters, signal generators, communications transmitters and receivers.

PRICE: 10 ch.—\$1075; 12 ch.—\$1210; 15 ch.—\$1345; 18 ch.—\$1480; 21 ch.—\$1615

f.o.b. Bozeman, Montana

Write for further details—MONTRONICS, Inc. (P. O. Box 345)  
703 W. Babcock Street, Bozeman, Montana

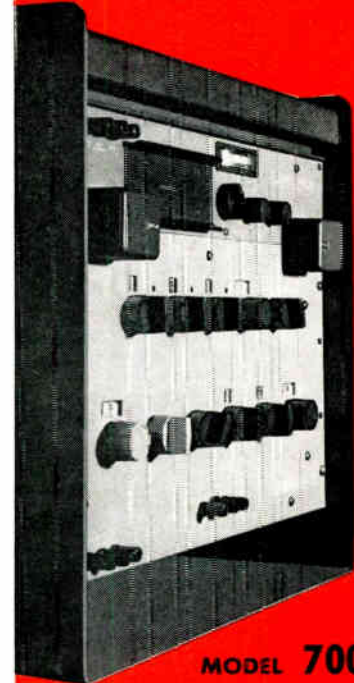


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**MODEL 700A  
Capacitance  
MEASURING SYSTEM**

Functionally designed — the industry's easiest-to-operate, high accuracy capacitance bridge. Wide-range, direct reading ratio transformer circuit features the specially designed, hermetically sealed, ESI air capacitor—temperature coefficient better than  $0 \pm 2$  ppm/C, long term drift not more than  $\pm 0.005\%$  per year. Accuracy of the measured capacitance is referred to this one standard which can be periodically checked and adjusted to agree with an NBS calibrated standard. Measures two and three-terminal capacitors in the range from 0 to 1.2 microfarads. Resolution—100 micro-picofarads ( $10^{-4}$  pf) per dial division for the lowest range. Typical applications: calibration of two- and three-terminal variable air capacitors; measurements of voltage and temperature effects on all types of capacitors. Complete system in metal cabinet—Model 707A capacitance bridge, Model 860B ac generator-detector—\$1750 f.o.b. Portland, Oregon.



For detailed information, request Catalog Sheet C-28; Engineering Bulletin No. 31, "Transformer Bridge Theory and Practice."

**Electro Scientific Industries**  
7524 S.W. Macadam Ave. • Portland 19, Ore

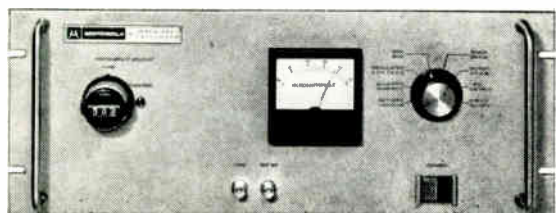
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**1x10<sup>-11</sup>**  
Stability

**5x10<sup>-11</sup>**  
Aging per Day

**5x10<sup>-11</sup>**  
Short Term Stability, 1 Second Counts

Less than **2x10<sup>-10</sup>**  
20°C ± 20°C



**Motorola 1011 Frequency Standard—  
the Ultimate in Stability!**

- True proportional control double oven construction.
- Constant gain oscillator circuitry.
- Selected 2.5 mc 5th overtone crystals.
- Solid state silicon design.
- 15-hour sealed nickel-cadmium batteries included.
- Power failure alarms.
- Frequency Adjust setable to 1 part in 10<sup>11</sup>.
- Fail-Safe dividers.
- Optional 5 mc crystal-filtered output for spectral purity.
- Regulated power supply.
- Design guaranteed by over 2 decades of Motorola crystal and oscillator experience.
- Model S1065AR includes 15 hour battery pack \$3,950.00. Model S1066AR includes 5 mc spectrally pure output \$4,650.00. Model SLN6076A extra 15 hour battery pack to provide 30 hour operation \$300.00.



**MOTOROLA**  
PRECISION MEASURING INSTRUMENTS

Ask your Motorola Instrument Representative for full details or write Dept. AE1322  
Motorola Communications & Electronics, Inc.,  
4501 Augusta Blvd., Chicago 51, Ill. A Subsidiary of Motorola Inc.

Circle 119 on Inquiry Card

# ELECTRONIC INDUSTRIES

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### TUNING FORK OSCILLATORS

### Models for Every Requirement

Send for complete  
information and  
literature. Engineering  
service on special  
problems.

**MODEL C**—Transistorized oscillator for maximum accuracy, operating temperature and frequency range.

**MODEL E**—Transistorized oscillator with limited features allowing a much lower price.

**MODEL K**—Binary and decade dividers for use with Model E Oscillator to obtain lower frequency output at minimum cost.

**MODEL M**—Miniaturized tuning fork oscillator: medium accuracy, suitable for printed circuit use.

**MODEL F**—Electric tuning fork alone. For printed circuit use by those who build their own audio frequency oscillators.

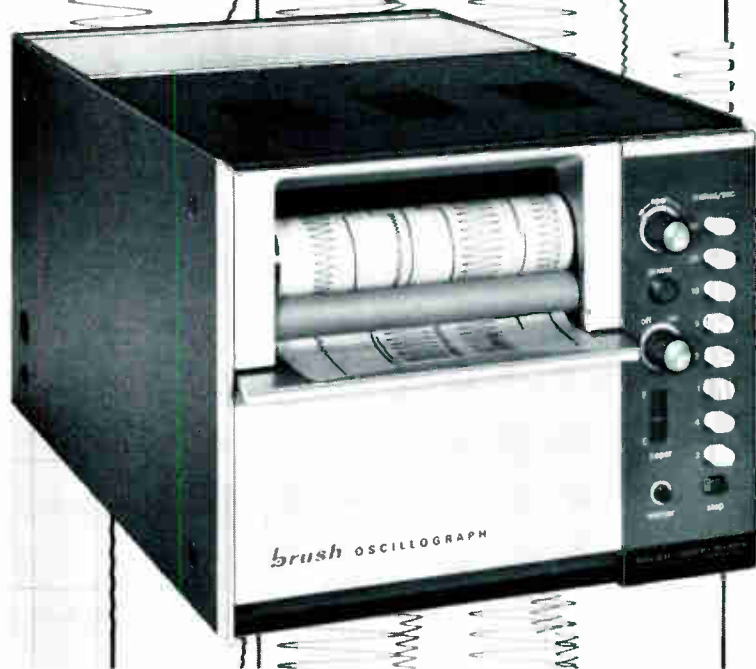
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DIVISION OF CLEVITE 37TH AND PERKINS, CLEVELAND 14, OHIO  
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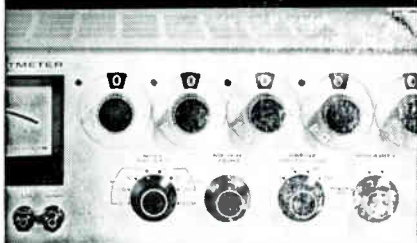
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100mv to 500v



within 0.02%



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Note on the Model 660

latest catalog available  
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# NEW TECH DATA

for Engineers.

## Light-Beam Oscillographs

Brochure 2300, 3 colors, describes the Series 2300 8 or 16-channel light-beam oscillographs. It uses an incandescent light source for simple, safe and economical operation. The brochure discusses the advantages offered by an incandescent light source and lists specs. for the oscillograph and its associated amplifiers. Brush Instruments, Div. of Clevite Corp., 37th & Perkins, Cleveland 14, Ohio.

Circle 455 on Inquiry Card

## Ion Beam Generator Bulletin

Bulletin IBG-1 describes an ion beam generator which produces a steady, controllable beam of metal ions. The ion beam generator has potential uses in semiconductor technology, image formation and research. Schematic and circuit diagrams, specs., and tables of typical operating conditions are also included. CBS Laboratories, High Ridge Rd., Stamford, Conn.

Circle 456 on Inquiry Card

## Light Measuring System

The Hydrophotometer Type HHP is an underwater light-measuring system which allows a means of accurate, sensitive and wavelength-selective measurements of irradiance and radiance in hydro-space. A 16-page booklet describes functions and uses. Hoffman Electronics Corp., 700 Hoffman Dr., Santa Barbara, Calif.

Circle 457 on Inquiry Card

## Nuclear Products

Brochure GET-3127, 12 pages, 2 colors, describes more than 30 nuclear instrumentation components. Included is information on fission counters, ion chambers, integral cable counters and chambers; pulse measuring equipment; current measuring equipment, power supplies and radiation monitors. General Electric Co., Schenectady 5, N. Y.

Circle 458 on Inquiry Card

## Pulse Generator

Tech. Bulletin 106 describes the Datapulse 106 pulse generator which offers linear, variable rise and fall times from less than 10nsec. A complete set of oscilloscope photos illustrates the unit's waveform capabilities, and a full listing of specs. is provided. Datapulse Inc., 509 Hindry Ave., Inglewood 1, Calif.

Circle 459 on Inquiry Card

## Tachometer Generator

Specs. and data are presented on Vibrac Bearingless Tachometer Generator which has meter and freq.-responsive module to provide a complete speed measuring system. Vibrac Corp., Route 129, Alpha Industrial Park, Chelmsford, Mass.

Circle 460 on Inquiry Card

## Resistance Standard Device

This 4-terminal rheostat provides exceptional resistance standards capability. It established 893 reference resistance standard values in 2 digits, in the ranges from 1 $\Omega$  to 110K $\Omega$ . The rheostat enables the use of resistance values at Rosa levels without the need for complex mercury cups. When used as a calibrating device, a conventional 0.1% bridge can be operated at an accuracy with 0.01% or better for all discrete resistance values within the 1 $\Omega$  to 110K $\Omega$  range. Angstrom Precision Inc., 7341 Greenbush Ave., N. Hollywood, Calif.

Circle 461 on Inquiry Card

## Oscilloscope Booklet

This brochure describes 14 types of oscilloscopes designed for rack and console service. Models covered include dual-beam, readout and sampling types with up to sub-nsec. ranges; and amplifier and time-base plug-in units. Instrument dimensions and mounting details are also included. The booklet contains information on plug-in unit storage cabinets and cradle mounts designed for rack-mounting installation. Requests should be made on business letterheads. Tektronic, Inc., Box 500, Beaverton, Ore.

Circle 462 on Inquiry Card

## Line Fault Analyzer

The Sierra 371A Line Fault Analyzer, which has a 200 mile range, is described in this report. It features a display of line faults reproduced from photos of an analyzer's scope presentations. The device can pinpoint fault locations remotely, and identify open lines, shorted lines, grounds, taps, and capacitor or transformer banks. Sierra Electronic Div. of Philco, Marketing Dept., 3839A Bohannon Dr., Menlo Park, Calif.

Circle 463 on Inquiry Card

## Tantalum Test Unit

This tantalum-capacitor test unit prints out characteristics of a capacitor under test in only 8 sec. The test compares the capacitance and dissipation-factor characteristics of unknown capacitors with the known values of standard capacitors. The results are presented as a percentage difference. RCA Electron Tube Div., Harrison, N. J.

Circle 464 on Inquiry Card

## Digital Catalog

A bulletin and price list on the Chrono-log digital clocks, digital calendars, digital counters and digital timers is now available from Chrono-log Corp., 2583 West Chester Pike, Broomall, Pa. It includes complete technical details and engineering specs. The price list covers over 50 standard models.

Circle 465 on Inquiry Card

# NEW TECH DATA

for Engineers.

## Controller Bulletin

This 8-page bulletin, B850, describes Hays Model 850 controllers for control of pH, conductivity, flow, gas analysis, pressure, current, humidity, etc. Four pages are devoted to schematics of basic control systems and principles of operation. The Hays Corp., Michigan City, Ind.

Circle 466 on Inquiry Card

## Electromanometer

Bulletin 1547C describes rack-mounted electromanometer systems which provide secondary pressure-standard accuracies for laboratory, field, or automatic process control. The precision pressure balances measure differential, gage, and absolute pressure to 500psi. Pressure balance may be separated from the servo amplifier by as much as 400 ft. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 467 on Inquiry Card

## Instrument Guide

"NLS Instrument Selection Guide," new 8-page short form catalog, is available from Non-Linear Systems, Inc., Del Mar, Calif. It lists the complete NLS line, including 15 new products. Basic specs., prices are given. The Delta Design, Inc., line of environmental test equipment, now being marketed by NLS, is also listed.

Circle 468 on Inquiry Card

## Precision CRT Display

A 6-page brochure describes Type 30 CRT Display. Digital display converts stored digital data into graphic or tabular form. Requiring only logic level inputs, it easily connects to most digital systems. Technical Publications Dept., Digital Equipment Corp., 146 Main St., Maynard, Mass.

Circle 469 on Inquiry Card

## PPI Indicator

An 8-page, 3-color booklet, ED 3-10-2, on new Westinghouse transistorized universal plan position indicator (indicator group AN/UPA-48) is available from Westinghouse Electronics Div., Box 1897, Baltimore 3, Md. It describes the features and gives reference data for the versatile unit.

Circle 470 on Inquiry Card

## True-RMS Voltmeter

This 4-page brochure describes the Ballantine Model 320A, a sensitive wide band true RMS-responding voltmeter with freq. range from 5cps to 4Mc, voltage range of 100 $\mu$ v to 330v and basic accuracy of better than 2%. Ballantine Laboratories, Inc., Boonton, N. J.

Circle 471 on Inquiry Card

## Solid-State Counter

Data describes Model 40-80 solid-state counter. Nine standard output frequencies are available in decade steps from 0.1cps to 10Mc. Plug-in components include a unit which counts from dc to 200Mc and a 200Mc to 1,000Mc frequency converter. Northeastern Engineering Co., Inc., Manchester, N. H.

Circle 472 on Inquiry Card

## Instruments and Standards

Catalog No. 75 contains over 160 pages of technical and descriptive information on precision measurement and calibration instruments covering voltage, current, power, frequency and magnetic quantities from dc to 1000Mc. The data on uses makes the catalog a useful textbook of precision measurements. Singer Metrics Div., The Singer Mfg. Co., 915 Penbrooke St., Bridgeport, Conn.

Circle 473 on Inquiry Card

## Magnetometer

A portable, battery-operated, laboratory magnetometer capable of detecting and measuring magnetic fields from 1 to 100,000 gamma is available from Marshall Laboratories, a sub. of Marshall Industries, 3530 Torrance Blvd., Torrance, Calif. Power requirement is 12v ( $\pm 10\%$ ), and the output is  $\pm 160$ mv. Additional specs. are available.

Circle 474 on Inquiry Card

## Test Equipment

The 16-page 1963 Short Form Catalog describes a complete line of X-Y recorders, T-Y recorders and laboratory test equipment. Also described are ac and dc voltmeters, dc amplifiers, ac/dc converters, log freq/dc converters and test calibration units. Houston Instrument Corp., 4950 Terminal Ave., Bellaire 101, Tex.

Circle 475 on Inquiry Card

## Transistor Devices

This short-form catalog of transistor devices contains prices and characteristics of approx. 200 new products. These products consist of audio amplifiers, i-f amplifiers, miniature rectifier transformers and tiny power-supply modules. Ferrotran Electronics Co., Inc., 693 Broadway, New York 12, N. Y.

Circle 476 on Inquiry Card

## Instrument Selection Guide

This guide lists the complete line of NLS instruments, accessories and standard systems with basic specs. and prices. Included is a line of environmental test equipment. It lists 15 new instruments and accessories. Non-Linear Systems, Inc., Del Mar, Calif.

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## NEW KEITHLEY 3500V D. C. SUPPLY

The extreme stability of the Model 242 is not specified in hours. Now—over several months—you can perform extended duration measurements. Cumulative drift of this regulated supply is prevented by a self-correcting feedback loop featuring a temperature compensated zener diode reference, photo-chopper comparator and wire wound sampling resistors. 300 V to 3500 V are delivered at 25 ma, with less than 1 mv combined ripple and noise—ideal for photo tube, photo multiplier and electron multiplier applications. Other specifications contributing to the outstanding value of the Keithley 242 are shown below.

- **output:** 300 to 3,500 V at 25 ma in 1 volt steps—plus, minus, or floating to 4500 V
- **stability:** 0.01% indefinitely, after 30 minute warm-up
- **accuracy:**  $\pm 0.1\%$
- **ripple and noise:** Less than 1.0 millivolt rms
- **line regulation:** 0.005% for 10% change in line voltage
- **load regulation:** 0.005% from zero to full load
- **overload protection:** Automatic disconnect if current exceeds 27 ma
- **price:** \$850

### Other Regulated DC Supplies

Model 241, 0-1000 V, 0.05% accuracy \$800  
Model 240, 0-1000 V, 1.0% accuracy \$345

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- True
- Bandwidth
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# SECTION **F**

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## **ELECTROMECHANICAL COMPONENTS**

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|  |     |
|--|-----|
| A Look at Coded Disks and Encoders           | F2  |
| New Standards for Rotary Switches            | F8  |
| Progress in Telemetry and Pulsing<br>Devices | F14 |
| Progress in the Relay Field                  | F25 |

Rapid advancement of the digital computer has contributed to the widespread use of digital methods. This has in turn brought about an increased demand for shaft position encoders and coded disks.

Anyone who recognizes the advantages of digital processing should read this enlightening article.

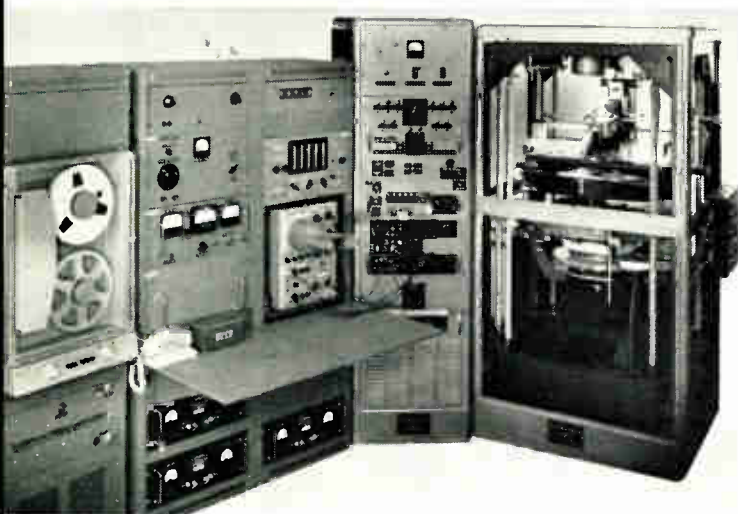
It outlines the types, applications, advances and trends of photoelectric shaft position encoders and coded disks.

# A LOOK AT CODED DISKS AND ENCODERS

THERE ARE SEVERAL DIFFERENT TYPES of shaft position encoders but only 2 main categories—contacting and noncontacting. These include, in the contacting types, those using brushes or commutation elements as the sensing means. The noncontacting category includes those operating on principles of magnetic, capacitive, or photoelectric pickup. Recently effort has been directed toward the improvement of high accuracy photoelectric methods. This effort has been concerned with accuracy improvements on coded disks and readout methods. Also as a result of this effort, economical lower-resolution photoelectric encoders have evolved which compete with the contacting types.

Of the various basic methods of encoding by non-contacting media, photoelectric methods appear to be

Fig. 1: Divided circle machine consists of two basic sections; a mechanical section (extreme right) comprised mainly of a highly precise turntable and an electronic programming system.



the most straightforward and advanced for generating digital information from shaft rotation. Among the advantages are the attainment of digital data directly from the coded disk and high accuracy. Only a few elements are needed to comprise a photoelectric shaft position encoder to obtain binary coded information defining the shaft position. These include:

1. A glass disk containing the desired opaque and clear sectioned pattern.
2. Input shaft supported by bearings.
3. A light source.
4. An optical system.
5. Photosensing elements.

Some of the more advanced types need only one low voltage to supply the light source. By using photovoltaic photocells, digital data is obtained directly from the photocell outputs. Thus the photoelectric type affords a simple and direct approach to acquiring digital data. Magnetic and capacitive sensors need excitation supplied by h-f oscillators and some means of detection to resolve digital signals. Usually this results in a more complex and therefore less reliable arrangement compared to photoelectric methods.

Key to the successful performance of the photoelectric encoder centers around the coded glass disk. A machine has been developed to rapidly produce accurate coded disks, which in themselves define the absolute maximum accuracy obtainable from an encoder.

By C. FARRELL WINDER

Baldwin Electronics, Inc.  
A Subsidiary of the  
D. H. Baldwin Co.  
Little Rock, Ark.

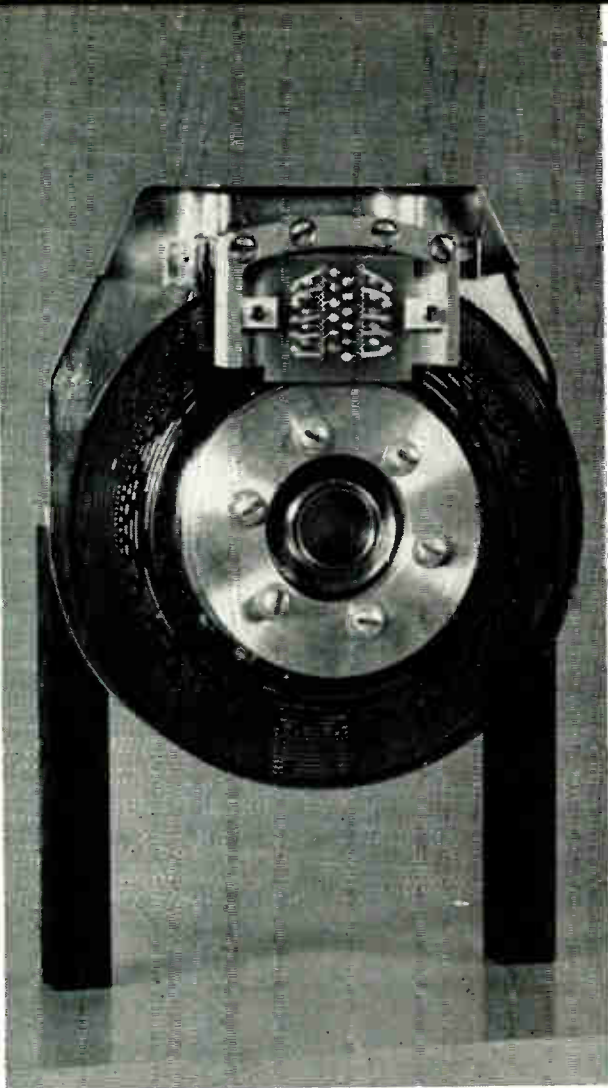


Fig. 2: Small 16-bit absolute reading encoder is only 4.5 in. in dia.

### Divided Circle Machine

A machine was designed and developed by Baldwin over a decade ago to make photographic glass disk masters for use in shaft position encoders. By 1959 pattern accuracy of this machine had reached to about one part in 1,048,576 ( $2^{20}$ ). A Baldwin disk was tested by the Bureau of Standards in Dec., 1959 and certified to 1.6 second positional accuracy.

Recently a fivefold improvement has been attained by use of error reduction methods which were applied to the master reference pattern on the machine. Patterns can now be produced having a positional accuracy of 0.3 seconds of arc and better, i.e., 1 part in better than 4,000,000. An electronic programming section in the machine allows almost any coded pattern to be produced.

### Basic Types

**The Continuous Lamp Trend:** While encoders using gaseous flash lamps have been widely used and are still produced, a scheme using a continuous lamp has been included in a number of new designs. Several advantages are gained by the use of a con-

tinuous lamp. One is that only a low voltage is needed to operate the lamps. Usually 6.3 v. or less is enough whereas anode voltages of several hundred volts and trigger voltages of several kw are needed to operate a flash lamp. Also, RFI, which must be carefully shielded in flash lamp designs, is eliminated. Using photovoltaic photocells, only the lamp voltage is needed to operate the basic encoder. Hence the encoder contains a minimum of active elements. This results in high reliability.

Another advantage is that the encoder itself becomes a storage device. Changes in the output occur only when the shaft is rotated. Thus intermediate storage logic to supply related circuitry is unnecessary for some uses. Rate information can also be readily obtained from a continuous-lamp encoder.

Lamp life can be made very long. A slight reduction from rated voltage will increase the lamp life substantially. Generally the lamp is designed to have a life in excess of 5000 hr. at rated voltage. A longer lamp life can be obtained by sacrificing a small amount of encoder output signal.

Amplification is usually needed since the available output direct from photovoltaic photocells is only in the millivolt range. One method, is to use suitable dc amplifiers. Another method is to use a basic R-C coupled amplifier arranged with provisions for pulsed-interrogation of the input. This is generally the preferred method if the encoder and amplifier are to be subjected to wide temperature variations. The pulsed amplifier also serves as a means for interrogation of the encoder position on demand. Some systems operate on an interrogation or sampling basis wherein data is commanded by the system clock signals. The pulsed amplifier permits interrogation rates from any rate greater than zero upwards to several kc. Typical interrogation pulses for Baldwin "TA Series" pulsed amplifiers are 5 v., 5  $\mu$ sec in magnitude.

**"Absolute" or "Full Word" vs "Incremental" Types:** For positional data needs, rather than rate data needs, "absolute" or "full word" encoders offer an advantage in reliability over others, such as incremental encoders. Absolute position encoders use a multiple track disk defining the input shaft position in a distinct binary word for each one of the total possible positions definable on a particular disk. The full word disk therefore serves as a permanent storage medium unaffected by the previous history of signals to or from the encoder.

Incremental type encoders are, however, useful for some applications. These usually use a disk having at least one track of equally spaced clear and opaque sections. Another track having at least one narrow



## DISKS AND ENCODERS (Continued)

clear section can serve as a zero reference position for the system. These encoders must have a reference position from which to count angular increments as opposed to absolute angular information, which needs no reference position. Since the data is derived in increments, it must be accumulated in some external logic circuitry if it is to represent position. Data on the direction of shaft rotation may be obtained by using the output of a second pickup. Output of this pickup is usually displaced in phase by  $90^\circ$  from the other output. Thus lead-lag data may be resolved through standard methods to feed into a reversible binary counter. One disadvantage of using incremental schemes to determine position is the possibility of incorrect data resulting from false counts being generated by noise transients. Gross errors can also result from power failure.

However, incremental encoders do provide a simple means of generating high accuracy rate data. By taking advantage of the high accuracy disks, which are now being produced, the resultant rate-data accuracy can approach that of the basic disk itself. It should be noted that inherently high accuracy digital data is possible through incremental methods. By

using only one track and one or more pickups from the same track, the error that could arise from incorrect relative positionings of multiple tracks, from optics to read such multiple tracks, and from associated radial misalignment of an optical indexing assembly, is eliminated.

High accuracy rate data, which can be obtained from incremental encoders, is finding increased usage in deriving rate information for gyro test tables and gyro gimbal readout.

### Advanced Models

**Prototype One-Inch O.D. 13-Bit Encoder:** Within the last year the Baldwin Research group has completed several prototype models of a new type subminiature 13-bit encoder. The effort to develop this design has resulted in a photoelectric encoder with only 1/10 the volume of other models of comparable resolution.

This prototype model is contained in a size 11 synchro package. The package also contains miniature electronics for sequential interrogation<sup>2</sup> of the photocell output signals and a time-shared amplifier. This encoder is provided with a continuous lamp to illuminate the coded disk.

Sequential operation is done through the interrogation of one photocell at a time, in time sequence. Logic within the package performs the function of

Fig. 3: Continuous lamp encoder with optional dc or interrogated amplifier. Operation of the interrogation stage is such that, during interrogation, any signal from the photocell is tempo-

rarily reduced to near zero level by the shunting effect of this stage during conduction. When the interrogation pulse is removed the photocell signal is R-C coupled to a normal amplifier.

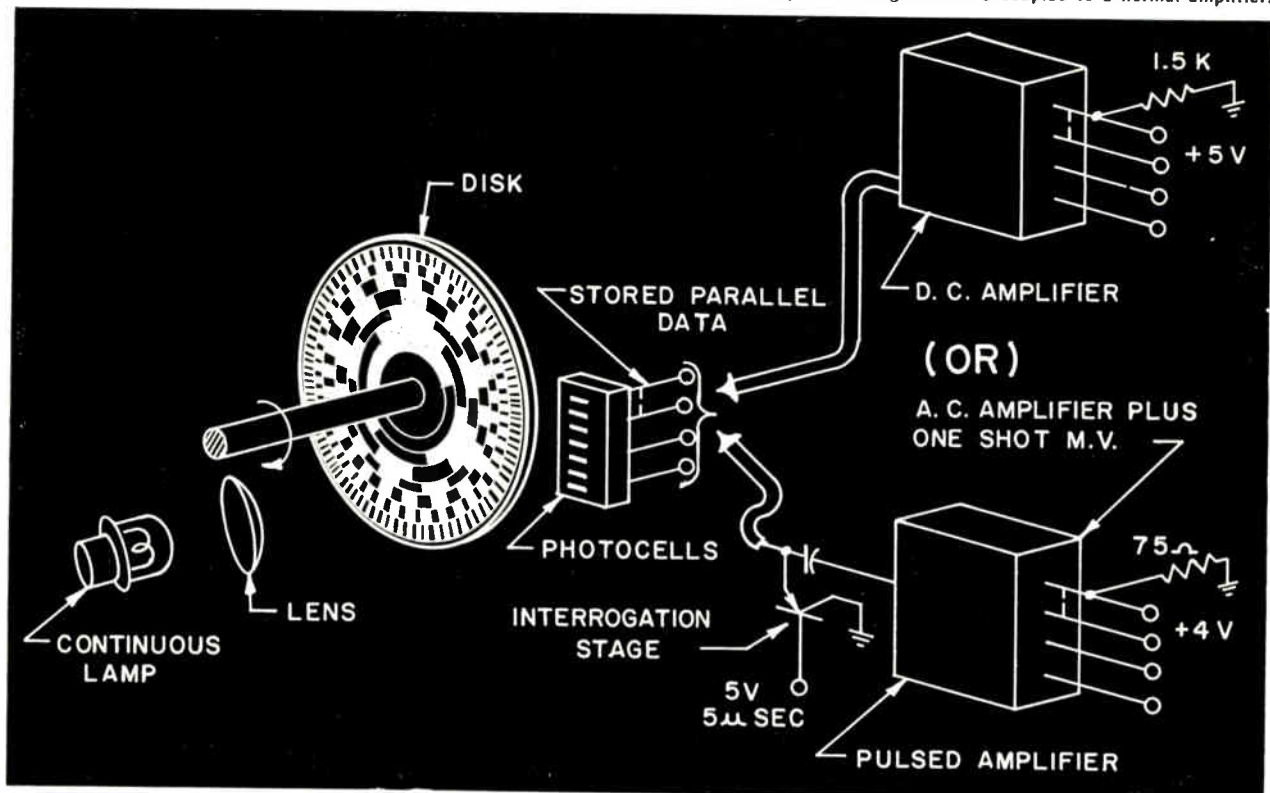
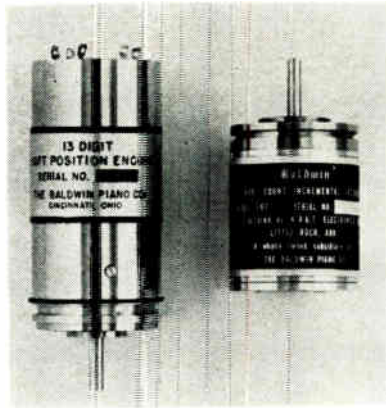


Fig. 4: Unit on the left is a prototype model of a new type subminiature 13-bit encoder. Unit on the right is a new subminiature incremental encoder for gyro rate measurements.



an electronic single-pole, multi-position switch. This switch operates at speeds permitting sample rates up to 1,000,000 digits/sec. Sequential operation of this unit permits the reduction of 13-bit data with only 5 connecting leads to the encoder. These encoders are now undergoing tests and evaluation by a government development lab.

The same packaging and optical methods using high-accuracy subminiature disks have been used to provide a new incremental encoder for gyro rate measurements. This unit features diametrically positioned readouts, direction sensing, cancellation of the dc components of the output signals and provision for increment multiplication. Photocells in this model have been positioned to give two sets of diametrical readouts. This makes possible the elimination of bearing-eccentricity errors.

Solid state circuitry, which provides increment multiplication up to 10 times, can be used with this model. The basic unit provides 600 counts per revolution and multiplication circuitry provides an output of 6000 counts per revolution.

**Small 16-Bit Satellite Encoder:** A recent advance in compact, high-accuracy, lightweight encoders has been achieved in the design and construction of a 16-bit absolute-reading encoder. This encoder is only 4.5 in. in diameter and is the smallest known photoelectric encoder having this high resolution. It uses an original master code disk to achieve a resolution of 1 part in 65,536.

To meet the needs of space operation, a reliability figure of 97% over a 12,000 hr life was demanded. To meet the severe conditions encountered during launch, a special optical train was devised to function with redundant lamps. Beam splitter optics provides for the light input from the two lamps. Ordinarily only one lamp is operating. If failure should occur in this lamp, the other is turned on by current detection circuitry placed in series with the first lamp.

The encoder weighs less than one lb. The mechan-

ical assembly can serve as an integrated gimbal mounting pivot. This encoder uses a continuous lamp and is operated in the sequential mode. A modified pulsed amplifier arrangement is used wherein 16 interrogation stages operating in sequence are used to feed the common input of a time-shared amplifier. The power consumption of the lamp, the sequential interrogation circuitry and the amplifier is less than 1.7 w. total.

This type package will find increased use on star trackers, attitude reference platforms and inertial systems.

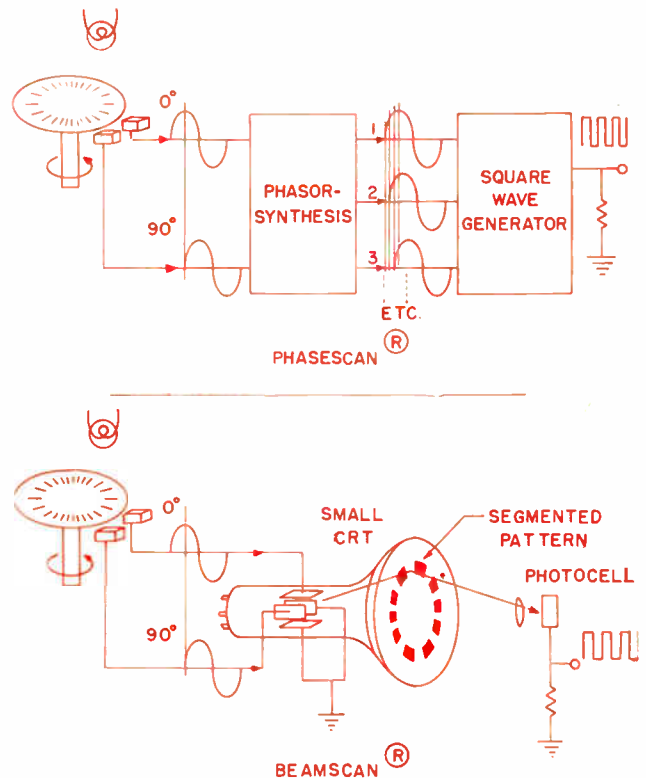
**18-Bit Encoder:** An achievement made possible only by using the high accuracy disks already discussed is the 18-bit encoder. Its diameter is only 9 7/8 in. and its height only 4 1/16 in.

Its construction is centered around a large dual bearing having a typical runout of only 10 millionths of an inch. This bearing is built to withstand axial loads up to 500 lbs and radial loads up to 6000 lbs. It can therefore serve as a rugged pivot member in a mechanical system.

This encoder uses modular construction throughout with easily replaceable modules for the power supply, amplifiers, and lamp assembly. A hollow shaft version permits a waveguide or optics to pass axially through the center of the encoder.

This encoder has been independently tested using

Fig. 5: Phasescan (upper) and Beamscan (lower) vernier techniques were verified by use of these two test arrangements.



## DISKS AND ENCODERS (Continued)

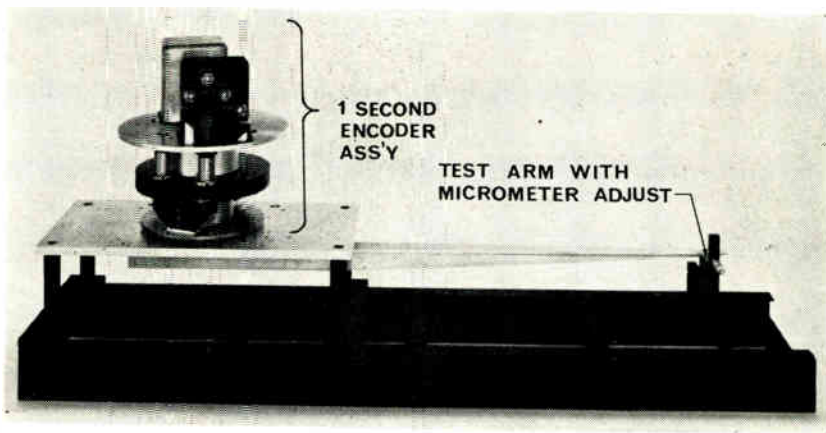


Fig. 6: The one-second encoder is shown on a test stand. In this encoder additional phasors are synthesized to produce a "ten-times" count from a disk having 129,000 increments (ten second-of-arc spacing).

4 autocollimators and an optical polygon having 16 prisms. Absolute accuracy of the prisms was specified as 1.25 secs of arc. Over a 360° positional check maximum deviation was only -3.5 secs of arc from averaged true reference. (Quantum of an 18-bit encoder is 4.94 secs of arc.)

**High Resolution Methods:** Frequent demands are made for resolutions and accuracies much beyond that now attainable from absolute or full-word coded disks of practical size. Two recent innovations have been used to advance high accuracy readout from photoelectric encoders as described below.

A phasor pickoff method known as Phasescan has been developed to provide outputs with resolution and accuracy in the order of one second of arc over 360° of rotation. This is done with a single disk rotating through only one turn. The basic Phasescan encoder is about 14 in. in diameter by 14 in. deep.

Where very high resolution readout is needed for position measurement such as 1 sec of arc or better, it is desirable to use an absolute reading disk for the coarser reading. Phasescan is then able to provide a vernier reading which is combined with the coarse output of the absolute encoder. Phasescan data is derived from a single track on the disk. The least significant digit (L.S.D.) of the absolute-reading code disk can serve for this purpose. A more ideal arrangement is to provide an added track having a higher multiple of the L.S.D. graduations for derivation of phasescan signals. Phasescan methods can also be used on incremental encoders or tachometers to add vernier readings. The basic principle makes use of photoelectric pickups, which establish an accurate 0° and 90° phase relation from a basic high-accuracy pattern. It should be noted that the resultant vernier data can at best be of only equal accuracy to that of the original disk. Thus the disk accuracy is of paramount importance in the resultant vernier digital output. By composing known encoder outputs to have 90° phase relationships and making these outputs

independent of angular velocity, it is possible to synthesize additional phasors.

In the one-second encoder, additional phasors are synthesized to produce a "ten times" count from a disk having 129,600 increments (10 second-of-arc spacing). These phasors, which describe essentially sinusoidal patterns as the disk is rotated, are individually fed into trigger circuits which provide square wave output. For positional data these outputs are combined with the absolute-encoder data to provide a composite output. For tachometer use, the output is applied to a counter. In rate measurements, it is compared to an accurate reference oscillator. Many error compensation features are used so that the output will represent the highest-attainable accuracy. Compensation is applied for errors arising from dc signal shift, variation in lamp voltage, lamp aging, line width variations on the disk, small imperfections on the disk pattern bearing runout, and imperfect disk centering.

Phasescan methods have at the present time an upper limiting factor of about 30-times multiplication. Where still higher resolution data is needed other methods have been successfully shown.

A further innovation of vernier methods, the Beamscan, has been used wherein vernier outputs of up to 100 increments for each input cycle have been realized. A method was described for deriving two waveforms of 90° phase relation. By applying these waveforms to a small CRT, a circular Lissajous pattern is described each time the input waveform completes one cycle. By placing a segmented pattern of alternate opaque and clear sectors over the circular scan, the resultant light output from the CRT represents vernier data of the output. A photocell is used to convert the light output to digital data. By using 129,600 divisions on the encoder disk and a pattern of 100 segments on the CRT, the Beamscan arrangement provides 1/10 sec. of arc increments (one part in 12,960,000 or one part in more than 2<sup>23</sup>) at the out-



put! These devices have been devised mainly for gyro testing, but the methods are broadly applicable. Experiments with the 1/10 sec. encoder have suggested that the unit would provide very sensitive digital seismometer.

Either the Phasescan or Beamscan methods can be used with coded disks to read out in many ways.

**Multiturn Encoders for Numerical Positioning and Control:** Digital shaft-position encoders are finding key roles in numerical positioning and control systems. In such uses as machine tool positioning, film readers and X-Y plotters, position data is needed to the order of 0.001 to 0.0001 in. over linear distances up to about 1000 in. maximum. Since rack and pinion arrangements or lead screws can convert linear motion to rotary motion with the required accuracy, then rotary shaft-position encoders are well suited to read out position data.

A typical need might call for readings in thousandths of an inch increments over 100 in. of travel. An encoder arrangement to satisfy this need would be an encoder reading 1000 increments per in. of motion with a rack and pinion converting each linear inch of travel to one turn of rotary motion. A second encoder must then be coupled to the input encoder, e.g., through a gear train, to establish a definite turns ratio between the two. In this example the

input encoder would supply 1000 increments per turn and the second encoder would supply 100 increments for a total of 100,000 increments. Since the second encoder is required to supply only 100 increments a 100:1 geared-down arrangement is used to couple the encoders together. This general category of encoders is termed multispeed<sup>7</sup> or multiturn.

Recent improvements in photoelectric encoders have afforded both a decrease in package size and a reduction in manufacturing costs, particularly for the lower-resolution types. Heretofore multiturn encoder arrangements have been provided chiefly by encoders of the contacting type. Some multiturn arrangements using resolvers have been used but they generally need complex logic to derive the desired digital data.

Photoelectric multiturn encoder assemblies offer many outstanding features. Among these advantages, when compared to the contacting types, are the elimination of contacting elements and their attendant problems of wear, bounce, noise and low reliability. With some contacting encoders the brushes or commutating segments must be lifted to prevent severe damage of the sensing elements during high speed slewing or traverse of the machine to which they are attached. Photoelectric encoders obviate this problem. These assemblies can also provide accuracy an

(Continued on page F26)

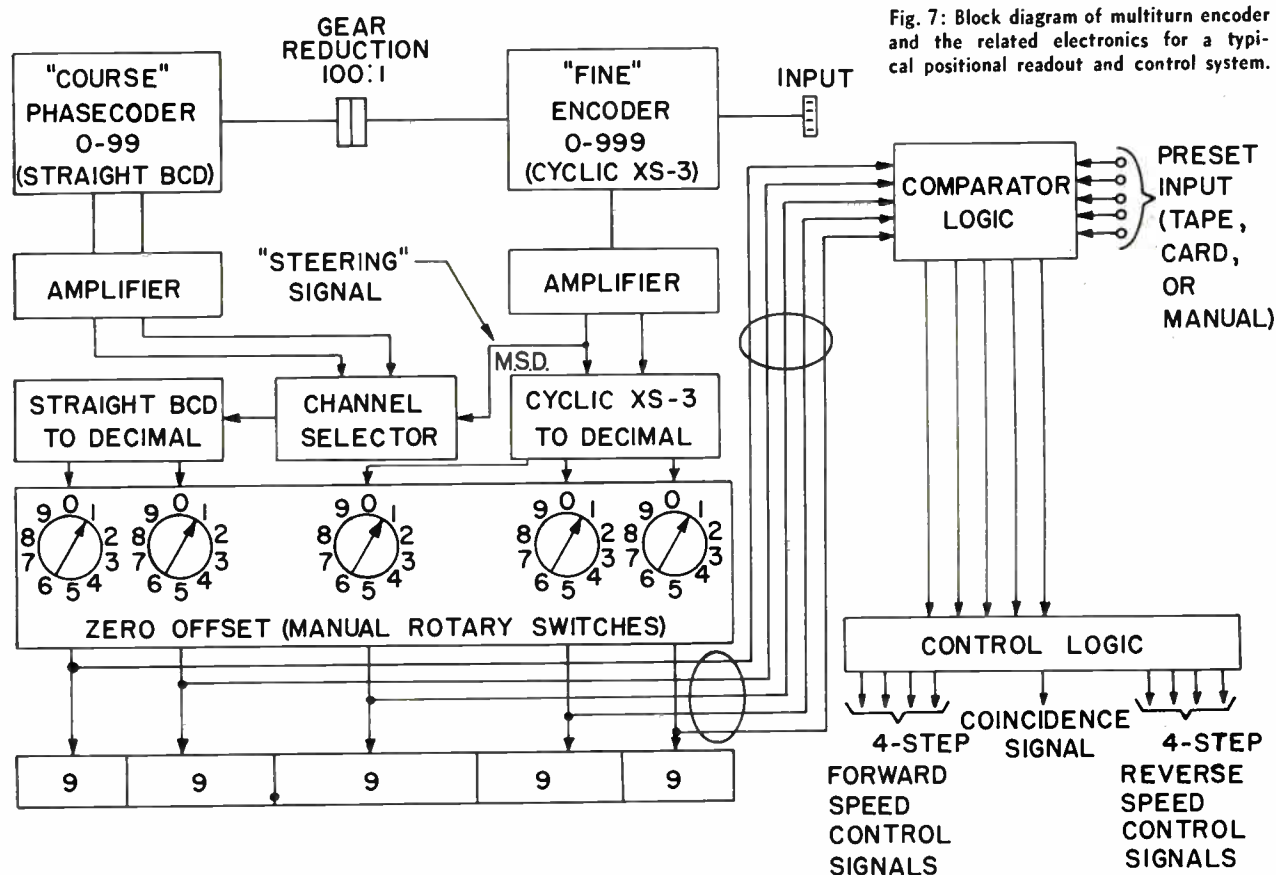


Fig. 7: Block diagram of multiturn encoder and the related electronics for a typical positional readout and control system.

MIL-S-3786A is based on important changes in service needs, availability of new materials and manufacturing techniques. It covers the latest designs in rotary switches. These are shown here so that the equipment engineer can obtain the rotary switch that gives the best performance.

# NEW STANDARDS FOR ROTARY SWITCHES

THE EQUIPMENT DESIGNER has many decisions to make when choosing a rotary switch for a specific use. One of the many factors he must consider is to have a switch work under the ambient mechanical stresses imposed. Is size and weight of prime importance; Or is the construction, insulation, or the maximum resistance to adverse environment the governing factor? There are now five types of construction, 3 levels of temperature-life characteristic, 2 basic types of insulation break-

down, 3 grades of vibration, and 2 levels of shock given in revised Specification MIL-S-3786A and Amendment 1. These are indicated in Tables 1 through 5. Each of these characteristics can be interlaced in any combination.

**Table 1**

Temperature-Life Characteristic.

| Symbol | Number of cycles of rotational life | Temperature range (°C) |
|--------|-------------------------------------|------------------------|
| A      | 10,000                              | -65 to +125            |
| B      | 25,000                              | -65 to +85             |
| C      | 25,000                              | -65 to +125            |

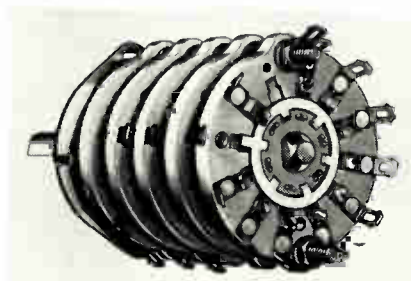
**Table 2**

Types of Construction.

| Symbol | Construction                              |
|--------|---|
| B      | Closed, without sealed shaft and bushing. |
| D      | Closed, with sealed shaft and bushing.    |
| E      | Explosion proof.                          |
| N      | Open, without sealed shaft or bushing.    |
| S      | Open, with sealed shaft and bushing.      |

**SR02 Style**

Oak Manufacturing Co. Type N5C.



**Table 3**

Vibration Grades.

| Symbol | Frequenc range in CPS |
|--------|-----------------------|
| 1      | 10 to 55              |
| 2      | 10 to 500             |
| 3      | 10 to 2,000           |

**Table 4**

Shock Types.

| Symbol | Type of shock |
|--------|---------------|
| M      | Medium impact |
| H      | High impact   |

**Table 5**

Types of Insulation.

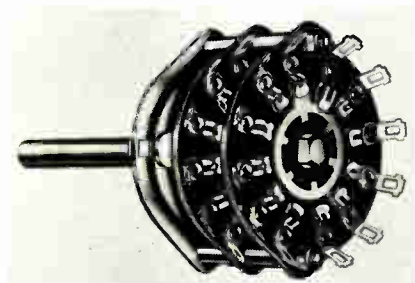
| Symbol | Insulation material |
|--------|---------------------|
| C      | Ceramic             |
| P      | Plastic             |

## Present Philosophy

This specification recognizes that it is not practical for the Military to standardize switches to their electrical shape, since rotary switches are one of the last items designed into equipment. The switching circuitry depends on the needs of the particular equipment, in the same way that a transformer is "custom tailored" for special gear. For this reason, no attempt is made to iden-

**By IRVING CAROL**

Standardization Div.  
U.S. Army EMSA  
Fort Monmouth, N.J.



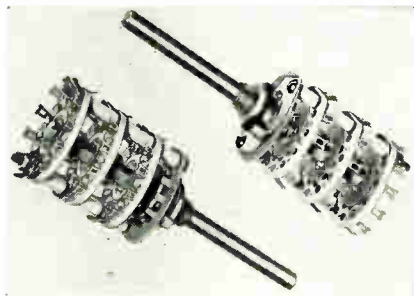
Oak Manufacturing Co. Type 514H.

**SR01 Style**

Switches designed to meet MIL-S-3786A in the style as indicated are shown.

**SR02 Style**

Centralab Div. Globe Union Inc. PA-2000 Series.



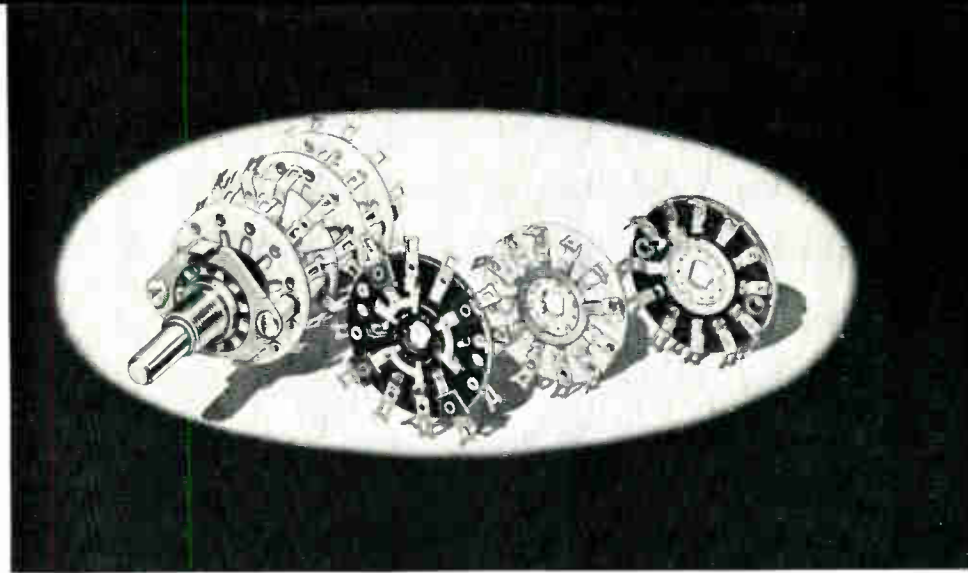
tify in the type designation the electrical circuitry, number of poles, positions and type of rotor blade per deck, and number of decks for each style of switch.

Ten detail specifications are presently included in MIL-S-3786A and several more are being processed. Each detail specification covers a widely used style of switch, designated SR01, SR02, etc. The wafer size, front plate and mounting dimensions, and other physical design and construction pertain to that style. The wafers (decks) can be either plastic or ceramic. Any plastic material can be used except cotton-base laminates or wood-flour or cotton-flour filled molding materials. Ceramic material must be grade L422 or a higher grade of Specification MIL-I-10A.

The most prevalent temperature-life available is B ( $-65^{\circ}$  to  $+85^{\circ}$  C for 25,000 cycles of rotation). However, some designs are being made in characteristic A ( $-65^{\circ}$  to  $+125^{\circ}$  C for 10,000 cycles), and C ( $-65^{\circ}$  to  $+125^{\circ}$  C for 25,000 cycles). Also, switches are now available for 50,000 cycles in an ambient of  $125^{\circ}$  C and a detail specification was recently issued to cover their type in style SR14.

Some manufacturers have already qualified for switches with 2,000 cycles vibration, high-impact shock, or both. As a rule, switches are specified to withstand 2,000 cycles vibration for Air Force use, while for Navy shipboard use, high-impact shock is specified.

The specification takes into account the changing military needs, changes in materials and manufacturing methods, and the increasing new uses for rotary switches. The scope of this specification covers rotary switches for making and breaking current up to 2 a. The specification was formed to be as simple and understandable as possible. The manufacturer's and user's viewpoints



*Centralab, the Electronics Division of Globe Union Inc. Series PA-600.*

#### SR03 Style

The switches seen here are designed to meet MIL-S-3786A in the style indicated for each.

were considered in each part of the writing and their opinions were viewed consistent with securing proper quality safeguards.

#### Features in the Specification

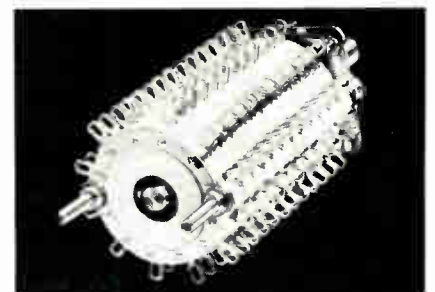
The original material to develop MIL-S-3786A was in a prototype specification prepared by the Armour Research Foundation (ARF) for the Wright Air Development Center under contract AF 33(600)-32206. ARF consulted with the various manufacturers of rotary switches while developing a draft. Next, ASESA, acting as agent for the Bureau of Ships, prepared an initial draft from the prototype specification as modified by a services coordination meeting. Comments from circulation of the initial draft were coordinated at a Service-Industry meeting in June 1960. The document was approved for use on 16 Jan. 1961. The subsequent Amendment 1 was likewise coordinated and approved for use on 10 Aug. 1962.

Several new features went into the specification, such as a standard size and location of the nonturn device. Some of the new tests and requirements of this specification include:

1. A solderability test like that now in MIL-STD-202B.
2. A method of terminal identifi-



*Out. Manufacturing Co. Type F.*  
SR03 Style



*CTS Corp. military Series 211.*  
SR03 Style

SR04 Style  
*Grayhill Inc., 23806 Series.*





## ROTARY SWITCHES (Concluded)

cation and orientation of deck wafers, as covered in Amendment 1.

3. A standard monitoring method to determine contact opening, if any, under vibration and shock.

4. A method of monitoring contact alignment of the first and last decks during the rotational life test.

During the vibration and medium-impact shock tests, the switches are checked for opening of closed contacts in excess of 10  $\mu$ sec. For high-

impact shock the time allowed is 5 msec.

Monitoring of the first and last decks for alignment during the rotational life test serves to realize the number of decks any switch style can have.

Terminal numbers for open-frame type switches are made visible and arranged CCW when viewed from the rear end of the switch. In addition, each wafer, the front plate, and the terminal identification marking plate (if used), must have a dot near the periphery between terminals 1

and 2 and on the plane facing the view from the rear of the switch. Terminal identification for closed-type switches has numbers, arranged CCW showing rows of the same numbered terminals, and visible from the rear end of the switch.

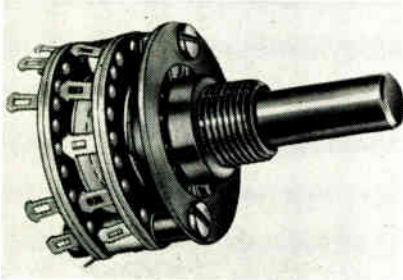
### Discussion of Rotary Switches

General purpose rotary switches are mostly of the open-construction types. Special needs for enclosed switches but not panel-sealed against moisture are covered by type B construction. Switches to be used where

Seen below are illustrative examples of switches designed to meet MIL-S-3786A in the style which is indicated for each picture.

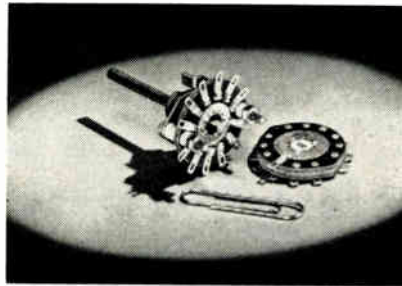
SR05 Style

Oak Manufacturing Co. Type A.



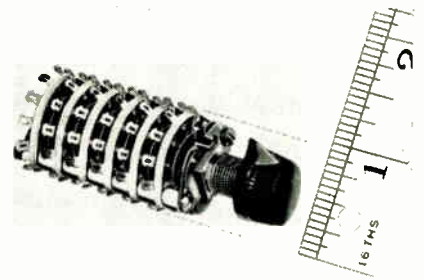
SR05 Style

Centralab Div./Globe Union Inc. Series 100.



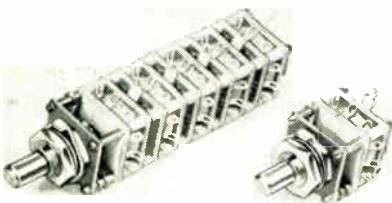
SR05 Style

J-B-T Instruments, Inc. V-7000 & V-5000 Series.



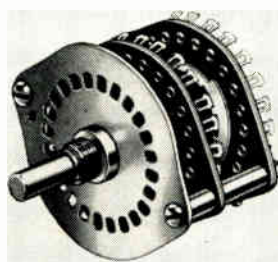
SR08 Style

Electro Switch Corp. Type MAG-12.



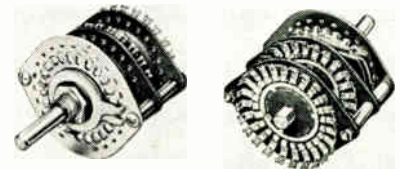
SR09 Style

Oak Manufacturing Co. Type MF.



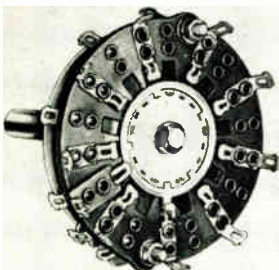
SR09 Style

Centralab Div./Globe Union Inc. Series PA-670



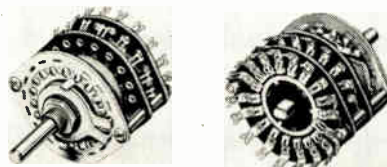
SR10 Style

Oak Manufacturing Co. Type DLX.



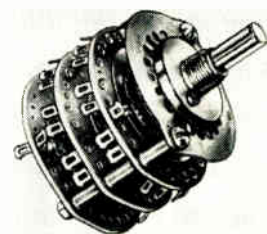
SR10 Style

Centralab Div./Globe Union Inc. Series PA-650.



SR11 Style

Oak Manufacturing Co. Type RK.



explosion is a hazard have type E construction. Enclosed panel-sealed switches are covered by type D construction. All switches have requirements for some particular level of vibration and shock as shown in tables 3 and 4.

The specification provides for qualification inspection of the styles with detail specifications. For switches without detail specifications, preproduction inspection is allowed, using the same tests and sequence of testing listed for qualification inspection.

For the qualification testing program, several changes were made in the group submission of sample units by Amendment 1. This is to get the greatest coverage by any qualification inspection and thus lower the cost of such testing. By submission and testing extra sample units, qualification can be obtained at the same time for switches rated for medium-impact and high-impact shock, and altitude-rated as well as sea-level-rated switches. In addition, qualification of sealed shaft and bushing switches in turn gives this status to like switches without sealing, also, qualification of higher grade vibration switches covers all switches of lower grade vibration types provided that exactly the same monitoring means is used and the results are the same.

To simplify testing and remove any doubts, the specification lists all environmental conditions, mechanical tests, and check tests and requirements in the specific order in which they are to be performed.

### Rotary Switch Specified

It is expected that MIL-S-3786A will have considerable impact on rotary switch design and upon equipment manufacturers. For the standard styles covered by the individual detail specifications, manufacturers of rotary switches are urged to submit their products for qualification,

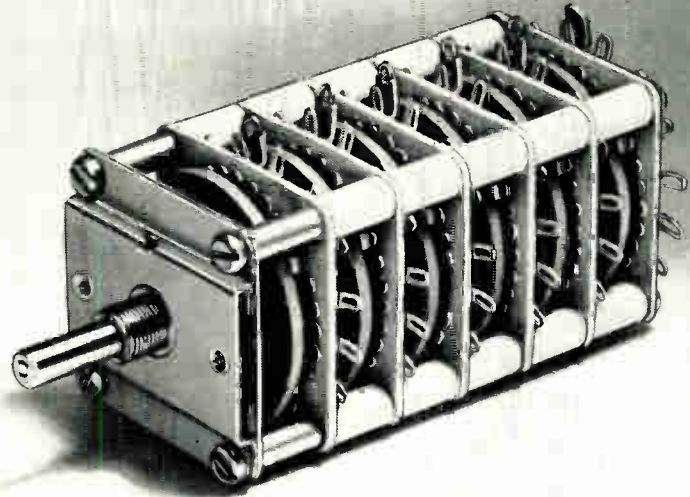
since this will aid the rotary switch market by cutting down on the delay which would normally occur due to constant retesting.

Qualification inspection is the responsibility of the Bureau of Ships. Its administration has been delegated to the Defense Electronic Supply Center, Qualification Division (DESC-EQ), 1507 Wilmington Pike, Dayton 20, Ohio.

To obtain qualification, the rotary switch maker should first write to DESC about the proper procedures and forms. This consists of requesting authority to perform qualification inspection either by a commercial lab approved for testing to MIL-S-3786A by DESC, or in-plant, or a combination of both.

If the in-plant method is used, then an inventory of equipment and facilities needed for the testing is submitted on the proper DESC form. Then the items listed will be physically inspected by an agent of DESC for adequacy and proper calibration.

When the manufacturer receives approval of his in-plant facilities, tests can then be made after authority to test has been obtained from DESC. The tests are monitored by a Government inspector and the



SR14 Style

Shallcross Manufacturing Co. Type SR14-1.

data is sent to DESC for study. If the data is satisfactory, DESC will grant qualification for the particular types or styles involved and will list the company on QPL-3786 for those units. Incidentally, this procedure is basically the same for qualification of any electronic component part which is administered by DESC.

Switches with new designs or without a detail specification must have a preproduction inspection. Details relating to the number of samples, place of testing, etc., should be shown in the contractual document. Problems relating to the preproduction inspection, should be discussed with the contracting officer for any information needed.

Since rotary switches are generally "custom-tailored" parts, it is necessary, for each switch being procured, that more than one document be used to completely specify the particular switch. Thus, a particular switch design, including the electrical configuration, will be covered by the basic Specification MIL-S-3786A, the particular detail specification for the basic style (e.g., SR03 is covered by MIL-S-3786/3), and ordering data describing the electrical circuitry. For items not covered

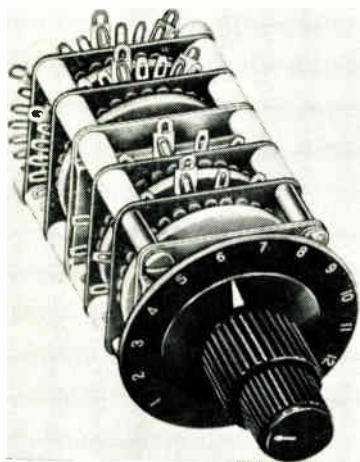


## ROTARY SWITCHES (Continued)

as a standard style by a detail specification, the ordering data in the basic specification spells out all details normally required to procure a rotary switch to MIL-S-3786A.

### Selecting a Switch

Equipment designers are urged to select from rotary switch styles covered by the detail specifications, since most of the widely used ones are included. This will help to omit many of the special designs, which could increase the problems and costs to the Services in stocking them. Special switches, which differ only in minor details from those



Shallcross Manufacturing Co. Type SR14-2.  
SR14 Style

covered by the detail specifications, should not be used.

The Services prefer that complete switch assemblies, including the detent and drive, should be normally procured from the switch manufacturer. However, there are uses where equipment manufacturers find a need to procure separate sections for a special switch assembly. In a case like this, it is the responsibility of the user to determine that switching assemblies made from separate sections are capable of passing the rotational life testing listed in Group V of the Qualification Inspection Table VII of MIL-S-3786A.

For added protection of rotary switches, which are to be mounted on panels which will be exposed to moisture or dust, panel seal boots should be installed which are in accordance with Type C of Specification MIL-B-5423B. For watertight switches the Bureau of Ships prefers this method in lieu of having manu-

facturers undercut and put "O" rings in shafts to meet the watertight test.

The author wishes to acknowledge the efforts of Mr. George Fogleman of the Bureau of Ships in filling in details about the historical background of MIL-S-3786A and his suggestions and comments relative to this article.

## GLOSSARY OF ROTARY SWITCH TERMS

Prepared by John M. Kikta, Chief Engineer  
Grayhill, Inc., La Grange, Ill.

**ROTARY SWITCH**—An electromechanical device which is capable of selecting, making or breaking an electrical circuit and is actuated by a rotational torque applied to its shaft.

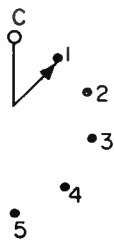
**ADJUSTABLE STOPS**—Usually the stop mechanism is at the shaft end of the switch, such that once the switch is assembled to a panel, the stops cannot be readjusted unless the switch is removed. Some have adjustable stops at the rear of the switch, so that the total angle of throw between stops can be altered while the switch is mounted. These stops are usually independent of the detent and contact systems, which are not disturbed when the stops are being adjusted.

**ANGLE OF THROW**—The number of degrees of rotation through which the shaft travels in moving from one position to the next consecutive position. (This term is at times wrongly used conversely with "indexing").

**BI-DIRECTIONAL ROTATION**—Switch shaft may be rotated either CW or CCW.

**BUSHING PROJECTIONS**—That portion of the threaded mounting bushing (if the switch is so equipped) which projects beyond the mounting surface.

**COMMON, OR COLLECTOR**—Also called a "pole terminal." That side of a switch circuit which is common to all other parts through the rotating elements. The diagram below shows a simple single pole, 5-position switch which will suffice as an example. "C" is the common terminal.



**CONTACT AGREEMENT**—The circuitry of the switch and/or the physical location of terminals and contacts on a switch section, or deck.

**CONTACT CLIPS**—Many open frame switches use clip type or clam shell contacts wherein the spring portion

of the contact and the terminal, or soldering lug, are one piece. Eyeletted to the wafer, or stator portion, they provide a versatile (from the switch circuit standpoint) switching arrangement.

**CONTACT FORCE**—The amount of force exerted by one side of a pair of closed contacts upon the other side. Sometimes called contact pressure.

**CONTACT RESISTANCE**—The resistance of a pair of closed contacts.

**CONTACT VOLTAGE DROP**—That drop measured across a pair of closed contacts.

**CONTINUOUS ROTATION**—A switch provided without stops so that continuous rotation of 360° in either direction is possible.

**CYCLE OF OPERATION**—Defined in several ways, but mostly as rotation of a switch from one stop to the other stop and return. In the case of a continuous rotation switch, it would be rotation from position #1 through position #12 and return (for a 12-position switch).

**DETENT**—This is the quick stop arrangement which enables your hand to feel its way from one position of a switch to another. (A good detent system will have a long life with a minimum torque reduction or loss of feel across its normal life span. It will be positive in that there will be little or no back lash or play on any position. The rate of torque change when rotating from one position to the next should be such that there is no tendency to overrun, i.e., rotate from position #1 to position #3 when you want to be on position #2).

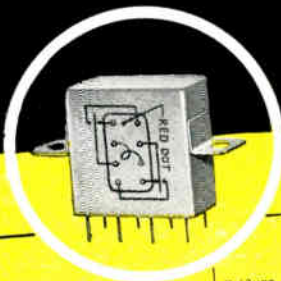
**DOUBLE END MOUNTING**—Some relatively long switches tend to twist so that it is advisable to use rear end mounting support in addition to the front end support. Switches usually have some means (extended through bolts, etc.) for fastening the rear of the switch to a bracket.

**ENCLOSED SWITCHES**—Those with all parts of the switch enclosed by some type of housing. (This does not mean hermetically sealed).

**FIXED STOPS**—Stops which are built into the switch to limit rotation of the switch to a pre-determined number of positions. (Continued on page F29)



# If you're interested in **MILITARY-TYPE RELAY RELIABILITY...**



C. P. CLARE & CO.  
TYPE F RELAY CONTACT LIFE RELIABILITY  
As of February 29, 1963

| Test Conditions  | Ambient Temp. | Failure Criteria  | Relays Tested | Operations Per Relay        | Total Relay Operations  | Early Failure Period Ends (Estimated Operations) | Fear Out Period Begins (Estimated Operations) | (1) Failure Rate per 10,000 operations<br>(2) Reliability Level per 10,000 operations At 90% Confidence Level |
|--|---------------|---|---------------|-----------------------------|-------------------------|--|---|---|
| Low Level - 10 mv. open ckt. Volt, 10 $\mu$ a, 3 cps. Contacts in series. Checked each 10 <sup>6</sup> operations for electrical parameters. | +25°C         | Contact resistance > 100 $\Omega$ on 4 or more operations           | 407           | Up to 8 x 10 <sup>6</sup>   | 381.5 x 10 <sup>6</sup> | 5000   | 8 x 10 <sup>6</sup>                           | (1) .158%<br>(2) 99.8%  |
| 1.0 ampere, 28 VDC res. Each leg loaded individually. Checked each 10 <sup>6</sup> operations for electrical parameters.                     | +25°C         | Welding. No continuity. Contact resistance > .1 $\Omega$ after test | 62            | Up to 10 x 10 <sup>6</sup>  | 216.5 x 10 <sup>6</sup> | N/A  | 10 x 10 <sup>6</sup>                          | (1) .054%<br>(2) 99.9%  |
| 2.0 ampere, 28 VDC res. Each leg loaded individually. Checked each 2.5 x 10 <sup>5</sup> operations for electrical parameters.               | +25°C         | Welding. No continuity. Contact resistance > .1 $\Omega$ after test | 66            | Up to 1 x 10 <sup>6</sup>   | 62.1 x 10 <sup>6</sup>  | N/A  | 1 x 10 <sup>6</sup>                           | (1) .084%<br>(2) 99.9%  |
| 3.0 ampere, 28 VDC res. Each leg loaded individually. Checked each 10 <sup>5</sup> operations for electrical parameters.                     | +25°C         | Welding. No continuity. Contact resistance > .1 $\Omega$ after test | 61            | Up to 4 x 10 <sup>5</sup>   | 22.8 x 10 <sup>6</sup>  | N/A  | 4 x 10 <sup>5</sup>                           | (1) .519%<br>(2) 99.5%  |
| 1.0 ampere, 28 VDC res. Each leg loaded individually. Checked after 10 <sup>5</sup> operations for electrical parameters.                    | +125°C        | Welding. No continuity. Contact resistance > .1 $\Omega$ after test | 257           | Up to 5 x 10 <sup>6</sup>   | 25.4 x 10 <sup>6</sup>  | N/A  | 1 x 10 <sup>6</sup>                           | (1) .306%<br>(2) 99.7%  |
| 2.0 ampere, 28 VDC res. Each leg loaded individually. Checked after 10 <sup>5</sup> operations for electrical parameters.                    | +125°C        | Welding. No continuity. Contact resistance > .1 $\Omega$ after test | 250           | Up to 2.5 x 10 <sup>6</sup> | 22.5 x 10 <sup>6</sup>  | N/A  | 2.5 x 10 <sup>5</sup>                         | (1) .834%<br>(2) 99.2%  |

**draw your own conclusions!**

This Clare Relay Reliability Report may be different from some other reports you have seen. For example:

- a**—This data covers standard, production-line relays sampled and tested on a weekly basis.
- b**—This Report gives the results of a formally-defined Quality Assurance Program, details of which are available for the asking.
- c**—Data is reported in terms of relay operations, not contact operations. Each operation of a dpdt relay requires four contact operations. Relay operations present the most stringent measurement of reliability.
- d**—Reliability levels reported above are derived by a recognized statistical method which produces reliability figures of assured authenticity.

What does this Reliability Report

mean to the user of Military Type Relays? You'll draw your own conclusions, of course. But here are two comments which will be important to you if you're concerned with reliability:

- 1**—Clare Relay Reliability statements are completely factual—backed by specific data compiled in actual, routine tests on standard Type F Relays.
- 2**—Every Clare Type F Relay—including those you are now using—carries the same assurance of quality and reliability.

Produced on a mature, controlled-process, large-volume production line, Clare Military-Type Relays are available to you at competitive prices and delivery.

Clare Type F Relays provide non-polarized, single side stable, single coil operation.

Operate times: 3.5 ms nominal, 5.0 ms maximum (including bounce), at nominal coil power.

Release times: 1.0 ms nominal, 5.0 ms maximum (including bounce), coil not suppressed.

Sensitivity: Just-operate power 250 mw.

(All ratings at +25°C ambient)

For additional information on Clare Military-Type Relays, circle Reader Service Number below . . . or address Group 6D7, C. P. Clare & Co., 3101 Pratt Boulevard, Chicago 45, Illinois.

| TYPE F ENVIRONMENTAL TESTING/Mil-R-5757D<br>(Summary of Test Results from Clare Quality Assurance Program) |  |  |   |
|--|--|--|---|
| Relays Tested  | Temperature Cycling<br>-65°C to +125°C | Mechanical Shock<br>65g—11ms half sine | Vibration<br>10-2000 cps<br>.125" da—20g      |
| 235  | 2 failures<br>(at low temp)            | 0 failures                             | 6 failures<br>(all over 15g<br>at > 1000 cps) |



# PROGRESS IN TELEMETERING AND PULSING DEVICES

There is a general and serious lack of knowledge about these electromechanical devices.

This is partly due to the fact that constant advances have been made in the past few years, and in part owing to the requirements of military security. This article is presented to help fill the void.

TELEMETERING DEVICES RECEIVE MULTIPLE SIGNAL INPUTS, scan them at a prescribed time sequence and transfer all of the signals to one output pulse train. Pulsing devices are akin to telemetering devices in internal construction but they take only one input and "chop" it into a pulsed output which can be used for timing or counting. The difference between these devices is shown in Fig. 1.

Since telemetering and pulsing devices are so similar, our discussion will apply to both types.

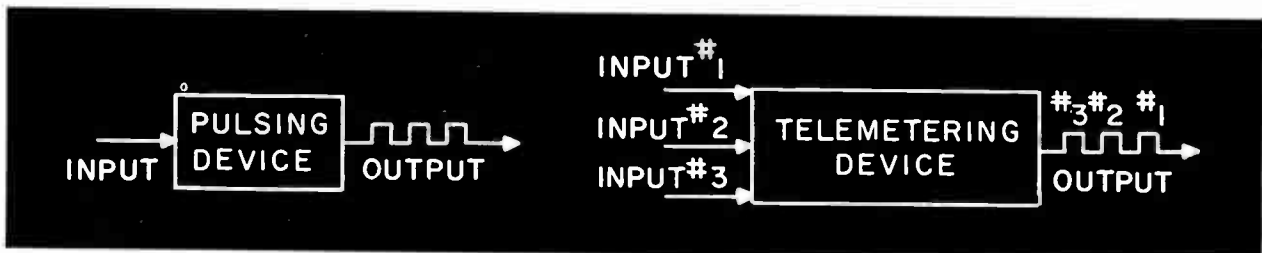
## Basic Definitions

Let us review some basic terms used in telemetering and pulsing devices.

**Channel:** This is the contact of the commutator. It may be shorting (make-before-break) or non-shorting (break-before-make), depending upon which is required.

**Sampling Rate:** This is the number of times a particular channel is sampled in a second.

Fig. 1: With regard to their function, these diagrams show the difference between the two types of devices named in the blocks.



The systems designer can choose from several types of telemetering and pulsing devices found in one of the following basic categories:

1. Motor driven electromechanical units.
  - a. Conventional types (brushes and contacts)
  - b. Mercury jet
  - c. Ball bearings
  - d. Magnetic reeds
2. Stationary devices (electronic solid state).
  - a. Conventional solid state
  - b. Beam switching tube commutator
  - c. Hall effect generator
  - d. Magnetic switching of elements immersed in a conducting liquid.

In this discussion, however, we will limit ourselves only to the description and operation of the electromechanical devices.

**Duty Cycle:** Channel duty cycle is defined as the ratio of the channel on time and the channel period. See Fig. 2.

**Noise:** Best described as the difference in pulse leading and trailing edges when compared to the theoretical pulse. See Fig. 3.

**Pole:** A pole is one complete circuit of multiple inputs and one output. Most units presently being manufactured are multipole.

**Contact Resistance:** The actual resistance at

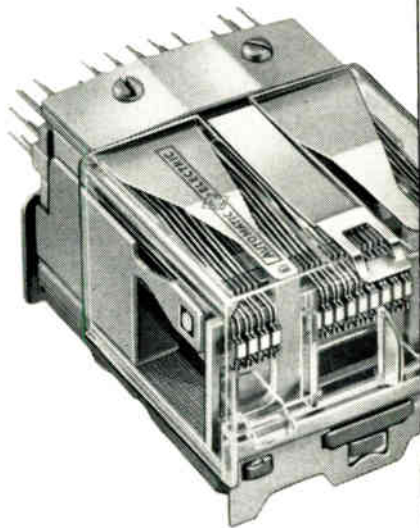
## By GEORGE MERKER

Director of Engineering  
Gyrex, Inc.  
38 Irving Place  
Garfield, N.J.

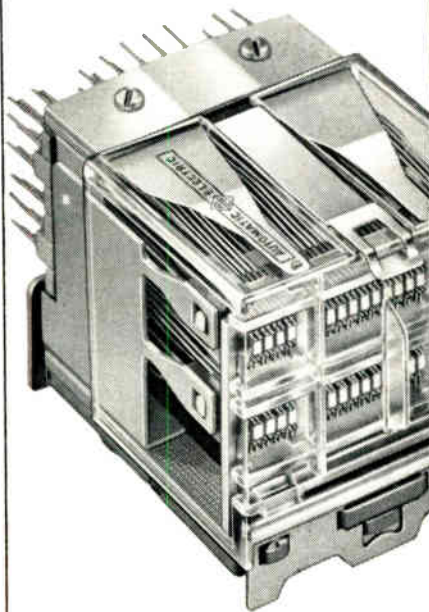
## and JOHN J. PIRET

Chief Engineer  
Airflyte Electronics Co.  
535 Avenue A.  
Bayonne, N.J.

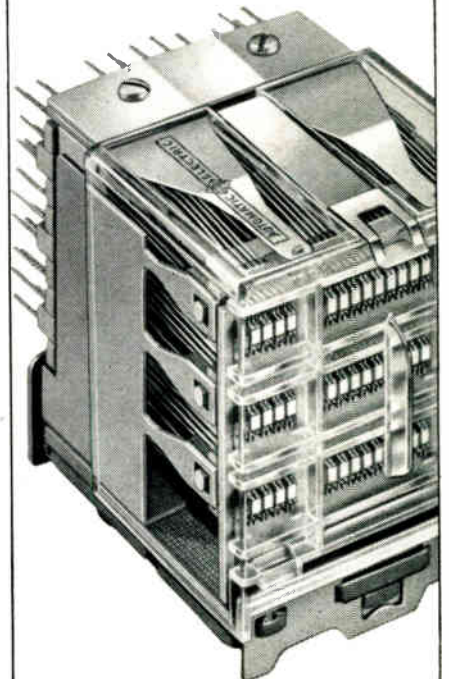
17...



34...



51...shift  
in one fast play



Assuring the simultaneous transfer of circuits in a multiple-relay group is one of the trickier problems faced by electrical and electronic engineers. AE's happy solution is the WQA Relay—the first industrial-control component specifically designed for uniform transfer of up to 51 circuits.

The modular construction of the WQA permits one, two or three rows of contact forms, each with a capacity for 17 circuit transfers. Unique, compact design saves valuable

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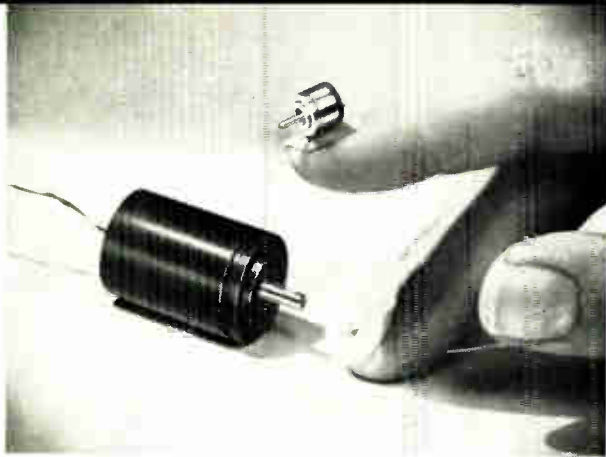
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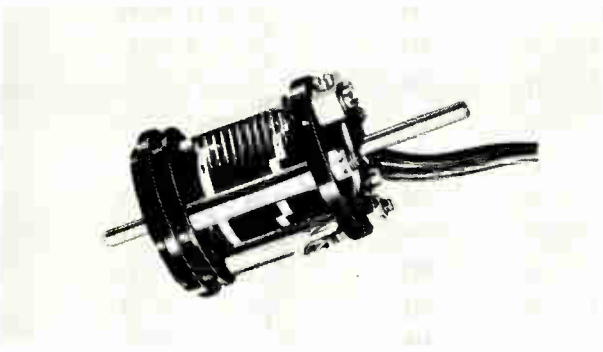
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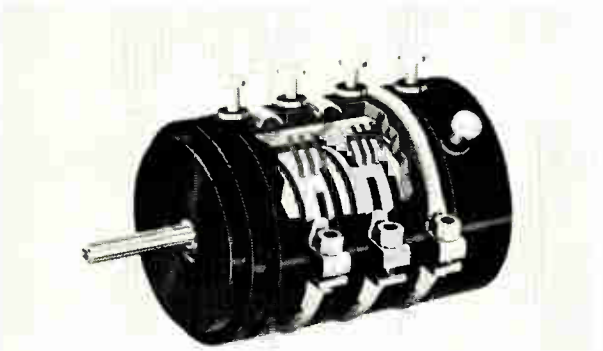




Size 3 (0.27 in. OD) and size 8 (0.75 in. OD) telemetering switches differ as above. Performance characteristics are similar.



Above is a close-up view of a telemetering switch which is rather small in size. There are 10 channels incorporated in this device.



The device shown in the above cutaway view is called a phase-adjustable switch. Striations in the brushes of the model are seen.

#### AUTHORS

George Merker



John J. Piret



## TELEMETERING DEVICES (Continued)

the contact interface. This is measured with the leads in the circuit but the actual resistance of the leads are subtracted from the total.

**Efficiency of Conversion:** The conversion efficiency is the nominal incremental output amplitude with respect to the input signal.

**Switch Accuracy:** This is the maximum allowable deviation of any channel from the nominal switching function.

**Phasing:** In the case of multi-pole units, phasing is defined as the maximum allowable deviation between corresponding pulses on each pole (Fig. 4).

### Design Considerations

In selecting the proper commutator these requirements should be considered:

1. Sampling speed
2. Power required
3. Signal level of input
4. Size
5. Weight
6. Physical requirements
7. Life
8. Accuracy
9. Reliability
10. Cost.

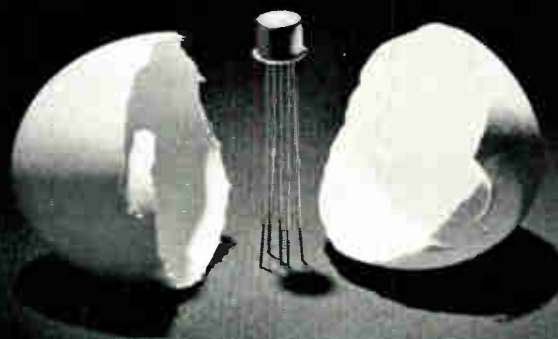
The order in which the above are listed is not a measure of their relative importance since any factor can be in the major area of possible conflict.

1. **Sampling Speed:** This has been defined as a rate. In mechanical devices the sampling rate should be less than 1000 samples per sec. Above that, an electronic switch should be considered, especially if long life is required. The sampling rate, depending on a fixed-speed motor, is held constant. Since this might be a drawback, it is possible to obtain a variable-speed device by controlling the deviation of the fundamental pulse frequency. The information is then fed into a simple closed loop to control the speed.

2. **Power:** As a rule, electromechanical devices require more power than electronic systems since there are moving elements which represent frictional losses. The required power is about 2 watts dc, but this is actually determined by the size of the commutator which is related to the number of poles and channels.

3. **Signal Level Input:** In mechanical commutation the signal level is usually in the low mv. range

*(Continued on page F18)*



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## TELEMETERING DEVICES (Continued)

to keep the commutating noise down. A level of 10 to 15 mv. is about normal with noise in the 50  $\mu$ v. region. The noise is a function of many variables such as contact material surface condition, speed of rotation and magnetic or capacitive pickup.

4. Size: This is difficult to define. For reliable airborne use, a switching device must meet shock, vibration, acceleration and other physical require-

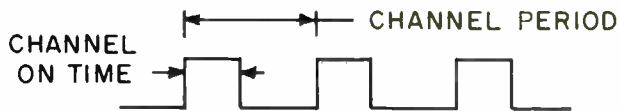


Fig. 2: Duty cycle is defined as ratio of the two terms given.

ments. Size is directly related to these requirements and is normally in the range of 20 cu. in.

5. Weight: This is a function of the size and must follow the same steps. By using high-strength alloys and miniaturized components, it is possible to reduce weight. This should not be done at the expense of reliability. Depending on the number of channels and poles, the mechanical units weigh from 0.5 to 5 lbs.

6. Physical Requirements: These must be considered very carefully: Shock, random or sinusoidal vibration, acceleration, humidity and temperature extremes and vacuum (to  $10^{-8}$ mm Hg). All have resultant effects on the performance, life and size of the device. To over-specify is to make the design more precarious, less reliable and quite costly. Often

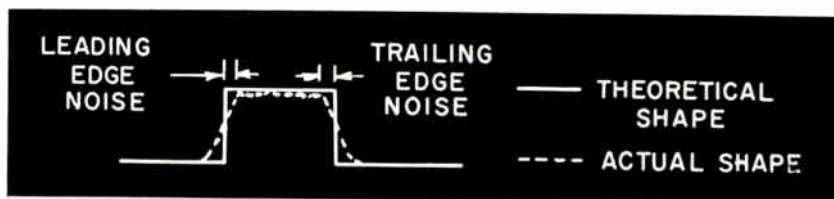


Fig. 3: The difference between the real and the ideal pulse is due to noise.

the requirements for a switch are the same as the entire system, although it will only be subjected partially to these tests.

7. Life: Can be defined as the useful life or the point at which the output can no longer serve as the useful signal. As a rule 300 hrs. is a practical duration. The life is not only based on the output of the commutator but also on the life of the motor, bearings, and other mechanical elements. Outside fac-

tors such as continuous vibration and shock can further shorten the life.

8. Accuracy: Accuracy in the electromechanical commutator is normally held to  $\pm 0.5^\circ$ . It can easily be converted to a time base accuracy or a percentage, if the speed of rotation and the number of channels is known. If the system designer selects components which require the commutator to have a tolerance less than  $\pm 0.25^\circ$ , it will be difficult and costly to obtain a satisfactory telemetering switch.

9. Reliability, or satellite and missile use reliability is of the prime importance. It can only be achieved by stringent control of materials, assembly by qualified personnel in white room areas and extensive testing of each unit before shipment.

10. Cost: This can become a stumbling block but, to meet all requirements, great care must be given to the design, manufacture and testing of the device. The actual price of the commutating switch is a small part of the cost of the entire system. However, performance should be the determining factor.

### Electromechanical Devices

Since we mentioned types of electromechanical devices, it is well to describe these in detail.

The basic electromechanical device (Fig. 5) consists of a circular plate of insulating material having a series of equally-spaced contacts. A collector ring completes the circuit. Each contact is wired to a given point. A set of rotating wipers (brushes), connected directly (or through a gear train) to the motor, makes and breaks continuously over the surface. The entire unit is enclosed in a housing and

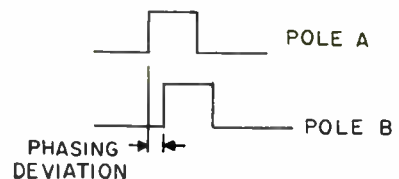


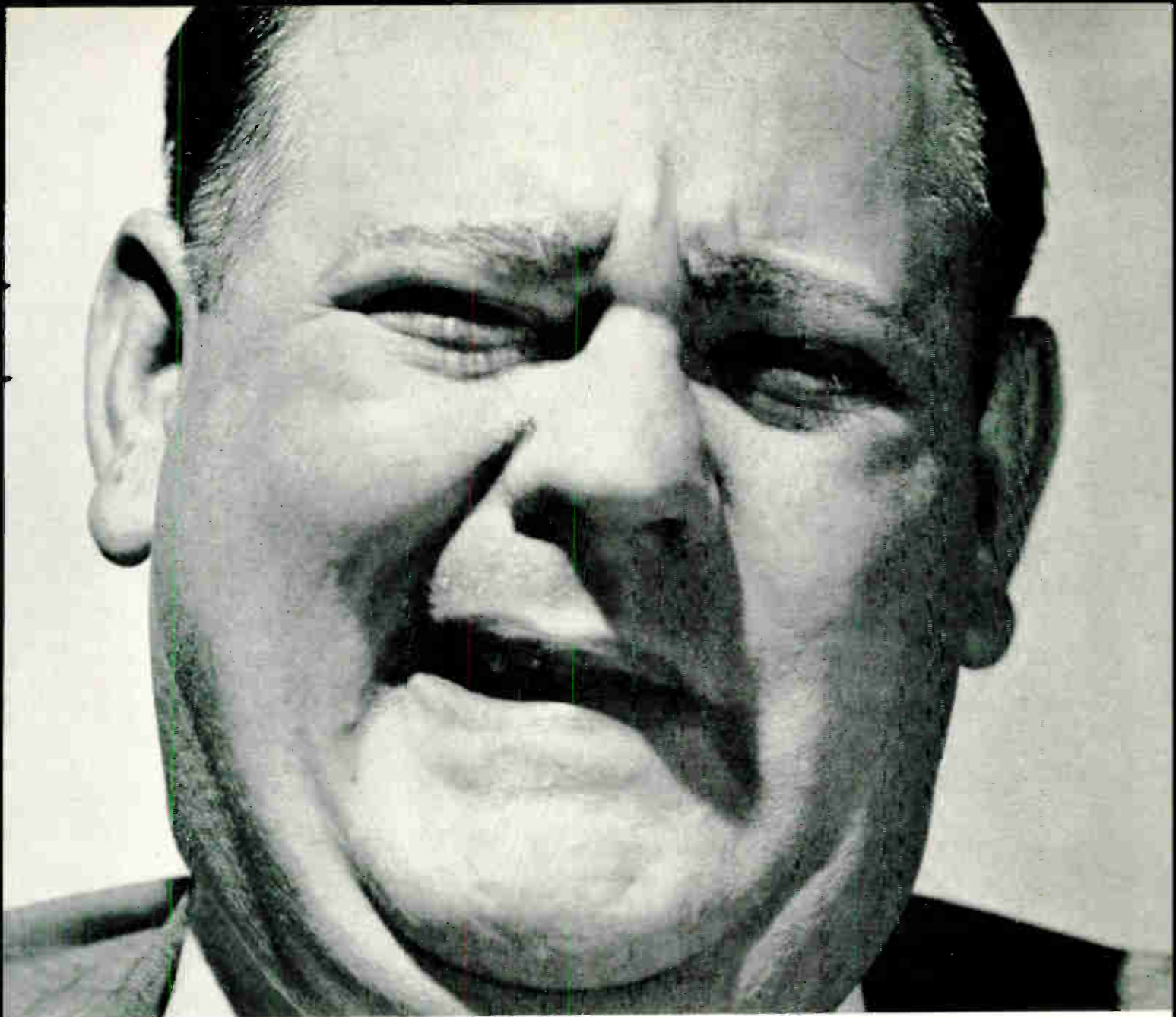
Fig. 4: Phasing in multi-pole units.

pin terminals or leads protrude from the unit. (This is basic for all types of switching devices.)

This is the simplest type of switch and can accommodate as many as 500 channels per pole. However, the ones mostly used have about 100 channels and 2 poles.

Failure of these units usually occurs between wipers and contacts in one of two ways. Buildup of metal particles between segments will short them out,

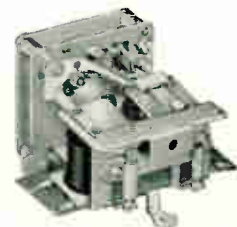




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World Radio History



Above is a 128-count true binary encoder. Brushes and segments of this A-D encoder are magnified as brought out in the circle.

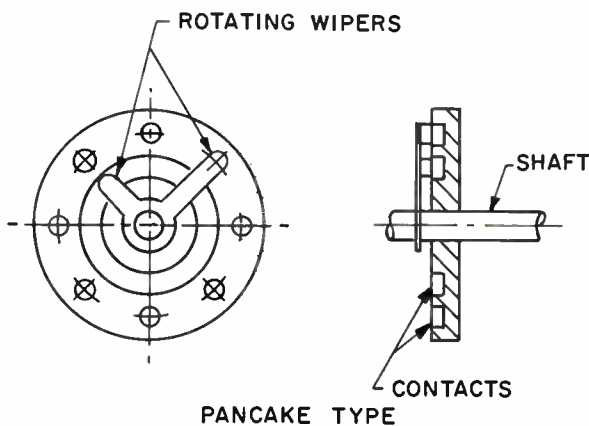
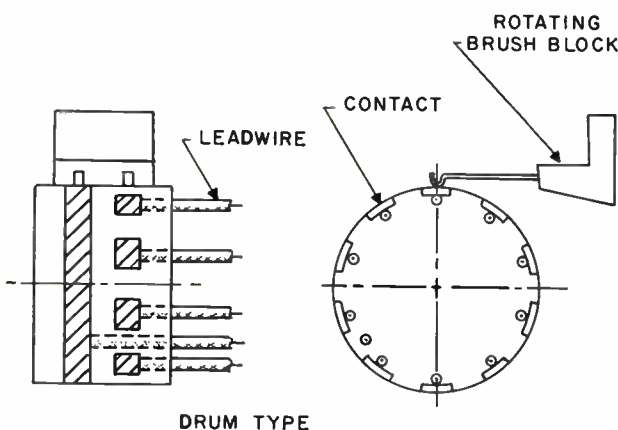


Fig. 5: Views of two basic forms of an electromechanical switch. These switches can have up to 500 channels for each pole. An entire unit is enclosed in a housing with leads coming out.



or tracking of insulation will cause opens. The result of a decrease in insulation resistance is a marked change in timing.

Catastrophic failure, such as motor burn out or bearing seizure, is possible. Increased joint effort between motor and switch manufacturers will help decrease the probability of such failures.

Since friction due to sliding motion and its resultant wear is a serious problem, other devices have been engineered. In the electromechanical field these are types worthy of discussion.

1. Mercury Jet: In this particular design a mercury jet impinges on a circle of contact pins located outside the rotor periphery. The mercury is then returned to a pump by gravity. It is lifted through a small centrifugal pump and pushed through a nozzle. While the stream is in contact with a terminal, a low resistance contact is made with the pool which is the common ground. Decks can be stacked to provide multipole construction. Noise is expected to be quite low since there is no contact bounce. Up to 120 samples at 6000 RPM have been obtained successfully. Size may become a problem with this type of switch.

2. Ball Bearing: This device consists of a miniature ball bearing which, by using rolling contact, sequentially dimples teflon-backed foil to provide contact between the segments. A motor drives the arm to which the ball is attached. About 60 channels per pole can be obtained but wafers can be stacked to obtain more poles. Really low contact resistance and life of 1000 hrs. is claimed for this device although motor failure is said to be the major problem rather than wear.

3. Magnetic Reeds: This consists of a number of magnetic reed switches placed around the given circumference of a circle. Closing and opening of the switches is done by a rotating magnet mounted on an arm attached to a motor. Shorting and non-shortening can be effected by proper wiring. The contacts, hermetically sealed in a glass tube, can operate for a long time in corrosive atmospheres. Response time is about 1 msec. For a given size, there are fewer poles in the continuously rotating switch, due to its having the glass tube.

### A-D Encoders

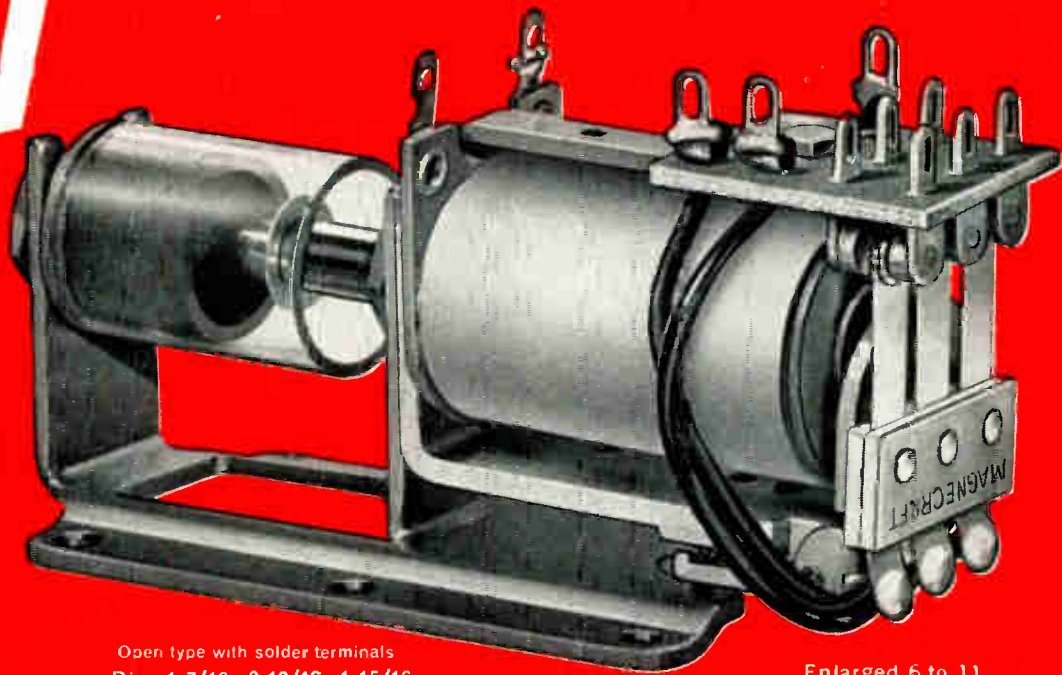
Analog-to-digital encoders provide accurate electrical digital readouts, usually in the form of true binary, binary-coded decimal or gray code, which describes the position of a controlling shaft. The electrical readout is fed, through logic circuitry, to a computer or lamp bank display to obtain meaning-

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# New

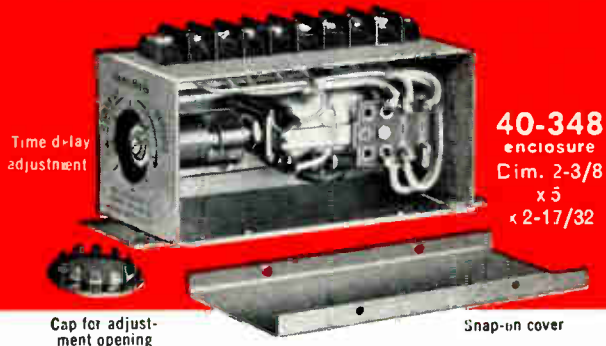
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110 Air Dashpot Time Delay Relay in heavy duty metal enclosure 40-348 with molded phenolic barrier screw type terminal block and snap-on cover. Snap-on cap provides access to timing screw.

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**SPDT, DPDT and 3PDT with 10-ampere rating.**

**DPDT with 15-ampere rating.**

**SPDT-ND Double Break with 50-ampere rating.**

\*AC models have built-in diode rectification.

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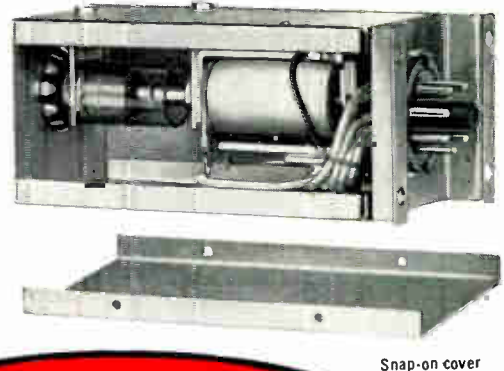
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## TELEMETERING DEVICES (Concluded)

ful information. In addition to telemetering, there are many uses for encoders, such as in military servo systems, machine tool control, and process control, all of which are filled by one of the three basic types of encoders on the market today: brush, optical, or magnetic.

**Brush Encoders:** The brush encoder consists of a rotating disk or drum which is divided into flush conductive and non-conductive segments by precision printed circuit or engraving techniques. Carefully positioned precious metal wipers (brushes) are mounted on a stationary member and the required output is transmitted as the conductive and non-conductive segments pass beneath the brushes.

**Optical Encoders:** The optical encoder eliminates mechanical contact between circuit elements by use of photocells and a light source. As the shaft turns (in either direction) photocells monitor the light output of a filament bulb through an interrupter (counting disk). The resulting pulses are fed through the required circuitry to remote readout or control devices.

**Magnetic Encoders:** The basic elements of a magnetic encoder are a code disk which is made from a magnetic material which contains the proper flux pattern for the code readout desired, and a set of readout heads which contain magnetic cores positioned close to the disk in the same quantity and general alignment as in the brush encoder. The signal from the readout windings is monitored as the code disk passes beneath the readout head.

## Pros and Cons

**Brush Encoder:** The main advantages of a brush encoder are its relatively small size and weight which are most suitable for space applications, and its modest price compared to the optical and magnetic type. The chief disadvantages are: (1) short life because of sliding friction between brushes and contacts, and (2) low resolution compared to the other types.

**Optical Encoders:** These encoders have the advantage of very high resolution and a shaft speed in excess of 10,000 RPM. However, they are limited in applications because of their size.

**Magnetic Encoders:** The magnetic encoder has the same general performance characteristics as the optical type except that it is more versatile and is being used in many commercial applications.

Many efforts are directed to making smaller switches with more channels and poles; at the same time, to reduce failures, increase life and reliability, and decrease costs. These statements appear to conflict but, with present technological developments, this is not impracticable. This means less wear by removing sliding friction, and improved contact arrangements. In addition, decreasing the number of required elements will improve life and reliability as well as decrease costs since there are fewer parts. At present we have under development a mechanical switch in which there is only one moving member (namely, a motor). All switching is done by solid state devices whose reliability has already been established. While this is not the final answer, we hope that it will successfully bridge the gap between electronic and electromechanical switching devices.

## NEW TECH DATA

### Airborne Telemeter

Data sheet details specs., characteristics of TCA Type 802 PCM Airborne Telemeter. Unique feature of all-silicon system is self-contained, precision 5v supply for transducer power. Telemetering Corp. of America, 7900 Haskell Ave., Van Nuys, Calif.

Circle 565 on Inquiry Card

### Mast Catalog

Catalog P offers information on pneumatically-operated masts and accessories for transportable communication systems. These modular-design masts are available in a range of sizes between 30 and 100 ft. of extended height. Detailed mechanical specs. are given. Andrew Corp., P.O. Box 807, Chicago 42, Ill.

Circle 567 on Inquiry Card

### Antenna Reflectors

Literature on parabolic K-band reflectors, ranging from 12 to 18 ft. in dia., is available from Advanced Structures Div., Telecomputing Corp., 5159 Baltimore Dr., La Mesa, Calif. The reflectors, which feature precise contour, optimum rigidity high resonant freq., low mass moment of inertia, are easily transported and assembled.

Circle 569 on Inquiry Card

### Voltage-Controlled Oscillator

Data is available on Model V-510 voltage-controlled oscillator, designed for accurate conversion of analog dc voltage to a linearly proportional sine wave freq. Special consideration has been given to its use in FM-FM telemetering systems and as an analog-to-digital converter. Solid State Electronics Co., 15321 Rayen St., Sepulveda, Calif.

Circle 566 on Inquiry Card

### Antenna Tower Chart

An antenna tower wall chart and condensed catalog, which provides the basic selection data necessary to select a tower to fit antenna-load requirements, are available. Construction and dimensional details are given as well as a complete table of accessories. Tri-Ex Tower Corp., Tulare, Calif.

Circle 568 on Inquiry Card

### Aerospace Ground Equipment

A brochure, "Seven Steps to AGE" (CAP-312) describes the 7 steps to providing reliable Aerospace Ground Equipment. Accent here is on conceptual design and manufacturing procedures rather than the cataloging of existing hardware. It consists of 12 pages defining the facility and capability performance available in this area at Electronic Communications, Inc., Box 12248, St. Petersburg 33, Fla.

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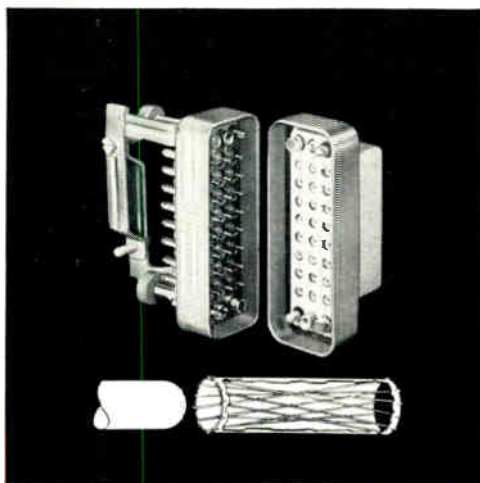


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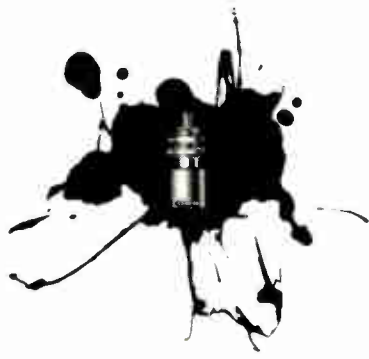


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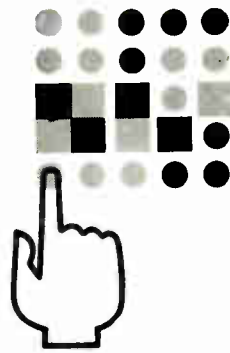
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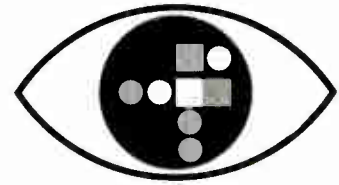




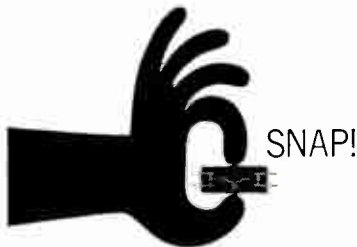
HERMETICS



SWITCHLITES



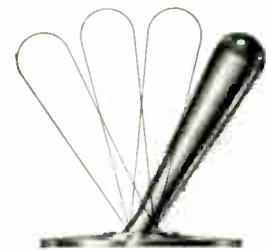
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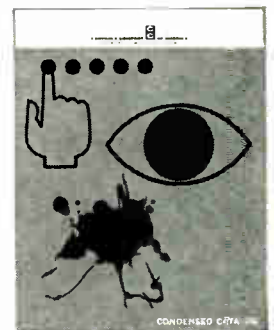


PUSHBUTTONS



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**CONTROLS COMPANY**  **OF AMERICA**  
CONTROL SWITCH DIVISION  
1420 Delmar Drive, Folcroft, Pennsylvania



## PROGRESS IN THE RELAY FIELD

Problems of miniaturization, wide current ratings, reliability, environment, and budget are a few of the problems facing relay designers. An eminent authority discusses these problems and offers a procedure to cut manufacturing problems.

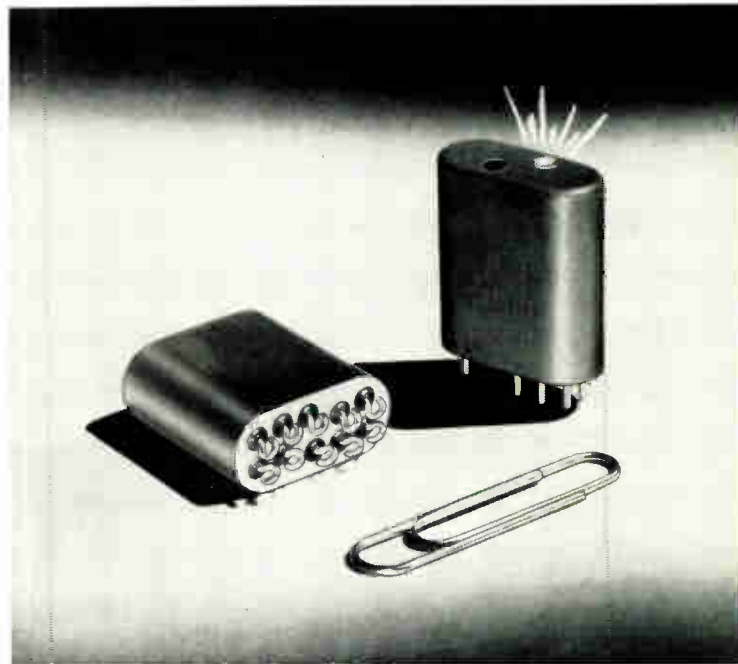
RELAY MANUFACTURERS CONTINUE TO MAKE PROGRESS in the development and design of electromagnetic and thermal relays. Because of the great emphasis placed on reliability, many relay manufacturers have subjected their product to exhaustive life tests, the results of which have been incorporated to make improvements and innovations. If, during these tests, an operating characteristic is found which improves the state-of-the-art, progress has been made.

The areas involved in determining overall relay reliability are far beyond the usual cut and fit schemes. To make an intelligent guess about the probable life of a relay, various tests must yield data from which useful conclusions can be formed. The correlation among the various test methods has been a contributing factor in improving test methods.

Relay contacts may be required to make, break, and transmit current from microamperes to hundreds of amperes. The requirements for a low-level or damp circuit have created many design problems. Therefore, testing dry-circuit and damp-circuit relays was a new division of relay engineering which had to be devised before novel ideas could be incorporated into a final product. These test results provided the reliability information needed for design purposes.

### Miniaturization

Component miniaturization, including relays, has brought additional problems in that certain physical limitations are imposed upon a device which makes and breaks a circuit. An obvious constraint would be the transient voltages which the device must withstand. The contact's air gap must have a fixed value for a given set of voltage conditions. Consequently the armature air gap, as well as the mechanical arrangement of the armature and core, seem to have definite lower limits. Although progress has been



Miniaturization has produced relays like this one from White Avionics Corp. The Series 700 can switch 250 ma up to 50 volts.

made in relay miniaturization, it appears that any further reduction in size and weight may not be as important in space-vehicle applications as the question of the power-supply weight.

Through study of materials that may be used for relay contacts, many contact characteristics have been determined. In some instances, relay contacts that satisfy one application are unsuitable for another. This becomes obvious when we consider that the

---

By **CHARLES F. CAMERON**

Professor  
School of Electrical Engineering  
Oklahoma State University  
Stillwater, Okla.

## RELAYS (Concluded)

current rating of one relay may be as low as ten microamperes and another may be as high as 300 amperes. These values present a range of  $10^8$  between the upper and lower limits. When the current is inductive, capacitive, or resistive, it is fantastic that only minor problems occur. In most applications, therefore, the dynamic or transient characteristics determine whether or not the device has performed successfully. The steady-state conditions are usually satisfied if the relay performs satisfactorily during the transient periods. These unusual requirements make the performance specifications a problem which has not been adequately solved. Most performance specifications are involved with static requirements, and do not satisfactorily delineate dynamic performance. However, the studies being performed on dynamic or transient characteristics should lead to useful information concerning the requirements of dynamic conditions.

### Testing

A great deal of emphasis has been placed upon an adequate testing program. Relay evaluation consists primarily of two factors: correct relay design and quality control. The performance characteristics decide if a relay is suited to an application. The static and dynamic performance may have to be determined to yield the needed information.

The environmental conditions may be a controlling factor on the dynamic characteristics or the reliability of a relay. For aircraft or space vehicles, the environments may be to the extremes. With temperature, for instance, a relay could cease to function because of either extreme.

### Manufacturing

When the requirements of a device are known, the next steps are design and manufacturing. The information contained in Table 1 presents the suggested procedure to be followed when manufacturing a relay.

If, after manufacture, a relay does not meet the outlined performance specifications, the original specifications should be re-examined. Occasionally the specifications are totally inadequate and the performance should be compared to the actual application requirements.

Test procedures vary depending upon the final objective. The test performed by the manufacturer may be considerably different than the acceptance tests. Frequently, acceptance tests are used by an agency to determine if the relay will fulfill their requirements. The evaluation test, however, is the only thorough test that determines performance.

Table 1

| PROCEDURE                   | PURPOSE   |
|-----------------------------|---|
| Application                 | End result or function.                                   |
| Specification               | Requirements.   |
| Design                      | Original design and modification.                         |
| Manufacturing               | Quality control and adjustments.                          |
| Performance                 | Static, dynamic, and performance application.             |
| Environment                 | Temperature, humidity, vibration, shock, and altitude.    |
| Evaluation                  | Performance, design, and quality control.                 |
| Performance test procedures | Performance tests, acceptance test, and evaluation tests. |
| Specification evaluation    | Does the specification fit the application.               |

Considerable progress has been made in testing relays. The numerous techniques have been revised where improvements could be made, and new schemes have been used to find the required test data.

### Conclusion

The advancement of the state-of-the-art of components will not be obtained by making the specifications more rigid. If there is a market which will justify the research and development expense, then some progress can be expected. Solid state devices and electromagnetic relays have found the areas for which they are best suited. Most unbiased observers think that there is a place for both, and in many cases, no doubt, these components will be used together to take advantage of their unique characteristics.

## DISKS AND ENCODERS (Concluded)

order of magnitude greater, as well as higher-speed data for higher speed control.

Multiturn encoder assemblies are provided as "fine" and "course" arrangements with one or more "course" encoders attached through reduction gears to the fine encoder. The course encoders serve to show the number of turns of the fine encoder which is connected directly to the input shaft being measured.

The problem in multiturn assemblies becomes one of coupling one or more encoders together to accurately read the total accumulated increments. This problem centers mainly around the gear errors and the backlash of the gears between encoders. If all other components in the multiturn encoders were perfect, gearing errors would still cause gross errors at some positions if some means was not used to remove these errors.

To prevent erroneous readings and to provide in addition as wide a gear tolerance as possible Phase-

coders® have been devised using special coded disks having two sets of tracks. These are coded such that one track of a set is displaced in phase from the other by 1/2 of a quantum sector. Object of this is to permit a readout on the course encoder only while the disk is well removed from a transition region. The Phase-coder offers one additional feature. Since it is possible to avoid transition regions on the disk of this encoder, a straight binary pattern is provided on all Phasecoder disks.

### Future Trends

It is predicted that continuing R&D efforts will provide even smaller, lighter-in-weight and higher accuracy photoelectric shaft-position encoders. It is thought that future models will use the recent progress in solid state light methods and thin film circuitry permitting more efficient and more compact units.

As digital methods become even more commonplace it is expected that encoder components will become integrated into many instruments and systems. In the more complex equipments such as antennas for guidance purposes and radio astronomy, use of existing shafts to mount the disk of an integrated encoder will eliminate coupling errors and permit the highest possible accuracy to be attained.

It is predicted that photoelectric encoders will continue to remain decidedly at the top of the list of

encoders where simple, low cost, high accuracy and high reliability digital shaft-position encoding is needed.

### Acknowledgments

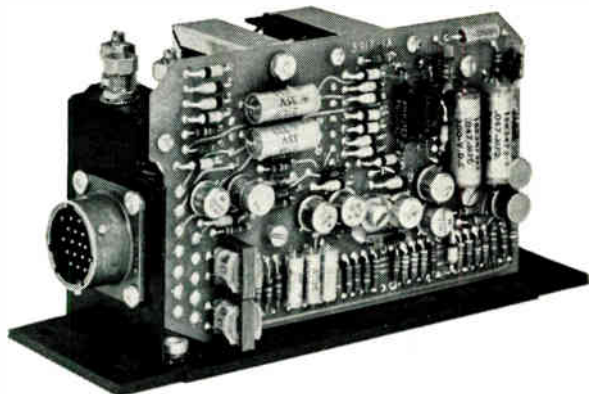
The author wishes to acknowledge the outstanding efforts of Messrs. William H. Mahaney, Project Engineer, and E. M. Jones, Baldwin Research Consultant, who have each, over the past decade, so largely contributed to the advancements of coded disks especially through their many innovations applied to the Baldwin Divided Circle Machine.

Acknowledgment is also made to the many Baldwin Electronic engineers who have contributed to the encoder advancements referred to in this article; in particular, to Garrard Mountjoy, Manager of Baldwin Electronics Encoder Research, Design and Production.

### References

1. Robert Nathan and Elizabeth Hanes, *Computer Programming Handbook*, Englewood Cliffs, N. J., Prentice Hall, Inc., 1962, p. 148
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6. "Tape Can Run the Machine Better," *Business Week*, March 30, 1963, p. 104
7. Notes on Analog-Digital Conversion Techniques edited by A. K. Susskind. Prepared by J. W. Breaun et al. Published jointly by The Technology Press of M.I.T. and J. Wiley and Sons, Inc., N. Y., pp. 6-60, 1957

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### OPERATES ANY SIZE MOTOR TO 1/4 HP

The Westamp Model A439 SCR Servo Amplifier provides a two-phase nulling output to drive servo motors from size 11 to 1/4 hp. It operates from 115 vac, 60 or 400 cycles. The completely transistorized amplifier functions from -55°C to over 70°C, has a nominal gain of 1000. The 32-ounce unit, including dust cover not shown, works with a large variety of motors.

Servo Amplifiers / Static Inverters / Power Supplies

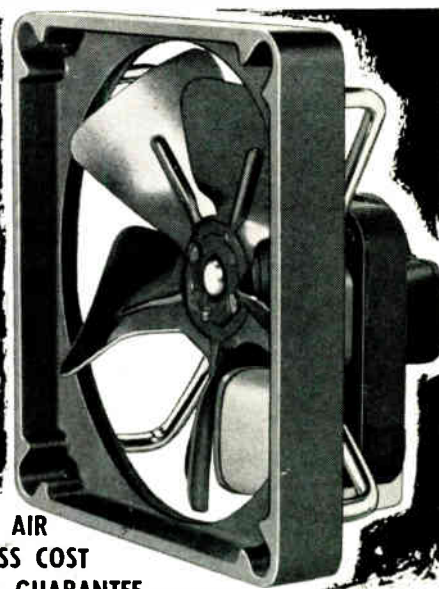
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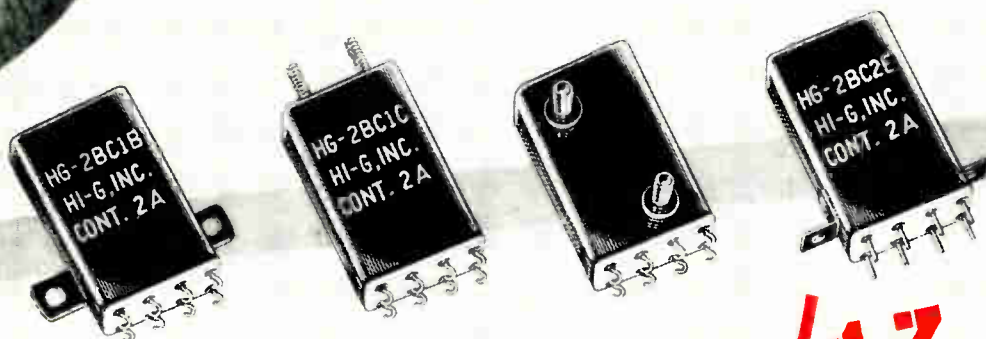
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**MIL-R-5757D/13**

| TYPE | COIL | RATED CONTACT | MAX. CONTACT | MAX. WGT. (oz.) | NOT   |
|------|------|---------------|--------------|-----------------|---|
| BCR  | AC   | 2A            | 6A           | 1.0             | Available in single (1BC, 1BCR) or 2 pole (2BC, 2BCR) units. Add suffix to indicate header style (1, 2, 4) and enclosure (A, B, C, D, E) desired. (See opposite page) |
|      | DC   | 2A            | 6A           | 1.0             |   |

# DC CURRENT SENSITIVE RELAYS

**COIL DATA:** Standard Coil Resistance available to 10K. Standard DC coil tolerance is  $\pm 10\%$ . Closer tolerances and higher coil resistances available.

**CONTACT RATING:** Standard rating, 2 amperes at 32 V DC. Dry circuit and special contacts also available. Refer to Appendix for contact rating vs. life, but note limits listed above.

**LIFE:** 100,000 cycles, standard. See Appendix.

**SENSITIVITY:** Standard DC sensitivity at pull-in at 25 C, 40 mw for DPDT; 25 mw for SPDT

**TEMPERATURE:**

DC Unit: 25 C to -125 C standard.  
AC Unit: -65 C to 85 C standard.

Higher temperature units available, both AC and DC.

**VIBRATION:** 20G to 2000 cps for standard sensitivity, for best sensitivity 10G to 500 cps. See Appendix for vibration requirements in excess of 20G.

**SHOCK:** 50G for 11 ms for standard sensitivity, 30G for 11 ms for best sensitivity. These ratings energized or de-energized with no contact opening. See Appendix for further data.

**SEALING:** 1.3 Hg, standard. Relay filled with dry nitrogen, standard. May be filled with nitrogen and helium, or dry air, if required.

**DIELECTRIC STRENGTH:** Contacts to Case 1000 VRMS, 60 cps. Mutually insulated terminals 500 VRMS Std. For higher Dielectric Ratings consult factory.

18

*Write for catalog*

**HI-G  
INC.**

SPRING STREET and ROUTE 75, WINDSOR LOCKS, CONN.

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World Radio History

## ROTARY SWITCH GLOSSARY

(Continued from page F12)

**FRONT END MOUNTING**—Most rotary switches for low power are mounted to the panel or mounting bracket by a threaded mounting bushing at the front end of the switch only.

**INDEXING** — Proper positioning or alignment of the movable contacts with respect to the stationary contacts. (Accurate indexing is primarily dependent upon a good detent system).

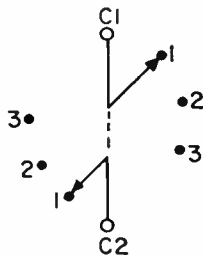
**IN-SWITCH CAPACITY**—The capacitance between various elements of the switch. (There are various means of making the measurements, which must be tailored to the application parameters.)

**NON-SHORTING CONTACTS**—A break before make contact. (In switching from position #1 to position #2, e.g., the rotor will break contact with position #1 before it makes contact with position #2.)

**NON-TURN DEVICE**—The feature which keys the switch to the panel or mounting bracket, so that the orientation of the switch with the mounting surface remains constant. This device is usually a tab protruding forward from the front plate of the switch, which fits into a hole in the panel. It can also consist of a keyway in the mounting bushing which mates with a key in the panel or a separate part which will combine the aspects of the other two means mentioned.

**OPEN FRAME SWITCHES**—Sometimes called wafer switches, these do not have their contacts enclosed by a housing.

**POLE**—An individual electrical circuit within a switch. The diagram below is an example of a 2-pole switch.



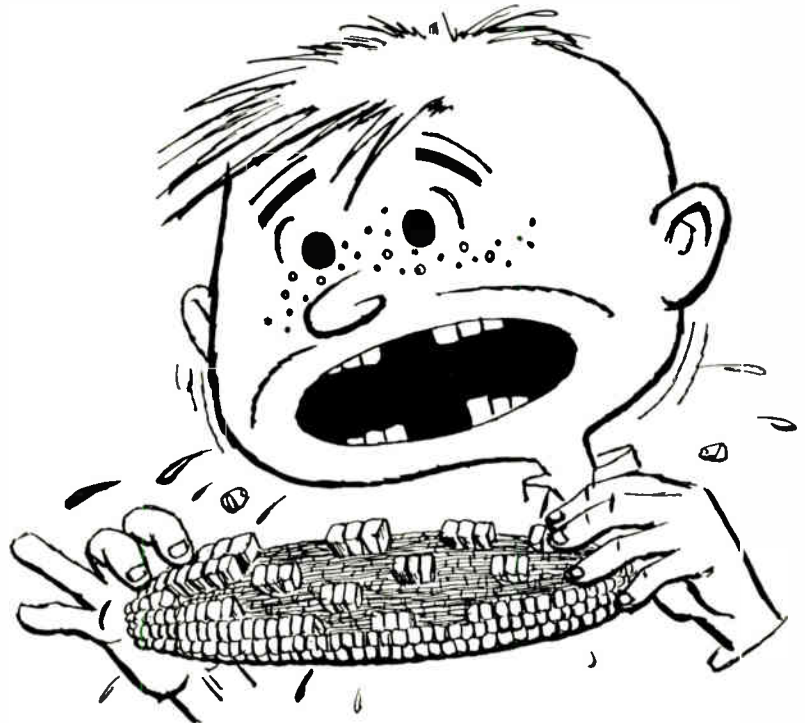
**ROTATIONAL TORQUE** — The amount of torque (in pound inches or ounce inches) required to rotate a switch between positions.

**ROTOR, OR WIPER**—The rotating contact of a switch (which is connected to common, or collector).

**SHAFT FLAT ORIENTATION**—Relationship of the shaft flat with the position being contacted by the movable contact. (Many shafts are flattened so that the set screw in the knob has a good surface with which to key. Thus it's necessary to carefully orient this flat with the switch keying or mounting means and/or the panel markings. Most shaft flats are oriented so that they are opposite the contacting position of a single pole switch—or something comparable on a multi-pole switch—a practice stemming from the construction of most pointer type knobs which have the set screw opposite the pointer).

(Continued on page F30)

# GOT A CONTACT PROBLEM?



## PROBLEM: Power Circuit Breaker main contacts to carry 100,000 amperes for 30 cycles.

A power circuit breaker operating in air is designed to have a time — current characteristic curve, such that it will remain closed against a fault current long enough to permit other protective devices nearer the fault to clear the circuit. This selective tripping feature imposes a severe load on the circuit breaker main contacts which must carry the fault current until the circuit is cleared. Most metals would weld under these conditions.

This application requires a contact that will not only carry the fault current without welding but also have low enough contact resistance and high enough conductivity to avoid overheating. The contact must also be hard enough to avoid being deformed by the breaker closing impact.

**ANSWER: Gibsiloy W-10 Contacts.** Gibsiloy W-10 is a silver-tungsten powdered metal type contact material that has the right combination of hardness, non-welding qualities, low contact resistance and high conductivity for this type of application. Its nominal characteristics are: conductivity, 62% IACS; hardness, Rockwell B65. Gibsiloy W-10 is one of the Refractory Gibsiloy's. This group of materials provides for the selection of particular materials with properties most suitable for specific applications.

### APPLICATIONS

Typical applications for Gibsiloy W-10 contacts:  
 Circuit Breaker Main Current Carrying Contacts  
 Molded Case Circuit Breakers  
 Heavy Duty Relays  
 Heavy Duty Switches

For additional information write for Catalog C-604 and Bulletin TB-506.



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**Gibsiloy**  
 ELECTRICAL CONTACTS  
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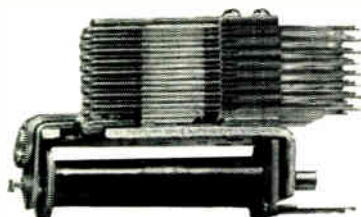


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## ROTARY SWITCH GLOSSARY

**SHAFT PROJECTION**—That part of the actuating shaft which projects beyond the end of the threaded mounting bushing, if the switch is so equipped, or a comparable dimension, if the switch uses some other mounting means.

**SHELF LIFE**—That period of time after manufacture that the switch can be in storage without deteriorating beyond certain pre-determined limits. This deterioration is usually contact contamination and corrosion, loss of solderability of terminals due to corrosion, etc. The rate of deterioration can be controlled and slowed down much by using more noble metals on contacts and terminals or special preservation and packaging.

**SHORTING CONTACTS**—A make before break contact. (Example: In switching from position #1 to position #2, contact is made with position #2 before it is broken with position #1.)

**SPRING RETURN**—A mechanism built into rotary switches when the switch is required to do some of the thinking for the operator. The switch is rotated against some type of spring arrangement (normally), in that when the knob is released the switch returns automatically to some neutral position.

**STOP**—Feature embodied in switch to limit rotation. (See "adjustable stops" and "fixed stops".)

**STOP STRENGTH**—The maximum rotational torque which can be gradually applied to the shaft against the stops before the stops sustain a mechanical failure.

**SWITCH LIFE**—The number of cycles of operation during which electrical and mechanical performance will meet pre-determined and stated life-limiting criteria. This term can best be defined only for a particular set of circumstances. Switch life can be limited either electrically or mechanically, and in some instances, both. It is usually dependent upon some previously established life limiting criteria for the application, such as: maximum allowable increase in contact resistance, minimum insulation resistance, minimum value for rotational torque, and others.

**SWITCH RATING**—The manufacturer's statement of the switch's load carrying capability.

**SWITCH SECTION, OR DECK**—The individual switching wafers, or units, within the switch proper.

**TERMINAL**—A lug extending outward from the switch section, or deck, which is used for soldering or otherwise fastening external connections to the switch.

**UNIDIRECTIONAL ROTATION**—A switch provided without stops so that continuous rotation is provided in a single direction.

**DRY CIRCUIT**—Circuit where the open-circuit voltage is .03 or less and the current 200 ma. or less. The above is generally agreed to be the most acceptable definition. The voltage is most important because at this level the voltage is not great enough to break through most oxides, sulfides, or other films which can build up on contacting surfaces.



### Cool it... with Western Gear Centrifugal Blowers

When the heat's on, write Western Gear Centrifugal Blowers into your specs and breathe easy again. The model shown above for example: 400 cycle, 80 CFM @ 1.0 S.P. @ sea level, 300 CFM min. @ 55,000' alt. Western Gear can provide you with AC or DC models, metal or plastic scrolls. Blower wheels from 1" x 6" diameter. Outputs from 10 to 500 CFM. Commercial or military specifications.

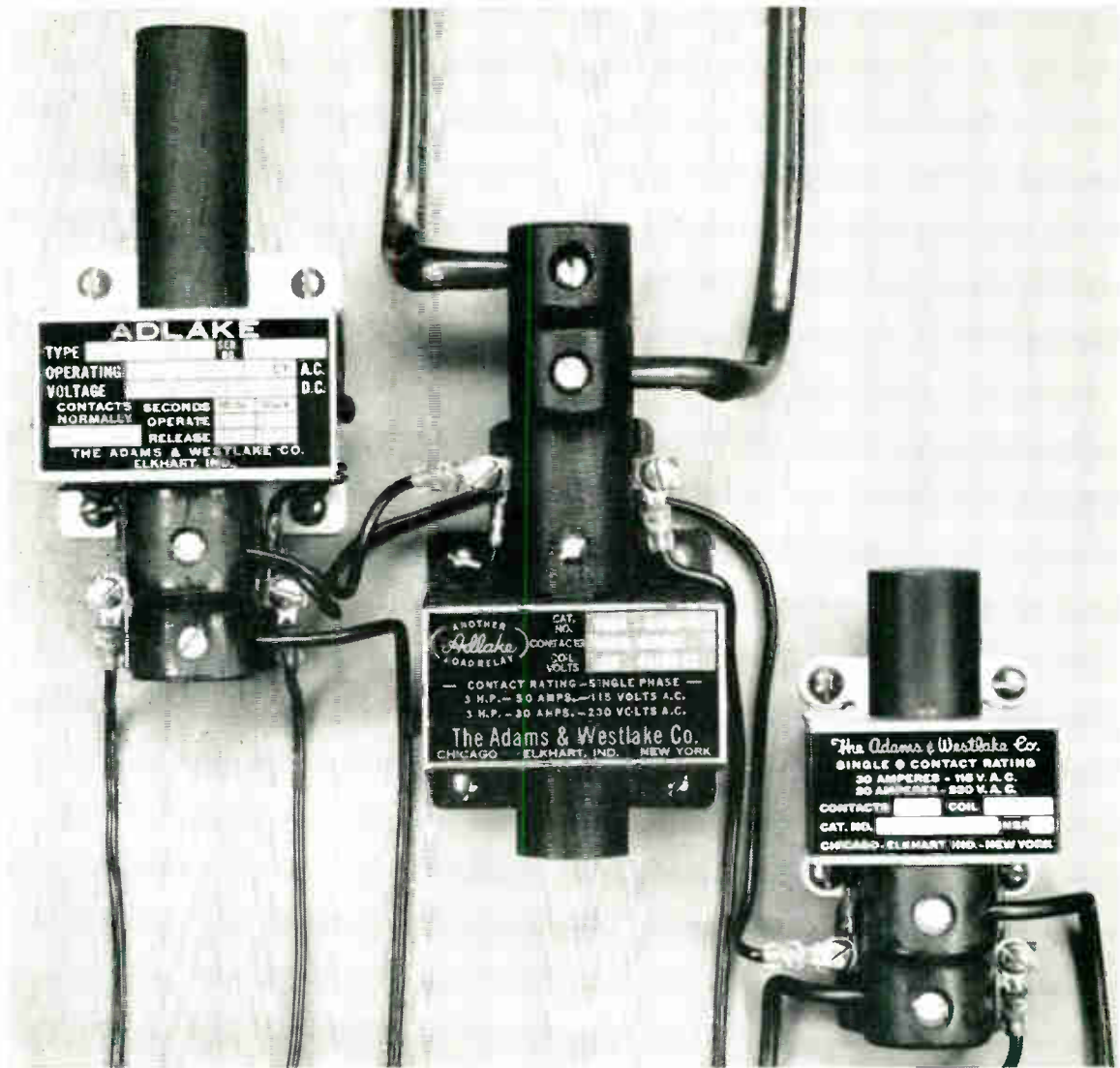
For all types of precision motors, precision gears and gear trains for commercial and government end use in electronics, avionics and aerospace industries, call us now. WESTERN GEAR CORPORATION, Electro Products Division, 132 West Colorado Blvd., Pasadena, California, telephone (area code 213) MURRAY 1-6604.



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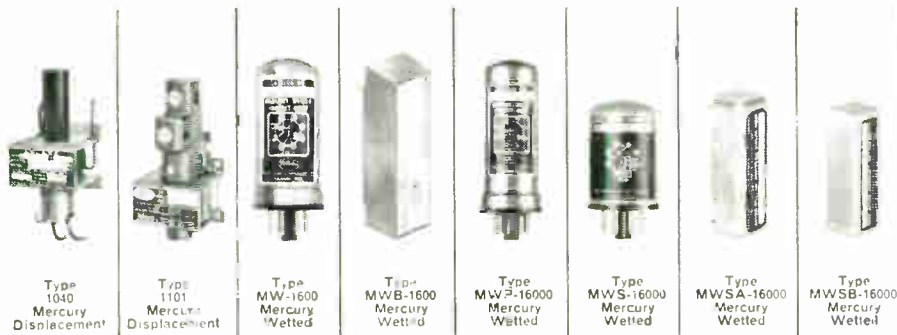
Circle 144 on Inquiry Card





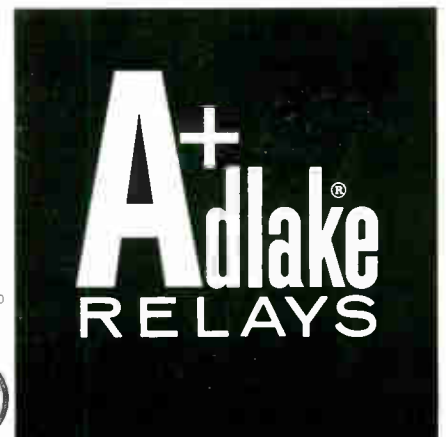
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Who needs panels and connectors? Adlake molded (epoxy) head relays fasten directly to the point of application. You save on materials. Because they install faster, production costs are lower. Other advantages include: excellent insulating ability, dimensional stability, proof against flame — and additional Adlake reliability. Available as time delay and quick-acting load relays. Ask for a catalog.



**Adlake makes more kinds of mercury relays than anybody.**

The Adams & Westlake Company, Dept. 8806  
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## NEW TECH DATA

### Crystal Case Relay

Bulletin 1077 describes Model 901 2PDT 1/6 size Crystal Case Relay. It meets or exceeds parameters of Mil-R-5757D. Miniature Relay Sales Dept., Union Switch & Signal Div., Westinghouse Air Brake Co., 1789 Braddock Ave., Pittsburgh 18, Pa.

Circle 421 on Inquiry Card

### Potentiometer Catalog

This illustrated 19-page industrial catalog describes the precision Series 62JA 10-turn potentiometer and the new Pad-ohm Series 56JA and 56JB trimmer potentiometers, precision single and multi-turn potentiometers, industrial controls and resistors. Clarostat Distributor Div., Clarostat Mfg. Co., Dover, N. H.

Circle 422 on Inquiry Card

### Capacitor Soldering

Technical report, "Automated Induction Soldering of Tantalum Capacitors," contains a drawing of a device made to do this job. Device solders the assembly and endseal of capacitors using variable-power induction heating generators and automatic turntables. McDowell Electronics, Inc., 105 Forrest St., Metuchen, N. J.

Circle 423 on Inquiry Card

### Air Motors

Two article reprints describe general advantages and uses of air bearing motors and other products, including instrument motors, servos, synchros, air movers, solenoids and similar equipment. Catalog listing over 700 types of motors is also available. IMC Magnetic Corp., Westbury, N. Y.

Circle 424 on Inquiry Card

### Miniature DC Motors

Brochure 102 describes the Type SS  $\frac{7}{8}$  in. dia. dc motor, motor and speed governor, planetary gearmotor and spur gearmotor. It has 19 armature variations. Max. rpm, voltage, and torque ratios are given. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

Circle 425 on Inquiry Card

### Knob Catalog

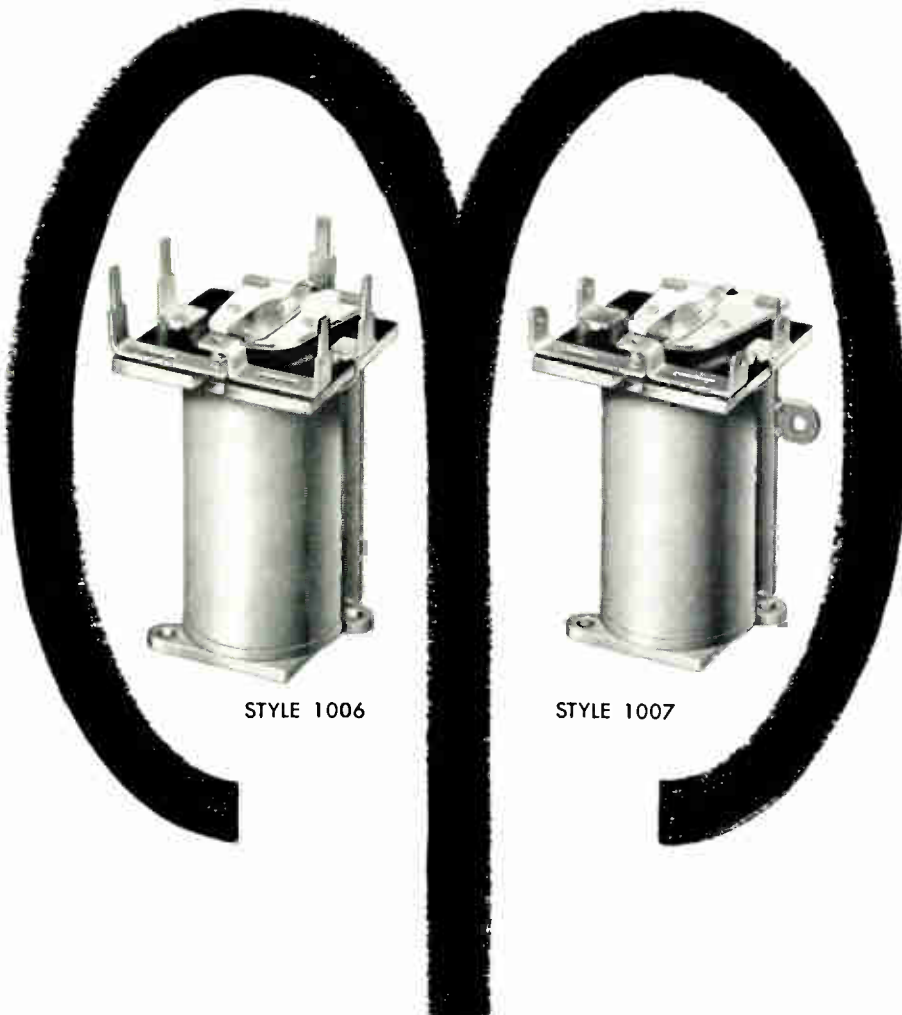
Catalog listing "Lerco" line of custom-printed knobs, terminals and other controls is available from Microdot, Inc., 220 Pasadena Ave., S. Pasadena, Calif. Calibration figures, letters, etc., can be printed on the knobs.

Circle 426 on Inquiry Card

### Small DC Motors

Brochure 103 describes the Globe Type BD and BL motors, rated at 1/45 and 1/30 hp continuous duty at 10,000 rpm, respectively. Both units are 1 1/2 in. in dia. while the BD is 2 9/16 in. and the BL 2 15/16 in. long. Globe Industries, 1784 Stanley Ave., Dayton 4, Ohio.

Circle 427 on Inquiry Card



STYLE 1006

STYLE 1007

## SENSITIVE RELAYS AT SENSIBLE PRICES

Price Electric Series 1000 Relays Now Feature . . .

Sensitive Operation • Solder or Printed Circuit Terminals  
Open or Hermetically Sealed Styles • Low Cost

These versatile sensitive relays are designed for applications where available coil power is limited. They retain all the basic features, such as small size, light weight and low cost, that makes the Series 1000 General-Purpose Relays pace setters in their field.

### TYPICAL APPLICATIONS

Remote TV tuning, control circuits for commercial appliances (including plate-circuit applications), auto headlight dimming, etc.

### GENERAL CHARACTERISTICS

**Standard Operating Current:**

1 to 7 milliamps DC at 20 milliwatt sensitivity

**Maximum Coil Resistance:** 16,000 ohms

**Sensitivity:**

20 milliwatts at standard contact rating; 75 milliwatts at maximum contact rating. Maximum coil power dissipation 1.5 watts.

**Contact Combination:** SPDT

**Contact Ratings:**

Standard 1 amp; optional ratings, with special construction, to 3 amps. Ratings apply to resistive loads to 26.5 VDC or 115 VAC.

**Mechanical Life Expectancy:**

30,000,000 operations minimum.

**Dielectric Strength:** 500 VRMS minimum.

*For additional information, contact:*

# PRICE ELECTRIC CORPORATION

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## Instrument Switches

A 16-page illustrated instrument switch catalog lists electrical characteristics, information on how to select a switch, standard contact deck and brush arrangements, dimensions, terminal board arrangements, and ordering information. Cinema Plant, Hi-Q Div., Aerovox Corp., 1100 Chestnut St., Burbank, Calif.

Circle 393 on Inquiry Card

## Step-Servo Motor Theory

A 10-page booklet covering theory and operation of step-servo motors is available now from IMC Magnetics Corp., 6058 Walker Ave., Maywood, Calif. Discussed are step-servo excitation, performance, efficiency of mmf generation and the dynamic characteristics. Illustrations, power angles, and schematics are included.

Circle 394 on Inquiry Card

## Miniature AC Motors

Brochure 106 describes Globe Type SC 1, 2 or 3-phase motors which operate on 60 or 400cps. Induction or hysteresis rotors available. Planetary gear reducers of 21 different ratios give up to 300 oz./in. max. continuous torque. Globe Industries, Inc., 1784 Stanley Ave., Dayton 4, Ohio.

Circle 395 on Inquiry Card

## Welder Ignitrons

Data sheet describes 2 high-power resistance welding ignitrons, NL-1081 and 1082. They are metal, water-cooled, mercury-pool ignitrons handling up to 65% more power than the standard size B and C ignitrons, respectively. Max. demand current at 500v. is 2000a. for NL-1081 and 4000a. for 1082. Specs., characteristics, charts and schematics are given. National Electronics, Inc., Geneva, Ill.

Circle 396 on Inquiry Card

## Magnetic Amp. Relays

A 6-page bulletin provides design specs. on Series 8200 60cps polarized magnetic-amplifier relays. Operating on dc input sensitivities ranging from 0.02 to 0.5 mw., they detect and act upon minute variations in current, voltage or resistance to add or subtract signals, or compare a variable signal with a reference. Sigma Div., Sigma Instruments, Inc., Braintree, Mass.

Circle 397 on Inquiry Card

## Wafer Bonder

This catalog sheet describes a new machine for bonding wafers, pellets, chips or dice to headers and other substrates. The machine is easily adapted to handle wafers of any practical size. Kulicke and Soffa Mfg. Co., Inc., 135 Commerce Dr., Industrial Park, Ft. Washington, Pa.

Circle 398 on Inquiry Card

## Potentiometer Test Report

Report on test results of the Clarostat Series 62 10-turn potentiometer for military and industrial use are available. Report includes conditions and results of tests, run over 1,000 hrs. Tests covered low temp. storage, low temp. operation, temp. cycling, load life, low-frequency vibration, moisture resistance, rotational life, acceleration, shock and high-frequency vibration. Clarostat Mfg. Co., Dover, N. H.

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## Manual Control System

Catalog 69 describes system of manual control and lighted legend display for modern panels. There are 4 units: 1 indicator for legend display and 3 operator-indicator units for control and display. The 20-page, 4-color catalog contains product photos, circuitry and legend charts, mounting dimensions and other information. Micro Switch, Freeport, Ill.

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## Chopper Article

Article describes dc feedback amplifiers and their microminiature electro-mechanical choppers. Analyses of chopper noise and offset are provided. Discussion includes descriptions of stabilization of wide-band dc amplifiers for zero and gain, stable transistor wide-band dc amplifiers, and transistor operational amplifiers. Schematics and oscilloscope patterns illustrate functions described in the article. Airpax Electronics, Inc., Cambridge Div., Cambridge, Md.

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## Cooling Equipment

Blowers for electronic uses are presented in this 42-page catalog. It describes packaged blowers, both commercial and Mil Spec., packaged propeller fans, orifice-mounted fans, dual and single centrifugal blowers and accessories. New line of RFI-shielded packaged blowers is included, as is new McLean Mil Spec. blower line. Engineering drawings, performance curves are given. A 3-page section contains design information on forced air convection for cooling electronic equipment. McLean Engineering Laboratories, P. O. Box 228, Princeton, N. J.

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## Miniature Potentiometers

Engineering Bulletin 42-1467 describes 3 types of high reliability, miniature composition potentiometers. This 2-color booklet was prepared for engineering use, and contains complete information on uses, electrical, physical and mechanical characteristics as well as environmental specs. A large portion is devoted to detailed engineering drawings. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.

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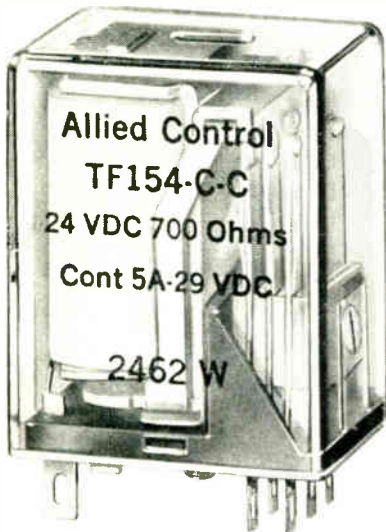
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# ALLIED CONTROL

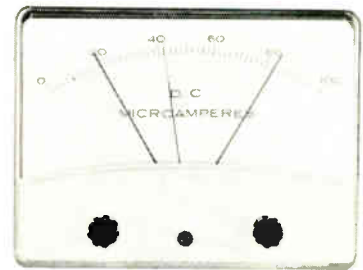


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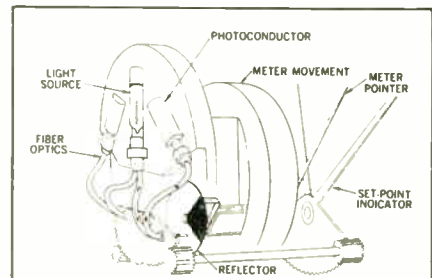
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# SECTION G

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## MATERIALS & HARDWARE

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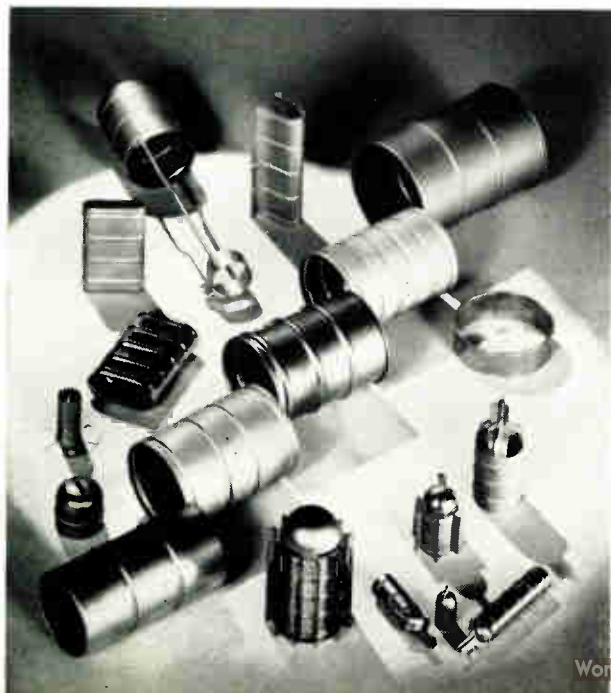
# REFRACTORY METALS IN ELECTRONIC COMPONENTS

Refractory metals go into a variety of products, including solid-state component parts and electrical contacts. These metals have exceptional stability, even in very thin film form. They are being called upon for top performance of thin film circuits, as superconductors, and for critical parts of instruments.

REFRACTORY METALS ARE WIDELY USED in the electronic industries. These high temperature metals have low coefficients of expansion, good corrosion resistance, and high strength. They are not abundant in the earth's crust and the yearly production of some of these metals is only a few hundred pounds. Molybdenum finds the greatest usage because it can be produced most economically and has a high strength-to-weight ratio. A molybdenum part weighs only half as much as a tungsten part and costs about one-third as much. Yet tungsten, columbium, and tantalum are used extensively where their special properties provide an advantage.

Rhenium, osmium, iridium, and ruthenium have only minor usage.

The major uses of the refractory metals in the electronic industries are in capacitors, vacuum tubes, electrical contacts, thin films, superconductors, and instrumentation. In some cases, only the refractory metals are suitable. The remaining problems, potential solutions, and some of the advantages of using refractory metals will be discussed.



## Capacitors

Tantalum, columbium, tungsten, and molybdenum are known as "valve" materials. That is, they form a protective high resistance oxide film on anodic polarization in preference to all other electrode processes. Tantalum is the most nearly perfect example of a "valve" material. A stable, nonporous, structureless, adhering film, grows uniformly thicker with increasing voltage in most all electrolytic solutions.

The protective high resistance oxide film of tantalum had first commercial importance for its rectifying action. (Balkite battery charger made in 1922.) Today, this oxide film is most important as the dielectric of the electrolytic capacitor: a "valve" material is chosen as the anode (positive electrode) and the oxide film (dielectric) is made by polarization of the anode.

For columbium, sister-metal of tantalum, the film is somewhat less stable, indicated by the normally high leakage and lower maximum formation voltage when compared to tantalum. Some columbium capacitors are made commercially. They have weight advantage over tantalum.

Tungsten and molybdenum readily dissolve during anodic polarization in alkaline solutions. Thick films are obtained during polarization in acidic solutions, but these are nonprotective. Passivating films have been produced on tungsten in certain buffered solutions, but the capacitors using these were unstable.

Fig. 1: The tube parts shown on the left are made with refractory metals.

By **RALPH F. HOECKELMAN**

Project Coordinator  
Fansteel Metallurgical Corp.  
2200 Sheridan Rd.  
North Chicago, Ill.





Three basic types of tantalum anodes are made; the sintered slug, foil and wire. Massive tantalum, with the aid of intermittent vacuum anneals, is cold rolled to a very thin foil of  $\frac{1}{2}$  mil or less. The foil is often etched to give more surface area (more capacitance) before formation and assembly into an electrolytic capacitor. The foil type capacitor handles the highest working voltage.

Far more capacitance is achieved in the same volume in a porous slug capacitor. In the conventional method a porous slug of 35 to 45% porosity is prepared by sintering a compact of tantalum powder. The surface area, density and porosity of the compact are dependent on the physical traits of the powder and the sintering temperature. The physical makeup, related to the method of preparation, varies from a structured powder which has a low bulk density to a very fine nonstructured powder with a higher bulk density. Higher voltage of formation is being achieved with powders of higher purity and more specific physical characteristics.

The porous slug capacitor may have either a wet or dry electrolyte. The wet electrolytic capacitor has been characterized by a long life and is more reliable than the dry electrolytic when operated on a low impedance power supply. The wet capacitor has a higher working voltage than presently obtainable for the dry capacitor. The dry electrolyte capacitor has superior capacitance vs. frequency characteristics and eliminates the danger of electrolyte leakage.

The wire type capacitor can have either a wet or dry electrolyte and is well adapted for low capacitance uses.

Future improvements in tantalum capacitors will be higher overall reliability, higher capacitance units and higher voltage units. These will come about from even higher purity and closer tolerance on the physical characteristics of the starting material, as well as improved methods for sintering, anodizing, encapsulating, etc.

### Vacuum Tubes

The metallic parts of a vacuum tube must be precision made from low vapor pressure material. The parts must keep their shape at elevated temperatures for long periods of time. The refractory metals are ideal materials for this. Tungsten, the most refractory metal, has a melting point three times as high as copper and twice that of martensitic stainless steel. Hence, tungsten has won acceptance as a heating element, X-ray tube target, heat shield, and as parts in electronic power tubes. Molybdenum is often used for anode and grid structures because of its superior

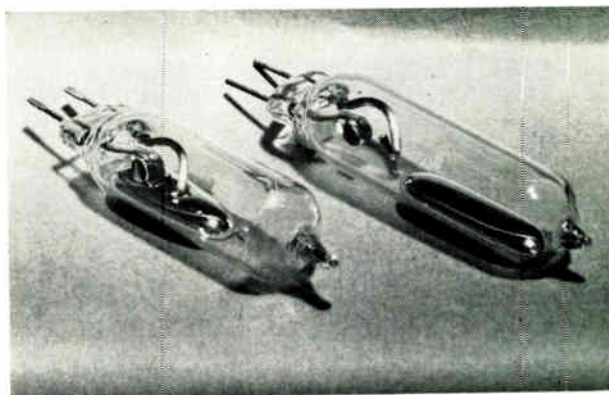


Fig. 2: The precision electrodes of these mercury switches are graphite-coated "moly" wire for wetted contact action.

physical properties, workability and low cost compared to tungsten. (Fig. 1.)

With continued emphasis on size and cost reduction, vacuum tube parts are being made smaller and with greater precision. Anodes used to be made by the welded cup and cylinder method. But now, using high purity molybdenum sheet, deep drawn moly anodes have become a reality. The uniform wall and end thickness achievable in a one piece structure without grooves or welds has improved both reliability and performance of the tubes. Structures too complicated or too intricate for normal fabrication methods are being "photo formed."

A problem in vacuum tube reliability is the hot cathode. From the earliest days of the light bulb, heated filaments have caused the most concern. In the case of the light bulb, back filling with argon greatly reduced evaporation from the filament. The addition of a small quantity of iodine gas has acted as a scavenger for evaporated metal and returned it to the filament, thus increasing its life. No such easy solution is in sight for the vacuum tube. Hot cathodes have been made from alloys of tungsten with rhenium or hafnium. The development of oxide coatings for low power tubes has provided greater emission at lower temperatures and has greatly improved tube life. Further improvements in the near future will most likely be found in improved materials and processing. Longer range solutions may be possible with cold cathode structures using field or tunnel emission from materials having low work functions.

### Electrical Contacts

Tungsten contacts are used primarily in places where very long life is needed, such as distributor parts, radio vibrators, voltage regulators and similar uses. These points not only provide long service under heavy arcing conditions, but are also able to

## REFRACTORY METALS (Continued)

withstand constant mechanical wear. Molybdenum oxidizes more readily than tungsten and has limited use in low voltage vibrators and relays. The spring properties of molybdenum can sometimes be used to combine spring action and electrical contact. Since molybdenum is wetted but not attacked by mercury, it is often used in mercury switches. (Fig. 2.)

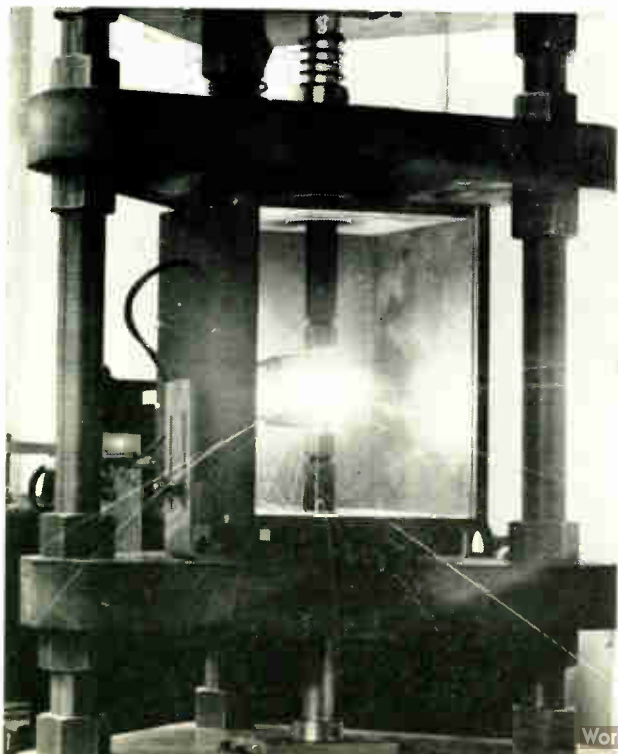
Tungsten and molybdenum are both used in making ohmic contacts to large area silicon rectifiers. The good heat conductivity and low coefficient of expansion, comparable to that of silicon, are the main reasons for its use.

Unalloyed refractory metal contacts have not been able to handle large currents. This problem has been solved by using sintered powder metal mixtures of tungsten or molybdenum, their carbides, and a good conducting metal, such as silver or copper. They have good conductivity, combined with excellent non-sticking properties, and higher resistance to high current arc erosion than any of their pure constituents. Contacts tested at 30,000 amperes shown in Fig. 3 help to determine arc erosion of heavy duty contacts under severe service conditions

### Thin Film

Thin films of refractory metals are being used in the expanding microelectronics field. Resistors, capacitors, interconnections, and sometimes inductors are being fabricated in two dimensional arrays, with film thickness measured in terms of hundreds of

Fig. 3: Powder metal contacts are being tested for arc erosion at 30,000 amps to determine best mixture for heavy duty.



angstroms. These thin film circuits are not only smaller and lighter, but are being touted as having greatly increased reliability and potentially less costly than normal electronic circuits. The reliability of the thin film circuits rests on the physical and chemical stability of the thin metal films comprising the circuit. The low vapor pressure and the low mobility of the refractory metals is an important factor in film stability. The high recrystallization temperature, the chemical inertness, the relatively high electrical resistivity, and good thermal conductivity are advantageous for preparing resistive films.

Thin film capacitors are conveniently prepared by anodizing a thin film of tantalum and covering the oxide with a vacuum deposited counter electrode of gold. The anodizing process also provides a means of trimming resistive films. Precision resistors with  $\pm 0.1\%$  tolerance can be produced. The oxide formed over the surface of the resistor during the trimming step protects it from physical damage and shields the resistive element from atmospheric contamination.

The preparation of thin film resistors, capacitors and interconnections is done by vacuum deposition of the tantalum, followed by photo-etch processing and anodizing. The relatively few number of processing steps make possible the high reliability and ultimate low cost.

Some of the problem areas facing the tantalum thin film circuit designers are high temperature coefficient of resistance, low ohms per square cm. resistance yield and stability of capacitors, and packaging. The solutions to most of these problems are in sight. By control of the atmosphere during sputtering of the tantalum films, compounds of tantalum can be formed. These compounds (tantalum carbide, tantalum nitride, tantalum oxide) increase the resistivity of the film and simultaneously reduce the temperature coefficient of resistance. Newly developed clearing techniques, which dissolve away the tantalum metal films underlying defects in the oxide structure, have greatly increased the yield and stability of capacitors. The packaging problem remains.

Transistor cans, while ideal for transistors and bulk process microelectronics, are not really suitable for the thin film microcircuits and no concerted effort is being made to solve this problem. Single components are available in a variety of form factors; circuit functions are available in a number of encapsulated and canned forms; multiple circuit functions resembling a miniaturized circuit board are available and may contain several hundred individual circuit elements.

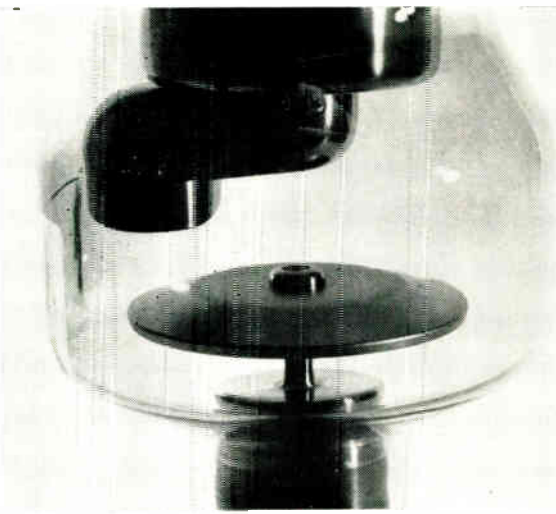


Fig. 4: This x-ray tube's anode is a typical use of tungsten. It may reach a temperature of 1800° F as it spins at 5000 RPM.

Many types of microelectronic circuits are becoming available. They are not mutually exclusive but in many cases are compatible. Circuit functions composed of active elements, with only a few passive parts needed, are most conveniently prepared as integrated circuits in silicon wafers. For the reverse case where passive components dominate the circuit function, the thin film approach is better. Tantalum thin film circuits will play a part on the road to microminiaturization. They are smaller, more reliable and potentially less costly than the micromodule or micro dot forms. They have tighter tolerances and shorter delivery schedules than the integrated circuits based on silicon planar technology. Tantalum thin film circuits have fewer processing steps and less critical vacuum needs than thin film circuits based on vacuum deposited nickel alloys and silicon monoxide.

### Superconductivity

All the refractory metals have been extensively investigated for use as superconductors, primarily because they have relatively high superconducting transition temperatures. This work shows that the refractory metals are generally rather poor superconductors in the pure state, because they do not support adequate current densities. However, alloy compounds show greatly improved current carrying capacities (far in excess of materials yet developed) and even higher transition temperatures. Specifically these materials are the columbium compounds; i.e., columbium-tin and columbium-zirconium although molybdenum-rhenium and others have shown promise.

The present potential uses for the refractory superconductors are as very high field solenoid magnets and very fast, economical switches and memory-core

elements. The magnets so far constructed have produced up to 100 kilogauss fields for fractions of the costs and current inputs of equivalent copper conductor, water-cooled electromagnets.

Because many variations of alloy compositions seem to offer promise as high strength superconductors it is not possible to single out any one as optimum, however, the principal available alloys at present are those of the Cb-Zr or Cb-Sn systems.

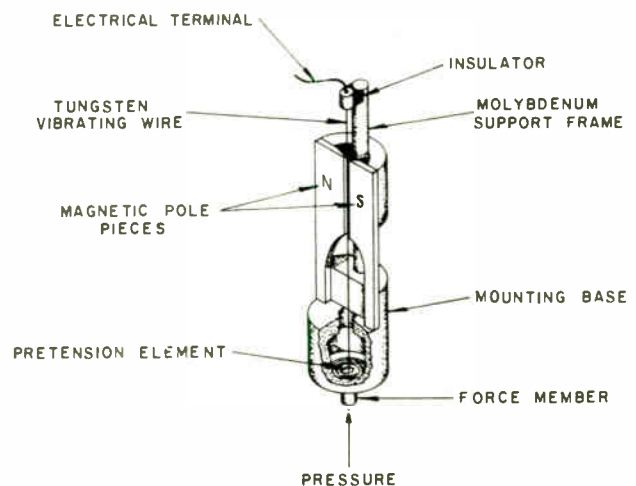
The principal problems are based upon the fact that relatively little is known of a theoretical nature on the reasons for bulk superconducting behavior. The other problems are essentially those of metallurgical preparation, since these alloys are brittle and quite difficult to produce in large, uniform, high quality lots.

### Instrumentation

Refractory metals are used in instruments where their special properties are needed to perform a given function. Cathodes in vacuum gauges and mass spectrometers and anodes in X-ray tubes (Fig. 4) commonly use tungsten or tungsten alloys. The highest temperature thermocouples and protection tubes need refractory metal compositions.

The high strength and corrosion resistant properties are often combined in applications needing pointed electrical probes, such as are used in resistivity measurements. Another use needing high strength and corrosion resistance is a miniature electronic transducer (Fig. 5). A tungsten wire held in a molybdenum frame vibrates at a constant frequency. Changes in the variables—acceleration, pressure, displacement, or temperature—change the tension and thus the frequency of the wire. These fluctuations are sensed electrically and produce an electrical output proportional to the variables being measured.

Fig. 5: Basic vibrotron pickup structure shown combines high strength and anti-corrosion in two of its critical gage parts.





New contour-hugging insulations are here in myriad shapes and forms.

Radiation chemistry has sired effective thermosetting polyolefin polymers that resist temperature and weather extremes.

Older molding-potting methods are losing favor. On the horizon are more versatile heat-shrinkable insulations for practically any electronic requirement.

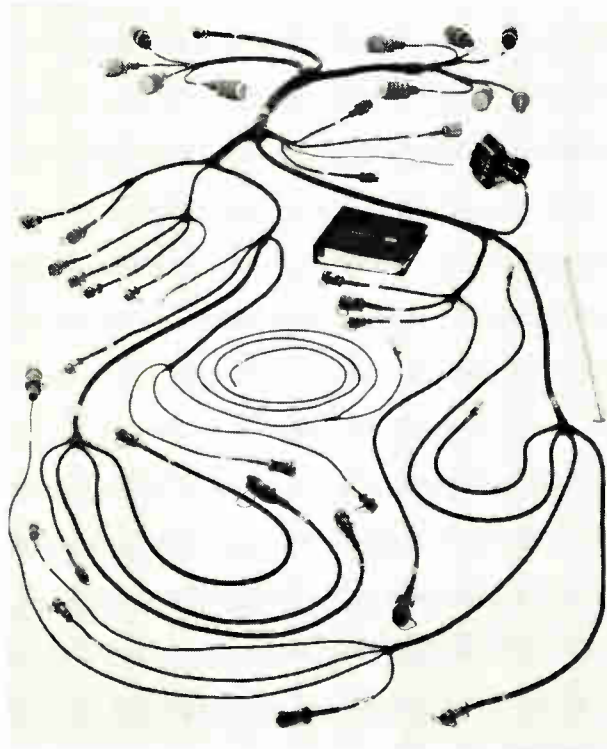
# HEAT-SHRINKABLE POLYMERS REDUCE INSULATION PROBLEMS

RADIATION CHEMISTRY OFFERS A "THIRD DIMENSION" to electronic engineers who must select insulating materials.

Less than ten years ago engineers chose sleeving only by determining length and a diameter that would allow the sleeve to slide loosely over a cable connection. Then they hoped it would stay in place during the life of the equipment. To seal harnesses they had to design molds, contend with either messy potting compounds or neoprene rubber stock.

Now, with the advent of irradiation-induced elastic memory in polymers, engineers can select sleeveings, cable jackets and pre-molded parts that shrink to conform with cable contours when heated. Thus, a

Environmental protection of harnesses is now possible using heat-shrinkable tubing and pre-molded parts, without wasted time and the cost of molding with neoprene or with sealants.



single operation can insulate, seal and provide strain relief. Engineers also have available a wide choice of irradiated plastic and elastomer material. The effect of ionizing radiation on polymers has been known for many years.<sup>1</sup>

In the dawn of the atomic age, researchers found that the physical properties of some materials improve when they are exposed to high-energy radiation from an atomic pile or an electron beam generator. They found, too, that a similar state could be induced through treatment with organic peroxides.

## Molecules Become Cross-Linked

When polyolefin compounds, such as polyethylene, are irradiated, their molecules become cross-linked into a three-dimensional gel network with elastic memory. In addition, entirely new materials have been created that behave like common elastomers, such as neoprene and silicone rubbers.

This means that an insulating resin such as low density polyethylene, which generally cannot be used above boiling water temperature, can be changed into a non-melting insulation. That is, it becomes thermosetting instead of thermoplastic. It will then withstand soldering iron heat, or short-term, high temperatures encountered when launching a missile.

When heated above 275°F the irradiated polymer turns to a rubber-like material which can be stretched sometimes as much as 600%. When a tubing or molded part is cooled in its stretched form, it will remain stretched. When heated, the material will shrink to its original shape. Accompanying drawings indicate the phenomena of molecular cross-linking, expansion and heat shrinking.<sup>2</sup>

By **DUANE D. RODGER**

Product Manager  
Raychem Corp.  
Redwood City, Calif.

Polyethylene is both crystalline and amorphous. By changing polymerizing techniques, total crystallinity versus amorphous constant can be varied over a broad range. This unique combination of crystallinity-amorphous constant makes this polymer the most versatile.

### Acts As Rubber-Like Elastomer

The significant point is that irradiated (cross-linked) polyethylene behaves as a semi-crystalline polymer below its crystalline melting point, and above that point it acts like an elastomer, being quite rubber-like and with significant strength, owing to its three-dimensional get network.

Uncross-linked polyethylene, on the other hand, has no measurable strength above its melting point. It merely melts and flows. It is the rubber-like quality and strength of such materials at elevated temperatures which make it possible to produce insulating materials that are heat deformable, possess elastic memory and serve a multitude of purposes in electronics.

The first products based on radiation chemistry were polyolefin insulated hookup wire, coaxial cable, and tape.<sup>3</sup> Irradiated, modified, polyolefin (IMP) insulated wire is solderable, and its covering weighs one-half that of other high-temperature insulations. It is ideal for wiring missiles. Satellites need radiation resistance among other properties, IMP wire again excels.

Heat-shrinkage molded parts and jacketing developments resulted in harness assemblies which could be completely sealed without laborious, time-consuming molding.

Harnesses required thicker, tougher, jacketing materials. Yet thickening the wall on polyolefin tubing made the tubing too stiff. To answer this problem heat-shrinkable tubings of modified neoprene and silicone rubber were created, and more recently, polyvinylchloride.

### Moisture Exclusion Important

A top insulation need is to exclude moisture. Radiation chemists foresaw a good market for materials that would encapsulate and embed in a single operation. They turned to selective cross-linking that resulted in a tubing with an outer wall fully cross-linked, giving it elastic memory. Being partially cross-linked the inner wall of the tubing becomes soft and viscous when heated, and is thereby forced into the interstices of wires and components. On cooling, the mass becomes a tough, homogeneous molding.

An interesting application for heat-shrinkable in-

Polyethylene in long-branch molecule form before high-energy radiation or chemical treatment resulting in cross-linking.



After treatment, polyethylene has three-dimensional gel form with primary valence bonds (heavy lines) called cross-links.



Relatively small part of cross-linked macrostructure (before heat is applied) to help visualize elastic memory phenomenon.



As cross-linked polyethylene is heated above its crystalline melting point, structure is destroyed and it becomes elastic.



In heated, elastic state the material is deformed by a force, and it returns to its original form on removal of the force.



If the cross-linked polymer is cooled in elastic distorted state the material will re-crystallize and remain deformed.



sulation is in the harnessing used in aircraft, missiles and ground support systems. Environmental protection of harnesses is now possible without the cost and wasted time of molding with neoprene or with sealants. One major missile builder estimated a savings of \$54,000 a year by using heat-shrinkable systems.

Cost savings are always attractive but reliability is more important in space and military applications. Several aerospace contractors have performed environmental tests on harnesses sealed with heat-shrinkable coverings. After impact, vibration at operating temperatures, temperature and humidity cycling according to MIL Standard 202A, and simulated high-altitude flight conditions, harnesses have still performed completely satisfactorily.

For wiring in missiles and aircraft, wire bundles must be compact and lightweight. In one missile it was found that almost fifteen pounds could be saved by changing from other plastic moldings to the heat-shrinkable system.

## HEAT-SHRINKABLE POLYMERS (Continued)

### Must Be Tough, Flexible

Harnesses must be tough and flexible to permit installation in extremely crowded conditions. This is done by combining strong polyolefin molded parts, for strain relief and mechanical protection, with neoprene or silicone rubber parts and jacketing, for flexibility.

Heavy-walled silicone rubber tubing and molded parts can provide thermal insulation for components located near a missile's blast area. Polyolefin tubing and molded parts will resist attack by the storable propellents used in second generation liquid rocket engines such as nitrogen tetroxide and hydrazine.

In ground support applications last minute changes in design can be accommodated from selection of more than 500 different sizes and shapes of molded parts. Since these parts can be expanded to about four times their recovered size, and will conform to any cable diameter between expanded and recovered size, one part can be used many places.

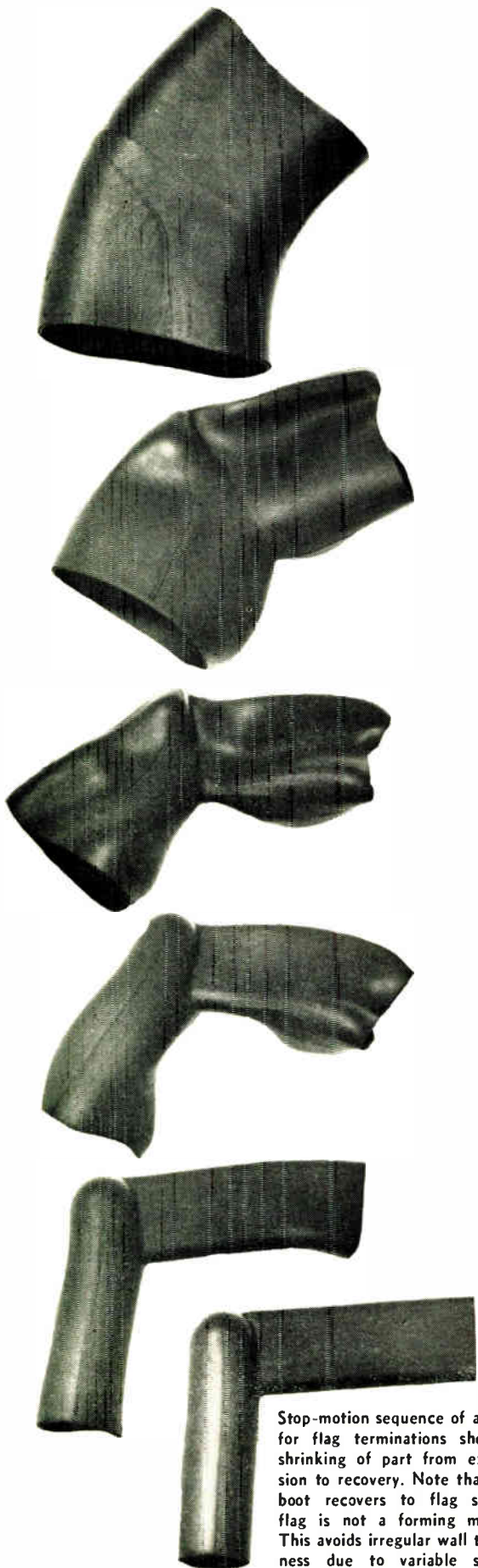
The only tools needed for a heat-shrinkable system are an adhesive package and heat source. Mixing equipment, curing ovens, or jacketing equipment are unnecessary. Work can be moved closer to a missile launching site. Also, using commercially available parts, one or two harnesses can be designed and built for almost the same average cost as a run of 500, making short runs very economical.

### New Mold Concept

A new concept for producing molds for epoxies, polysulfides, polyurethanes, and silicone RTV's has been developed using heat-shrinkable molded parts. Standard molds are available to fit most connectors and breakout configurations commonly needed in a harness. Parts come in expanded form, easy to slide over wire bundles. After heat-shrinking, molding compound can be injected with standard air-operated potting guns, mold openings tape sealed, and harnesses set aside to cure.

By using heat-shrinkable molds it is no longer necessary to design, machine, clean and maintain aluminum molds. Ordinarily, there is a wait of as much as three hours between uses for aluminum molds. With heat-shrinkable molds these delays are gone. Harnesses can be finished as fast as wires can be bundled and terminated.

Heat-shrinkable molds may be left in place to give added protection to compounds inside. Less expen-



Stop-motion sequence of a boot for flag terminations showing shrinking of part from expansion to recovery. Note that the boot recovers to flag shape; flag is not a forming matrix. This avoids irregular wall thickness due to variable stress.



sive polysulfide sealants can be used satisfactorily with polyolefin molds protecting the outside.

Unusual problems are being solved with heat-shrinkable molded parts. One manufacturer, using coaxial cable as a low-capacitance hookup wire, wanted to terminate the conductor and shield with 24 AWG hookup wire and protect the splice area. The part that solved the problem was a simple transition boot.

Signal Corps engineers for years have been looking for a better method to terminate their spiral four cable. Taping is time consuming and frequently unreliable. The part designed to solve this problem was another type of simple transition boot. (See illustrations for typical examples.)

### Anti-Strain Connector Boot

Miniature coaxial cables with extremely small center conductors are susceptible to breakage. Although technicians are aware of this, they occasionally forget and use the cable as a handle to remove the coax connector from its socket. The part designed to cope with this situation is a cable connector boot with an elongated strain shank.

A dramatic example of what can be accomplished with a heat-shrinkable part is demonstrated by a boot designed to cover a flag termination. The end of the boot that seals on the round wire must be expanded 600% to permit the right angle terminal to pass through. (See photo series of shrinking operation.)

Radiation chemistry is a young technology. The materials discussed above are only the beginning in the heat-shrinkable insulation industry. New developments on the horizon include devices which accomplish several functions simultaneously such as terminating a wire, insulating it electrically, sealing out moisture, and supplying mechanical strength.

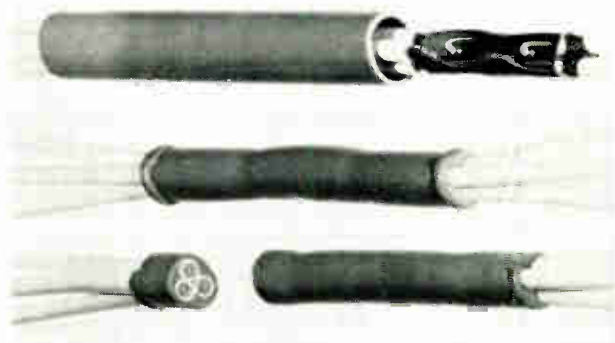
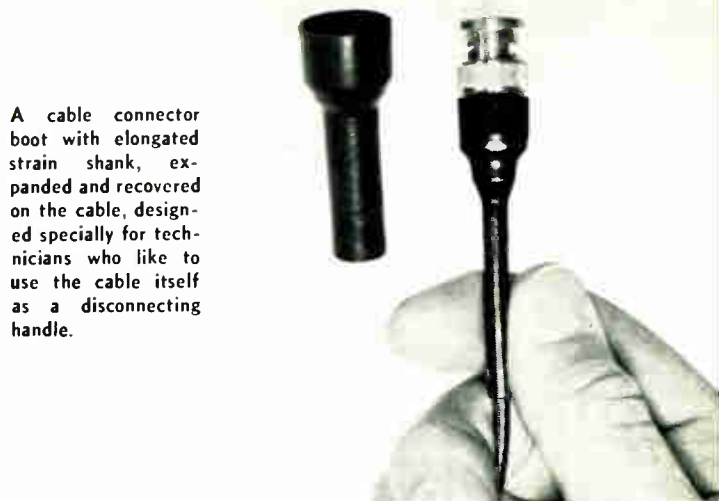
Different materials, some with higher temperature resistance, others with greater strength and flexibility are foreseen. Heat-shrinkable molded parts with extremely high temperature and chemical resistance can also be produced when the market demands such parts.

The electronic industry is making greater demands of its insulating materials than ever before. Radiation chemistry is providing many of the materials to satisfy these demands.

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1. Charlesby, Arthur, Proc. Roy. Soc. (London) *A215*, 187 (1952).
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3. General Electric Technical Report No. 2730 (1956).

A cable connector boot with elongated strain shank, expanded and recovered on the cable, designed specially for technicians who like to use the cable itself as a disconnecting handle.



Self-potting, dual-wall, heat-shrinkable sleeve for splices, terminations and component encasement. Inside wall melts as outside shrinks. Cooled mass is hard, tough and homogenous.



Transition boot insulating a shielded wire or coaxial cable, with shield and conductor spliced and terminated with ordinary hook-up wire, that helped solve many insulation problems.

Heat-shrinkable harness parts showing expanded and recovered boot (right) and transition boot (left), with potting ports, samples of standard molds available for most harness needs.



# THE OUTLOOK FOR ADHESIVES IN ELECTRONICS

Structural adhesives offer unusual advantages in solving many design and assembly problems. For example, they bond with uniform spread of load stresses to permit use of lighter gage materials. This article explains various types of these high-strength adhesives and their properties.

IN ELECTRONICS, STRUCTURAL ADHESIVES ARE NOW USED TO assemble speakers, gear and shaft assemblies in timing mechanisms, various types of relays and controls, coils of synchrotrons and containers for shipment and storage of complex instruments and systems. Due to the advantages of adhesive bonding, many assembly applications will be developed in the electronic industry in the future.

## Advantages of Adhesive Assembly

Reasons for increasing interest in the use of structural adhesives are:

1. **Stress Distribution:** Adhesives produce continuous bonds and thus distribute stress loads evenly over the entire joined area. This produces joints of greater strength and rigidity, and permits the use of lighter gage materials. The full strength of the thinnest sheets can be utilized.

2. **Fatigue Properties:** Flexibility even though minute, along with uniform stresses, helps improve resistance to vibrational fatigue.

3. **Reduces Corrosion:** Adhesives make it possible to join dissimilar metals with a minimum of bi-metallic corrosion, and to minimize corrosion from entrapment of moisture between surfaces. The adhesive acts

as a continuous insulating barrier between the two metals.

4. **Sealing:** Adhesive bonding provides continuous contact between mating metal surfaces, thus sealing as well as bonding in a single operation.

5. **Smooth Contours:** An adhesive bonded joint eliminates gaps and bulges common with intermediate fastenings and has no external projections as with rivets and bolts. Also, it has no surface mars due to the heat and pressure of spot welding electrodes, thus eliminating the need for post finishing operations.

6. **Maintain Soundness of Structure:** Adhesives maintain integrity of structural members. Holes for insertion of fasteners, countersinking to give a flush surface, and excessive heat of fusion joining, which can ruin heat treatment or distort parts, are eliminated by the use of adhesives.

## Thermosetting Film Adhesives

Film adhesives offer many design

and cost saving advantages. They provide uniform thickness throughout the joint, confine adhesive to the bonding area, allow clean bonding, and simplify the use.

Film adhesives do not contain solvents, which eliminates fume disposal and drying problems. They are available in varying thicknesses and widths; and can be die-cut into complicated shapes. This type of adhesive gives the best compromise of shear strength, peel strength, shock and fatigue resistance.

Film adhesives stick to metals and plastics and offer good flexibility, impact strength, vibration absorption, fatigue resistance, and peel strength. Many of them have very good resistance to fuels, lubricants, humidity, and salt spray.



By **EUGENE F. HESS**

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They provide shear strengths from 2000 to 6000 psi. Depending on the use and formula, some film adhesives can make high strength bonds at temperatures as low as  $-80^{\circ}\text{F}$ . In some cases shear strengths as high as 7300 lbs. have been achieved at  $-67^{\circ}\text{F}$ .

Generally, these adhesives can be used in continuous service in the  $250^{\circ}\text{F}$  range. Some bonding film adhesives will withstand moderate stress at temperatures as high as  $500^{\circ}$  or  $600^{\circ}\text{F}$  for short periods. Typical shear strengths at  $300^{\circ}\text{F}$  are about 2000 psi. At  $400^{\circ}\text{F}$  shear values of over 1000 psi have been reached using MIL-A-5090D specification test methods.

There are 2 basic types of film adhesives: Those which give off a volatile by-product or gas during the heat curing process (Elastomer-phenolic type); and those which release or liberate no volatiles during the heat curing process (Elastomer-resin type). Both types require heat and pressure to effect a cure but these requirements differ in degree.

Elastomer-Phenolic thermosetting film adhesives require pressures of 25 to 150 psi, to bring the parts into contact and to contain the volatile by-products. Exact pressure required depends on the rate of heat input to the bond line and the composition of the specific adhesive film. If sufficient pressure is not maintained during cure, the vapors given off will cause a porous bond.

Elastomer-Resin thermosetting film adhesives are of more recent development. The outstanding physical property of these adhesives is their high peel and shear strengths and overall performance up to  $250^{\circ}\text{F}$ . Room temperature peel strength is 80 to 150 lb. per in. width. Room temperature shear strength is 5,000 psi.

Chemically the important difference between this type of film adhesive and the elastomer-phenolic

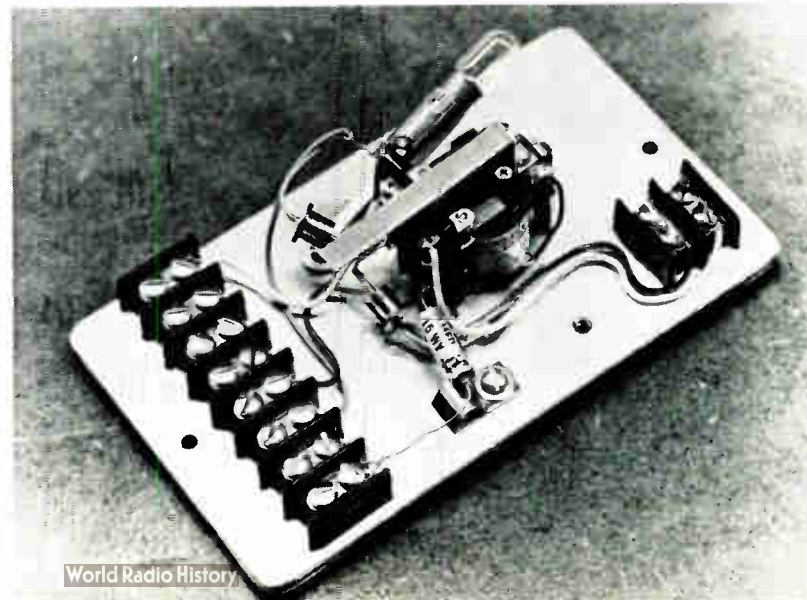


Above shows tape-bin panel fabrication using sprayable adhesive to bond sheet aluminum to a paper core. The panels can be handled as soon as assembled.



An example of bonding metal to plastic is seen above. Here, a two-part epoxy adhesive helps to position the on-off switch inside the shell of the phone.

Terminal switch is bonded to steel plate of this improved dictating system. The assembly time is reduced since there is no need for drilling and tapping.





## ADHESIVES (Continued)

type is the lack of volatile by-products given off during cure. Thus, bonding pressure needs are lower with elastomer-resin types and range from contact to 50 psi during cure.

### Modified Liquid Epoxy Adhesives

Modified liquid epoxy adhesives are chemical curing and are excellent for metal-to-metal and metal-to-plastic bonding. These adhesives are available in two-part, room temperature curing and one-part heat curing types. Modified epoxy adhesives offer high strength, resistance to creep under constant stress and adhesion to most surfaces. They are self-filleting, which makes them very good for use with honeycomb sandwich construction. Both the one

and two-part types are 100% non-volatile liquids or pastes. Since no gaseous by-products are given off during the curing cycle, they are used for bonding impervious surfaces. The paste type is good for filling voids and is used to join loosely fitting parts. These adhesives require only contact pressure during cure. This eliminates the need for elaborate jigs and fixtures.

Epoxy resin adhesive will produce from 1000 to over 5000 psi overlap shear strength depending on the particular adhesive used. Heat curing epoxies have higher strengths than the room temperature curing formulas.

High temperature resistant epoxy

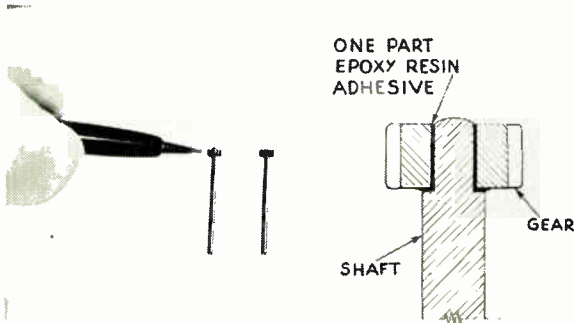
adhesives have shear values in excess of 2500 psi at 300°F. Strengths at extremely low temperatures are also good. At -67°F, shear strengths will range from about 500 psi to more than 4000 psi.

Chemical resistance depends on the formulation; but in general, epoxies will resist most solvents, mild acids, and mild alkalis.

One-component modified epoxy heat curing liquid adhesives eliminate the need for accurate weighing and mixing of the hardener and base resin by the user. Besides saving time and minimizing the chance of human error, this system allows an unlimited working life. Heat curing is required in using this type of adhesive. The table below shows the different combinations possible for curing.

Stages in adhesive-bonding process. Upper photos show (left) the parts to be assembled; (right) a rotor shaft is dipped in a

container of adhesive. Lower left, a timing gear being pressed on a coated shaft; and right, gear train with bonded pinion.



TYPICAL TIME - TEMPERA-  
TURE CURE CYCLE  
RELATIONSHIP

| Temp.<br>(°F) of<br>Bond Line | Time (Min.)<br>At Cure Temp.<br>Adhesive<br>EC-2214 | Time (Min.)<br>At Cure Temp.<br>Adhesive<br>EC-2186 |
|-------------------------------|---|---|
| 250                           | 40-60   | —   |
| 300                           | 15-20   | 120-180   |
| 350                           | 6-12  | 40-60   |
| 400                           | 1-2   | 15-20   |
| 450                           | —   | 6-12  |
| 500                           | —   | 1-2   |

Two-component modified epoxy adhesives consist of a base resin and a separate liquid catalyst or accelerator. The 2 materials, base and accelerator, must be mixed in the proper proportion prior to use.

Two-component modified epoxy systems will cure at room temperature, making them useful for many bonding operations where heat or pressure are not feasible in making a high strength bond. A rapid cure can be obtained after the parts are assembled by merely heating the assembly in an oven or under infra-red lamps.

Standard adhesives of this type tend to produce rigid bonds. Adhesive EC-2216 produces a flexible, high-peel-strength bond while it maintains its high shear and tensile strength.

### Typical Uses

The use of adhesives to assemble components of the new Nyematic Dictating System has reduced assembly time in addition to providing a flexible assembly method at Nye Products Company, Seattle, Washington (see the 3 photos illustrating).

A fast-drying, sprayable adhesive, EC-1828, is used to bond aluminum facings to paper honeycomb cores to make panels for a recording-tape storage bin. A two-part modified epoxy adhesive, EC-1838, bonds metal and plastic components of the dictating system.

In the tape-bin panel manufacture,

the fast-drying adhesive permits the immediate assembly of the honeycomb core and aluminum facings. Because of the high immediate strength of the adhesive the panels can be handled as soon as they are assembled.

The two-part epoxy adhesive is used to bond parts of the tape storage bin; an on-off switch inside a plastic phone housing; and an 8-conductor terminal switch to a steel plate.

In the assembly the on-off switch must be properly aligned with the push button controls of the phone. The epoxy adhesive's heavy body helps in positioning the switch.

The terminal switch assembly time is reduced by eliminating drilling and tapping. Adhesive bonding the terminal switch also saves space, since a mounting plate is not needed.

A two-part epoxy adhesive was chosen for bonding these metal and plastic components because the parts did not lend themselves to heat curing operations.

The Haydon Division, General Time Corp., Torrington, Conn., has

been assembling timing gears by adhesive-bonding small pinion gears to rotor shafts. These are shown in 4 photographs. These timing gear assemblies are used in synchronous timing motors which require small gear trains of high accuracy. These gears, therefore, are accurately machined and heat treated to provide sufficient hardness for wear resistance.

The previous joining method consisted of brazing the pinion gears to the rotor shaft. This method, in many instances, distorted the gear configuration or effected metal hardness due to the high temperatures involved in brazing.

EC-1386 is a one-part high-strength adhesive with an epoxy resin base selected by Haydon for this use.

This adhesive bonding method has provided savings by: reducing rejects which were distorted by the heat of brazing, eliminating secondary operations required with the previous brazing method, and eliminating the need for 100% inspection for shaft distortion.

## NEW TECH DATA

### Encapsulating Compound

"Polcast" is a new encapsulating compound with excellent adhesion to polyethylene. Applied hot, it can also be used to laminate polyethylene to itself or polypropylene to itself, bonding instantly. It is applied easily by heating to 300 to 350°F and pouring into the polyethylene or polypropylene shell. Electronics Research Div., Adhesive Products Corp., 1660 Boone Ave., Bronx 60, N. Y.

Circle 639 on Inquiry Card

### Silicone Insulators

Tech. data describes a new line of high-reliability room-temp. vulcanizing silicone rubbers. RTV silicone rubbers remain flexible over a wide temp. range and are good insulators. They are used for making flexible molds and phototypes where minute detail must be reproduced. Hysol Corp., Olean, N. Y.

Circle 640 on Inquiry Card

### Voltage Breakdown Tester

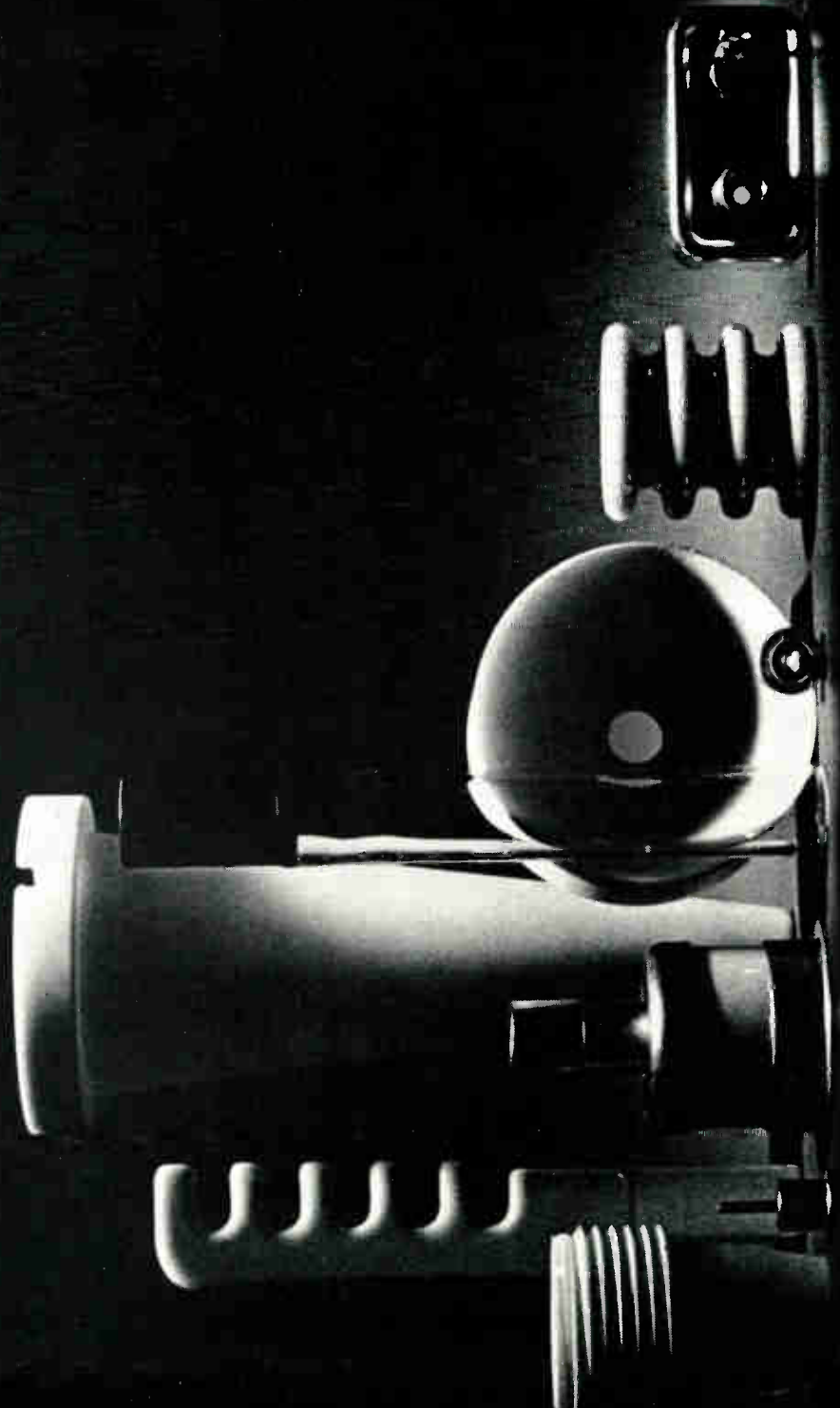
Data sheet VBT-1A describes voltage breakdown tester Model 1901A. This VBT is non-destructive in that it limits the time factor of the test rather than the amount of current or voltage applied to the test specimen. Uses include testing capacitors, transformers, r-f cavities, and insulation. Microdot Inc., 220 Pasadena Ave., So. Pasadena, Calif.

Circle 641 on Inquiry Card

### Encoding Systems

A 12-page brochure describing the Microgon® angle-encoding systems is available from Norden Div., United Aircraft Corp., Norwalk, Conn. The shaft-angle encoders have an accuracy of ±1 count in over 2 million. In addition to a comprehensive explanation of each product, the brochure contains photos, characteristic graphs, and block diagrams.

Circle 642 on Inquiry Card





Some experimental single-crystal silicon carbide components have been recently developed. If they can be produced in uniform quality, greater reliability may be added to micro-circuits. Thermistors, rectifiers and even transistors of high heat resistance, fast response time and good stability are the goals. These and other ceramic components and materials are reviewed.

CERAMICS HAS UNDERGONE A MAJOR CHANGE in the past 20 years. While some of it has been self-generated, most has been induced by the increase of knowledge and material needs in other engineering areas. In thinking about future advances in ceramics, therefore, one must speculate on probable developments in these other areas.

Thinking about ceramics in electronics yields four major trends which will have more and more influence: 1. Increasing miniaturization, both in scope and degree. 2. Much greater strengths, particularly in withstanding thermal and mechanical shock. 3. Higher operating temperatures. 4. Ultra-high purity or precisely controlled composition. These criteria apply to many ceramic materials used in electronics today. Their future depends on the growing needs of users and how the ceramist reacts to meet them.

### History of Ceramic Insulators

The history of ceramic insulators shows the changing nature of electronic ceramic materials.

Electrical-grade porcelain was the prime material until 1930. It functioned well at lower frequencies and is still used to transmit power. As frequencies increased, porcelain was found wanting and steatite came into use. This is still quite useful, being inexpensive and easily processed. However, the need for greater strength and better thermal shock resistance has led to widespread use of alumina.

Although the most expensive of the 3, alumina has several advantages: good electrical properties, hardness, toughness and good chemical resistance. More recently, 2 other ceramics, boron nitride and beryllia, have been used as insulators. Both have low-density, which makes them good for aerospace systems.

Ceramics have long been used as insulators and this use is increasing. Ceramic components shown at left include alumina, steatite, graded glass-to-metal and ceramic-to-metal seals.

# CERAMICS: A NEW DIMENSION IN CIRCUITRY

Because they satisfy the 4 criteria, alumina, beryllia and boron nitride will be the important ceramic dielectrics in the future. The problems in handling toxic beryllia have been largely overcome and it seems certain that the moisture resistance of boron nitride will be upgraded, opening many new uses for both materials.

### Silicon Carbides

In recent years, ceramics have also become important in the semiconductor field. Ceramic resistors, particularly those of silicon carbide, have been used for many years, mainly in varistors for lightning arrestors and telephones. Higher temperature environments and greater unit loads have created demand for more and better ceramic semiconductors. Besides silicon carbide, these include many mixed oxides, and in the future will undoubtedly spread to other carbides, borides and possibly nitrides.

Perhaps the fastest growing area for ceramic semiconductors is thermistors. Both positive and negative temperature coefficient devices have a wide range of resistance and beta values. Some ceramic bodies being researched have beta values 3-4 times higher than commercially available thermistors.

Ceramic semiconductor devices available until now have been made from polycrystalline bodies. Quite recently, two labs developed single-crystal silicon car-

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## CERAMICS (Concluded)

bide thermistors. This should extend the uses for this type of device. These thermistors will be of minute size with fast response time, and should have better stability and reproducibility of response than polycrystalline bodies. More important, however, the single-crystal devices will be useful at temperatures far above the upper limits of multi-crystal ones.

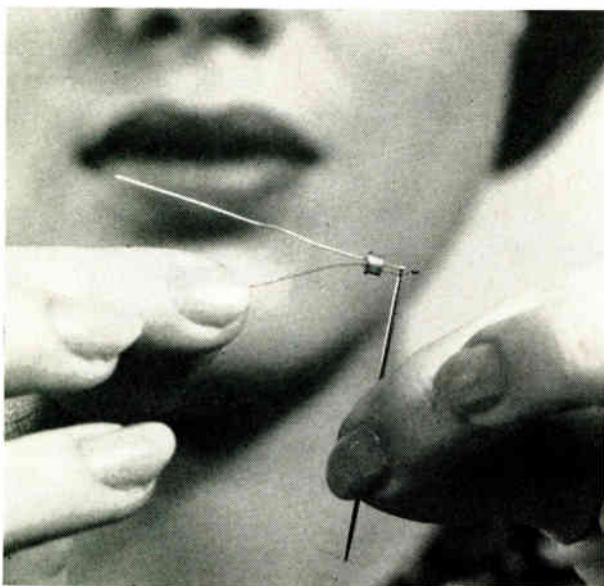
### Very High Temperatures

It appears likely that operating temperatures over 1000°C. will be possible for the single-crystal devices. One of the interesting problems here is the need to develop a ceramic encapsulant to protect the electrical junctions where the metal leads join the crystals. This appears feasible.

Many labs have been working with another type of silicon carbide single crystal to make a high-temperature rectifier. Some success has been attained and it appears that these devices will be available commercially in a few years. An effort is also being made to develop silicon carbide transistors. These have been produced experimentally, but prospects appear slim for an early breakthrough in the controlled crystal growing methods needed to mass-produce them.

Microminiaturization is already highly dependent on ceramics. Parts of such circuits are deposited on tiny ceramic wafers, generally of high purity alumina, which are then stacked and interconnected. These

One of the major criteria which will influence the future of electronic ceramics is miniaturization. A new single-crystal thermistor is shown being inserted through eye of a needle.



wafers are less than 1 mm. thick and free of surface imperfections. Growing of more pure ceramic single crystals should make all components of these materials increasingly useful in microminiature circuits.

Silicon carbide bodies like those used for refractories find a new use in dummy loads for both microwave and r-f transmitters. Such bodies readily absorb energy at these frequencies and can easily withstand strong local heating as well as high transient heat pulses. The high thermal conductivity of silicon carbide allows the absorbed energy to be quickly conducted to a cooling bath or fins.

### Lasers and Masers

The recent development of lasers and masers appears important to the ceramist as well as the electronic engineer. Single-crystal alumina doped with chromium was the first material to show laser action. The effectiveness of this material depends upon crystal perfection and impurity control. Many other ceramics demonstrate this action. Neodymium-doped calcium tungstate, doped glasses, and strontium fluoride with uranium show stimulated emission. Gallium arsenide recently produced coherent radiation by direct electrical stimulation.

Ceramic electromagnetic windows for space uses are becoming more important. Radomes are often formed from alumina, which has the strength, abrasion, heat resistance and dielectric characteristics for the high frequencies involved. The need for better infrared windows in detection and guidance systems has led to the development of better, controlled fabrication methods. Both hot pressed magnesium fluoride and single crystal magnesia are used here.

### Other Uses

Other special ceramics for electronics deserve comment. One of these, the ferrites, has been much discussed. Electro-mechanical ceramic devices have good frequency control. Ceramic band-pass filters hold side frequencies to a minimum. Ceramic piezoelectric devices are often used as frequency standards.

Looking to the future, there is a broad field of direct energy conversion, fuel cells, thermionic and thermoelectric converters and MHD, much of whose long range success appears to depend on ceramics. High operating temperatures will characterize many of these operations. The needs of the processes for electrical insulators, temperature sensors and controls and ionic conducting membranes will be satisfied in many cases by ceramic materials. For the ceramist these are exciting challenges.

\* \* \*

# THE SEARCH FOR NEW SEMICONDUCTOR MATERIALS

Semiconductors are only as good as the materials used to make them. What are these materials? What qualities do they have that make them the best for the job? What do they lack? What advances have been, and need to be, made in the materials area?

THE SEMICONDUCTOR INDUSTRY used about 60,000 lbs of silicon ( $S_i$ ), and a somewhat smaller amount of germanium ( $G_e$ ) in 1962. As transistors, rectifiers, and controlled rectifiers continue to invade the power market, material needs will increase. Moreover, unless a replacement for solar cells is developed, that area alone could add several thousand pounds a year to the usage of  $S_i$ . Thus from a supply standpoint, if any other material is to displace  $S_i$  and  $G_e$  appreciably in the next few years, it will have to be available in quantities of 50,000 to 100,000 lbs/yr. and at some reasonable cost. Even if better performance could be obtained from a more costly material, it seems unlikely that the general market would bear a higher cost.

## Least Expensive

$G_e$  is easy to process but scarce, so its price probably will not decrease much unless new sources are discovered. Even now almost all scrap  $G_e$  is reclaimed.  $S_i$ , on the other hand, comprises about 25% of the earth's crust, but is more difficult to process than  $G_e$ . However, as processes are improved and usage increases, high-purity  $S_i$  prices will probably decline. In the case of compound semiconductors each component must be purified before compounding; even if both (or all) components are readily

available (which is not the case for gallium), we may expect the processing costs for compound semiconductors to be about twice that of elemental semiconductors. This leads to a price projection for gallium arsenide ( $G_aA_s$ ) which is twice that of  $G_e$ . All of this leads to our first conclusion, that  $S_i$  will remain the least expensive material during the next 5 yrs.

## Finding the Best

This takes us to the next problem, that of finding the best material. Consider the operating temperature range. For most classes of devices, operation is restricted to temperatures for which  $n_i$  is small compared to the impurity doping level. Table I shows some approximate upper temperature ranges for various band gap materials. Desired operating range is creeping up, due both to more severe environmental conditions and to the desire to extract more power from a given device. Even so,  $G_e$ ,  $S_i$ , and  $G_aA_s$  are the only contenders far enough advanced to be considered during the next few years. And Table I shows that even  $G_e$  is marginal.

## Important Factors

As semiconductors invade the higher power areas (which with solar cells will probably account for the majority by weight of material used), mechanical

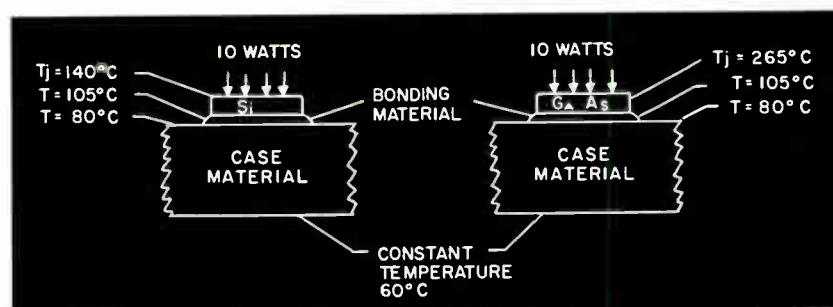


Fig. 1: Some possible temperature drops across the semiconductor, the solder and the case, for silicon and gallium arsenide.

By Dr. W. R. RUNYAN

Texas Instruments Inc.  
Dallas, Texas



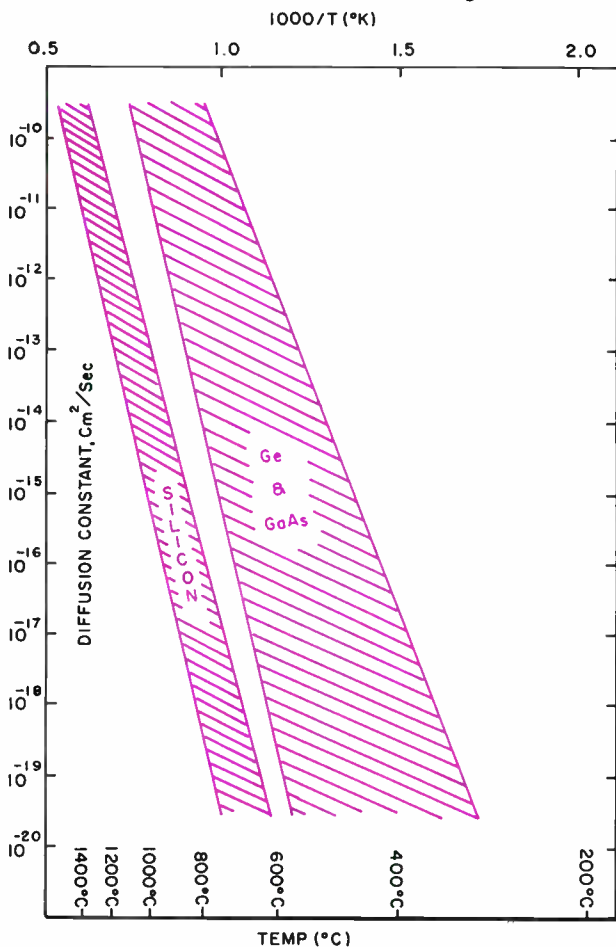
## SEMICONDUCTOR MATERIALS (Continued)

strength and thermal conductivity will become more and more important factors in the choice of material. Table II shows some "average" values of these properties in the room temperature range.

The thermal conductivity of  $S_i$  is highest, followed by  $G_e$  and then by  $G_nA_s$ , with a value of only about  $\frac{1}{4}$  that of  $S_i$ . Fig. 1 shows some possible temperature drops across the semiconductor, solder and case, for  $S_i$  and for  $G_nA_s$ . It becomes apparent for power uses that the lower thermal conductivity can offset the higher potential operating temperature of  $G_nA_s$ .

The breakage rate encountered in handling large-area  $S_i$  and  $G_e$  wafers is not prohibitive except when their thickness is less than about three mils (0.003). For  $G_nA_s$ , however, much difficulty is found even with 10 to 20-mil thick wafers. This behavior is reflected in their relative breaking strengths, Table 2. Also, the weaker the material, the more likely that poor handling methods will cause mechanical damage that will reveal itself only during later operations. For example, most semiconductors, if subjected at

Fig. 2: Extrapolated diffusion coefficients vs temperature for a range of values for germanium, silicon and gallium arsenide.



room temperature to high localized stress, as from test probes, will dissipate the elastic energy at high temperatures by plastic flow. In wafers, small cracks or even gross failure can occur because of improper matching of the thermal expansion coefficients of the semiconductor and its contacts. Again, the lower the breaking strength, the more likely that such defects will occur.

### Defects

Better methods of studying defects in semiconductors and improved methods for preventing their formation must be developed. As an example of the present status, as late as March 1963, stacking faults covering square cm's of area were first reported in  $S_i$ . Also, the old standby of dislocation counting can certainly be misleading. The photo shows a network of dislocations found in "dislocation free"  $S_i$  by x-ray topography. These comments do not imply that  $S_i$  is particularly bad, but rather that it is the only one studied appreciably at the present. Though impurity-impurity, and impurity-defect interactions have long been studied, only now are their practical effects on device fabrication performance and reliability being considered. The desire for more radiation tolerance in semiconductors is requiring a closer look at the effects of radiation-induced traps on lifetime. It also raises the hope that eventually effects of such traps may be minimized by proper doping prior to irradiation.

In view of increasing demands for reliability, we will consider possible interaction of reliability and materials. Construction of a reliable device requires that its characteristics must remain within tolerable limits during its normal life. The first thing to examine is the possibility of bulk changes which could affect device performance; e.g., a redistribution of impurities caused by precipitation, diffusion, electrolysis, or additional alloying from contacts caused by high localized heating.

It is hard to establish simple criteria for setting limits on the amount of diffusion allowable. So it was assumed that the diffusion should be such that a point on the diffusion front three orders of magnitude lower in concentration than the initial must move less than 0.03 microns (1/10 of the base width of a present day h-f transistor). This requires a  $Dt$  (diffusion coefficient-time product) of less than  $2.5 \times 10^{-11} \text{ cm}^2$ . If a device is to be used for 5 years,  $D$  must be less than  $1.2 \times 10^{-19} \text{ cm}^2/\text{sec}$ . Fig. 2 shows extrapolated diffusion coefficients vs temperature for a range of values appropriate for  $G_e$ ,  $S_i$  and  $G_nA_s$ . Observe that in the case of  $S_i$  and  $G_e$  the temperatures at which any appreciable diffusion occurs are



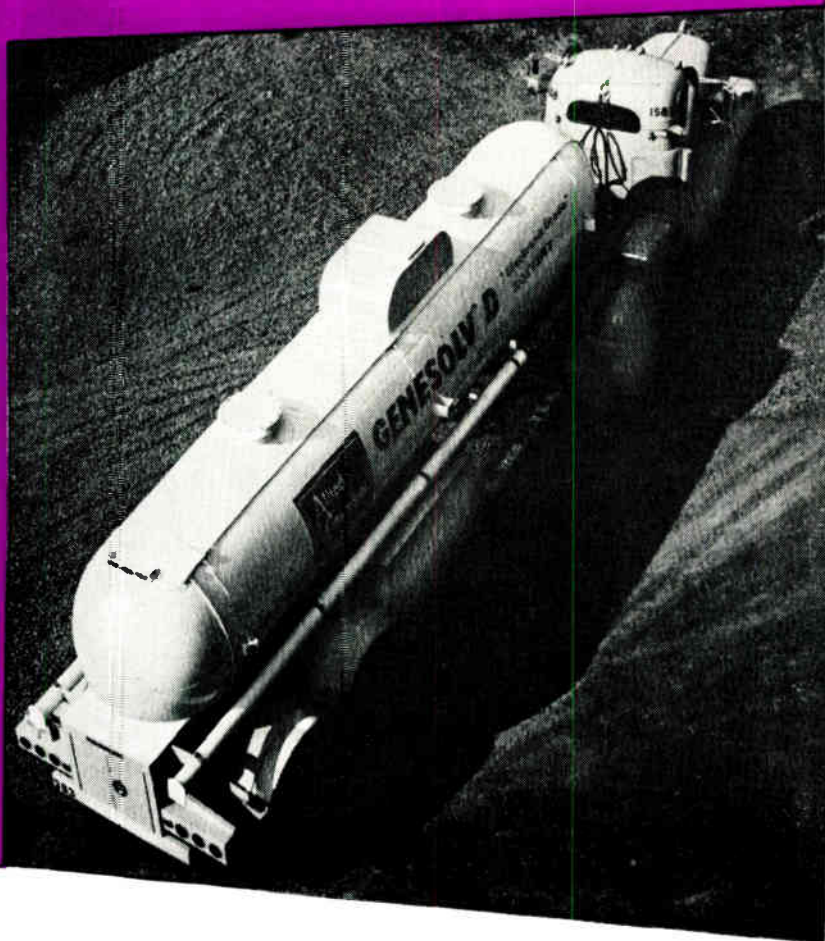
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## SEMICONDUCTOR MATERIALS (Continued)



Dislocations found in "dislocation free" Si by x-ray topography.

well above any possible operating temperature. On the other hand, the  $G_nA_s$  diffusion coefficients are higher and this may prevent its use at the elevated temperatures that its wider band gap would allow. As a matter of fact, the drift of  $G_nA_s$  tunnel diode characteristics has been attributed to a change in the impurity profile near the junction caused by a combination of diffusion and field-induced drift.

There are some elements, e.g. lithium and zinc, in  $S_i$  that have high diffusion coefficients at low temperatures, and whose movement can be influenced appreciably by low electric fields. This property is useful in making "adaptive" devices, but care must be taken to keep such elements away from standard device material. Also, there is only a small amount of data on the diffusion rate along grain and twin boundaries, but the rate is greater than in the bulk. Thus, the accidental inclusion of such a defect in a device could lead to eventual failure unpredicted by the previous argument.

Precipitate formation of another phase has an effect both through removing impurities from solid solution, and through the electrical behavior of the precipitate itself. There is little data available on the rates of precipitation vs temperature and temperature cycling, and mechanical stress cycling. The demand for further reliability will require a more extensive study of these effects in the future.

The more serious problem is not movement in the body of the semiconductor, but rather chemical reactions at the surface, and surface migration. Device performance is very dependent on the semiconductor-surface layer bonds, so any changes with time are usually undesirable, and some are catastrophic. The search for an appropriate stable surface film continues. It has met with little success except in the case of  $S_i$ , whose oxide has proven nearly ideal. Use of the material oxide is unique to  $S_i$  since it is apparently the only one whose conductivity is low enough not to interfere with device operation. For

other semiconductors, either a different compound must be "grown" onto the surface to tie up the broken bonds, or a completely foreign material must be added. Neither of these solutions seems as good as the native grown silicon oxide (with its good mechanical and electrical properties). This is another reason why  $S_i$  will probably hold an edge in reliability for years to come.

Our second conclusion, then, is that  $S_i$  will be the most widely used material during the next 5 years. This is because of its better physical properties and probable economic advantage. Our third conclusion is that, as the degree of device sophistication and the demands for reliability continue to increase, a much better understanding of material-device interactions will be needed.

### Materials for "Specials"

In the case of special low-volume items needing properties peculiar to a particular material, the arguments just advanced are not applicable. It is interesting, however, to do some speculation of a different nature in these areas. Use of  $G_nA_s$  for diode light emitters and optically coupled transistors implies a continuing industrial study of  $G_nA_s$  fabrication and diffusion methods. The possibility of using  $G_nA_s$  in either a good high-temperature or high-frequency transistor is not so clear at the moment, but its future is probably slanted toward high-frequency uses. This end use requires development of more material purification methods and crystal growing methods that will ensure reproducibly high mobilities.  $G_nA_s$ 's ability to be doped with oxygen to a high resistivity makes it intriguing as a material for functional electronic blocks, since it would offer more latitude in element placement and isolation than is now possible. In order to take full advantage of this property, epitaxial growth of layers is needed. This will necessitate development of much better methods for depositing  $G_nA_s$  epitaxially; these will in turn extend the technology and use of epitaxial methods to con-





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## SEMICONDUCTOR MATERIALS (Concluded)

pound semiconductors in general. Again, because of the various factors mentioned earlier, it seems unlikely that this usage will supplant large-volume use of  $S_i$  for functional electronic blocks within the next 5 years.

Indium antimonide has long been used as an infrared detector (both photovoltaic and photoconductive), but desires to operate detectors at temperatures above that of liquid nitrogen are causing a shift to other materials (notably indium arsenide). On the other hand, the large mobilities in InSb and the possibility of using indium antimonide to achieve a solid state analog of the traveling wave tube will be enough stimulus to maintain a continuing active indium antimonide materials program in many labs.

### Recent Advances

Now consider some recent advances in semiconductor material technology, and their probable impact on future developments. Development of methods of growing single crystal semiconductor films on inexpensive polycrystalline substrates by either micro-melting or "rheotaxial" process will probably be more applicable during the next few years to new types of small area active thin film devices than to present day designs. Certainly the realization that epitaxial methods could be used to advantage in building many device configurations marks a major advance. The development of dendrites and webs has not yet made an impact, even though it makes possible direct

transformation from a melt to wafers without intermediate cutting and polishing procedures and is a big improvement in crystal growing technology. With the increased emphasis on reliability of finished devices, the development of a dependable surface stabilizer for  $S_i$  (thermally grown oxide) represents a milestone.

The combination of epitaxy and web growing, plus an artful use of oxide masking and stabilization, makes feasible the concept of a fully automatic transistor assembly process, which starts with bulk material. Some gaps still exist in the technology—notably in the area of a continuously selective etching process, but some promising avenues are available. Thus, instead of growing crystals, slicing, mechanically or chemically polishing, making an epitaxial deposition, masking, diffusing, etc., one can visualize: (1) a continuously fed dendrite or web machine supplying a ribbon of material directly into an epitaxial deposition furnace (2) next the ribbon receives an oxide coating, which is selectively removed in the following step by an ultraviolet-catalyzed etch (3) the ribbon then progresses to a diffusion or epitaxial furnace as appropriate (4) steps 2 and 3 are repeated as needed depending on the complexity of the device to be built (5) vapor-plated metal contacts are added (6) the ribbon is converted to dice and assembled on headers, given a protective envelope, and tested. There are, of course, many mechanical problems associated with this undertaking but a final conclusion is that such machines will be in operation in about 5 years.

Table 1  
COMPOUND AND ELEMENT SEMICONDUCTOR PROPERTIES

| Semiconductor | Band Gap (ev) | Electron Mobility $cm^2/Vsec$ | Hole Mobility $cm^2/Vsec$ | Max. Temp. (usable °C) |
|---------------|---------------|-------------------------------|---------------------------|------------------------|
| Ge            | 0.67          | 3,900                         | 1,900                     | 85-100                 |
| Si            | 1.11          | 1,500                         | 500                       | 150                    |
| C (diamond)   | 6.70          | 1,800                         | 1,200                     | >1,000                 |
| InSb          | 0.18          | 65,000                        | ≈1,000                    | ≈196                   |
| InAs          | 0.33          | 20,000                        | ≈200                      | ≈30                    |
| InP           | 1.25          | >4,000                        | >100                      | ≈300                   |
| GaAs          | 1.35          | >5,000                        | >400                      | ≈400                   |
| GaP           | 2.25          | >100                          | >20                       | ≈650                   |
| AlSb          | 1.52          | >400                          | >400                      | ≈450                   |

Table 2  
MECHANICAL PROPERTIES OF SOME SEMICONDUCTORS

|      | Young's Modulus* dynes/cm <sup>2</sup> | Breaking Strength*† dynes/cm <sup>2</sup> | Thermal Conductivity Watts/cm deg. |
|------|--|---|------------------------------------|
| Ge   | $10.25 \times 10^{11}$ at 25°C         | $2.23 \times 10^{10}$                     | 0.7 at 300°K                       |
| Si   | $13.56 \times 10^{11}$ at 25°C         | $2.65 \times 10^{10}$                     | 1.3 at 300°K                       |
| GaAs | $1.64 \times 10^{11}$ at 25°C          | $1.98 \times 10^9$                        | 0.37 at 300°K                      |
| AlSb | $6.02 \times 10^{11}$ at 25°C          | $1.38 \times 10^{10}$                     |                                    |

\*[100] direction, 25°C

†1/30 shear modulus

1. McSkimin, *Journal of Applied Physics*, Vol. 24, No. 8, pp. 988, Aug. 1951 (for Ge & Si).

2. *Selected Constants Relative to Semiconductors*, Pergamon Press, 1961 (for GaAs & AlSb).

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## Hall Effect Pocket Booklet

A 23-page, pocket-size booklet, entitled "The Hall Effect and its Applications," discusses the Hall Effect and contains sections on history and theory, practical devices, and instructions for putting the principle to work. For readers who care to conduct actual experiments and apply the Hall Effect to practical problems, "Hall-Pak" kits consisting of a circuit board, magnets, "Hall-Pak" device and the booklet can be supplied. Kits vary in price. Booklet is free. F. W. Bell, Inc., 1356 Norton Ave., Columbus 12, Ohio.

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## Avalanche Rectifiers

This brochure entitled, "Double Diffused Avalanche Regulated Silicon Power Stud Rectifiers" covers mechanical, performance and environmental features as well as absolute max. ratings, thermal and electrical characteristics. It describes stud rectifiers for 3a, 6a, and 12a. uses, and operate at 1 kv. Atlantic Semiconductor, Inc., 905 Mattison Ave., Asbury Park, N. J.

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## 25-Amp. Transistors

Engineering Data Sheet 2N2636—2N2638 describes a series of three 25-amp. high-speed switching transistors capable of switching clamped inductive loads in  $\mu$ sec at peak powers of 1000, 1500, and 2000w respectively. Information includes schematics, curves, and specs. Bendix Semiconductor Div. of Holmdel, N. J.

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## Optical Maser Brochure

Full specs. and prices on the complete line of laser optics, dielectric coatings and single crystals available from Perkin-Elmer Corp., are given in a new 12-page brochure, "Optical Maser Services." Brochure also includes coating transmission curves, material transmission characteristics, and typical dimensional tolerances. Electro-Optical Div., Perkin-Elmer Corp., Norwalk, Conn.

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## Receiving Tube Booklet

A 16-page booklet, "The Box with No Bottom," characterizes the electronic tube carton as a magician's box from which come endless developments and products. Booklet contains details of 22 recent developments in compactrons, receiving tubes, ceramic tubes, photoconductive cells, and reed switches. Receiving Tube Dept., General Electric Co., Owensboro, Ky.

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## Semiconductor Catalog

Over 3,500 semiconductor devices, including glass zener diodes, silicon controlled rectifiers, silicon and selenium small, medium and high power rectifiers, photocells and zener reference elements are described in 24-page Short Form Catalog No. SFC-1-2. Ratings, characteristics and other descriptive data are included. International Rectifier Corp., 233 Kansas St., El Segundo, Calif.

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## Tube Catalog

The 68-page illustrated 1963 Quick Reference Catalog describes Eitel-McCullough, its products and facilities. Products described include microwave tubes, power klystron and power grid tubes. Power grid tubes are subdivided into rectifiers, triodes, tetrodes, pentodes and pulse modulators, sockets and other products. Eitel-McCullough, Inc., San Carlos, Calif.

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## Low-Impedance Silicon Zener

This brochure describes a new line of low-impedance, 1w. miniature silicon zener diodes. Complete specs., a cross sectional drawing, curves and features are included. Diodes, Inc., 9261 Independence Ave., Chatsworth, Calif.

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## Transistor Amplifier

Data on T-2857 silicon planar-epitaxial transistor amplifier for h-i military and industrial communications circuits is available. Device, which has been functionally tested, exhibits an 18db power gain and a 4.5 typical noise figure at 100mc. It is tested at 100mc in actual amplifier circuit. Essential operating characteristics of the transistor are measured during circuit operation. Noise figure and gain are measured at the same point under the same conditions. Lansdale (Pa.) Div., Philco Corp.

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## Industrial Tube Guide

Industrial Tube Guide (Form T-23) contains details on the uses, construction, capabilities, number and military uses of industrial tube types, including ballast, computer, electrometer, hydrogen, thyatron, phototube, power triodes, transmitting, voltage amplifier pentodes and voltage regulators. Tung-Sol Electric, Inc., 1 Sumner Ave., Newark 4, N. J.

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## Triode Bulletin

Tech. data is available on the Calvertron A2900 long-life double triode. It is similar to the 12AT7 but has closer tolerances on characteristics, especially balance of current and slope and control of "cut-off" voltage. Also, the A2900 will tolerate long periods of operation under "cut-off" conditions, important in "flip-flop" circuits. Calvert Electronics, Inc., 220 E. 23rd St., New York 10, N. Y.

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## Tunnel Diodes

Two series of microwave germanium tunnel diodes for h-f uses are described in literature available from Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. J. The devices, D4961 and D4971, have typical resistive cutoff freqs. from 3gc to 32gc and peak currents from 2.0ma to 100ma.

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## High-Conductance Diodes

Two high-conductance, low-capacitance silicon planar epitaxial diodes with fast recovery times, hpa-1001 and 1002, are described in this data sheet. Attached chart compares combination of high conductance and fast switching with that of other diodes, using the ratio of conductance ( $I_F$ ) to capacitance ( $C_0$ ), vs. recovery time ( $T_{rr}$ ). HP Associates, 2900 Park Blvd., Palo Alto, Calif.

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## Silicon Transistors

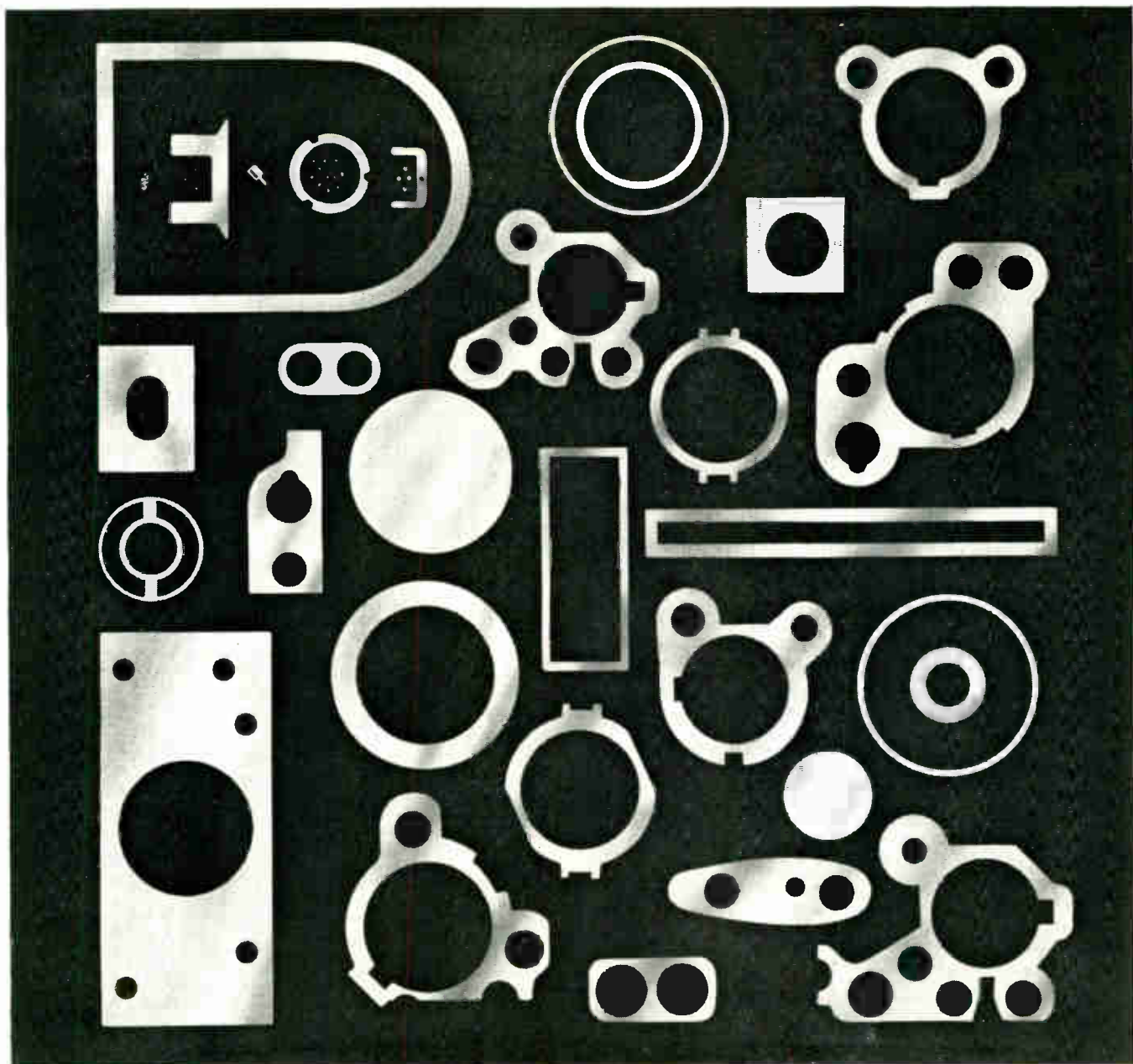
A condensed catalog describes silicon planar/epitaxial transistors. Included are full listings and basic specs. on: high-voltage universal amplifiers, low-level and small-signal amplifiers, universal amplifiers and switches, low-storage saturating switches, CBF and VBF amplifiers and non-saturating switches, industrial types and low-level choppers. Transistors listed are production-run types. Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

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## Tunnel Diode Measurements

A brochure, "Technical Report on Tunnel Diode Measurements," includes methods of measuring series and negative resistance, junction capacitance, max. freq. of oscillation, and resistive cutoff freq. Circuits and graphs are included. Microwave tunnel diode line is listed. Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

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# GLOSSARY OF TERMS IN OPTICS AND SPECTROSCOPY

Compiled by Alva H. Bennett,  
American Optical Co. (Retired)

**ABERRATION**—In an optical system any systematic departure from an idealized path of light rays forming an optical image, causing the image to be imperfect.

**ACHROMATIC**—The property of being free of color. In an optical system, freedom from chromatic aberration.

**ACUITY, VISUAL**—The degree of keenness of vision.

**ACUTANCE**—The degree of sharpness and contrast of edges in an image.

**ANAMORPHIC**—A difference in magnification along two mutually perpendicular axes. Also applied to an optical system producing this effect.

**ANASTIGMAT**—A lens system corrected especially for freedom from the aberration called astigmatism.

**ANGSTROM**—A unit of length applied in specifying the length of light waves. It is equal to one ten millionth of a millimeter ( $10^{-7}$  mm).

**APERTURE**—An opening or hole, often circular in outline, through which light or matter passes.

**ASTIGMATISM**—An aberration of a lens or lens system which causes an off-axis point to be imaged as two separated lines perpendicular to each other.

**AXIS, OPTICAL**—The line joining the centers of curvature of the surfaces of a lens or lens system.

**BLACKBODY**—A body which absorbs all the radiation falling on it; the best radiator, and a complete absorber, of radiant energy.

**BREWSTER, LAW OF**—When light strikes a surface at such an angle that the reflected and refracted rays are at an angle of  $90^\circ$  to each other, maximum polarization of the light occurs in both reflected and refracted rays. The maximum polarization in the reflected ray is perpendicular to the plane containing the ray and the normal to the surface, while the maximum polarization of the refracted ray lies in this plane.

**COLLIMATOR**—An optical device which converts diverging or converging rays of light into parallel rays.

**COLORIMETER**—An optical instrument designed to compare the color of a sample with that of a standard sample or a synthesized stimulus. In a three-color colorimeter the synthesized stimulus consists of three colors of constant chromaticity but variable luminance.

**CONSTANT, ABBE**—A constant of an optical material defining the ratio of its refractivity to its dispersion. Thus a high value of the abbe constant indicates good ability to bend the light rays relative to its dispersing them into their component wavelengths.

**DEFINITION**—When an object is optically reproduced into an image, the degree of clarity of the image resolution and contrast combine to produce this clarity of an image.

**DIFFRACTION**—When a light-wave strikes the edge of an obstacle a part of the wave travels straight ahead,

without change of direction. By interaction between the light wave and the edge, another portion changes its direction. For this reason the edges of opaque objects do not form absolutely sharp shadows, as some of the light is directed into the edge of the shadow. This phenomenon is caused by diffraction and basically arises from the finite wavelength of light. Diffraction plays a part in all image formation in optics. Diffraction gratings, used in spectroscopy, depend upon diffraction as the basis of their action.

**DISPERSION**—The process by which light is broken down into its component wavelengths. In this process light beams of different wavelengths are separated from each other by undergoing a different angular deviation. Prisms and gratings are examples of the devices for accomplishing dispersion. The term is also applied to the variation of refractive index of materials with the wavelength of light.

**EMISSIVITY**—The ratio of the radiant emittance of a source of radiation to the radiant emittance of a blackbody radiator at the same temperature.

**FIBER BUNDLE, COHERENT, FLEXIBLE**—A flexible bundle of fibers that transmits an image from one end to the other.

**FIBERSCOPE**—Optical glass fibers, when systematically arranged in a bundle, transmit a full color image that remains undisturbed when the bundle is bent. By mounting an objective lens on one end of the bundle, and an eyepiece at the other, the assembly becomes a flexible fiberscope that can be used to view objects that would be inaccessible for direct viewing.

**FIELD FLATTENER, FIBER OPTICS**—A plate made of fused optical fibers, with both surfaces ground and polished, having the entrance surface so contoured from a plane perpendicular to the axis of the fibers that it precisely fits the contour of an image formed on that surface, and transmits it to the exit surface that is flat.

**FLUORESCENCE**—The emission of light on longer wavelengths excited by the absorption of radiation of shorter wavelengths in certain materials.

**FOCAL LENGTH**—The distance from a lens, or some point therein, or from a mirror, to the image of a small, infinitely distant source of light, known as the focal point.

**INFRARED**—That part of the electromagnetic spectrum lying beyond the red, having wavelengths from a few millimeters to 7500 angstroms. The infrared region contains heat rays.

**INTERFEROMETER**—A device employing the interference of light for purposes of measurement of lengths, angular displacements, and optical path differences, or for isolating different portions of the spectrum.

**LASER**—A device for transforming incoherent light of various frequencies of vibration into a very narrow, intense beam of coherent light. The name is

derived from the initial letters of "Light Amplification by Stimulated Emission of Radiation." In the emission of ordinary light the molecules or atoms of the source emit their radiation independently of each other and consequently there is no definite phase relationship among the vibrations in the resultant beam. The light is incoherent. The laser, by means of an optical resonator, forces the atoms of the material of the resonator to radiate in phase. The emitted radiation is stimulated by the excitation of atoms to a higher energy level by means of energy supplied to the device. In the microwave region the corresponding device is called a maser, and hence the laser is often known as a light maser.

**LUMINESCENCE**—The emission of light of certain wavelengths or limited regions of the spectrum in excess of that due to incandescence and the emissivity of the surface. This property is not exhibited by all materials.

**MODE, TRANSMISSION, OPTICAL FIBER**—When the diameter of an optical fiber approaches the wavelength of light an unusual manner of light transmission occurs. The light that can travel along the length of the fiber is limited to certain angles of travel which produce patterns of reinforcement and interference upon emergence. These patterns are characteristic of the transmission modes. Wave guides for waves longer than light, such as microwaves, act in a similar way.

**OPTICS, FIBER**—A transparent fiber of a homogeneous transparent material such as glass or plastic when enclosed within a material having a lower index of refraction will transmit light by a series of internal reflections, or if its cross-section is suitably small, in the manner of a wave-guide. If many fibers are assembled into a bundle, each individual fiber being encased in a surrounding medium of lower index of refraction, an entire image can be transmitted when it is formed on the entrance end of the fiber bundle. Always each individual fiber transmits but one element of the composite emergent image. The size of this element becomes larger as the cross-section of the fiber is increased. Since the definition in the emergent image depends upon the smallness of each element composing it, it is desirable to keep the cross-section of the fibers small. The image can be transferred in a great number of ways. If the spacing of the fibers increases toward the emergent end of the bundle, the image is magnified. If the fibers are more closely packed together at the emergent end, the image is reduced in size. By crossing the fibers systematically or randomly, the image is accordingly distorted or scrambled. Distortions of the image can be introduced or corrected. Curved image surfaces can be converted into flat ones or of any other form by forming the ends of the bundle into convex, concave, or other shaped surfaces.

**PHOTOCONDUCTIVE EFFECT**—The change of electrical conductivity produced by the absorption of varying amounts of radiation.

**PHOTOEMISSIVE EFFECT**—The case in which radiation incident on matter causes electrons to be emitted.

**PHOTOMETER**—An instrument for measuring the brightness of a source



of light by comparing it with a standard source.

**PHOTOVOLTAIC EFFECT**—The generation of a difference in electric potential between two electrodes when radiation falls upon one of them.

**PLANCK'S CONSTANT**—A quantum of energy is equal to the frequency of the radiation multiplied by a constant known as Planck's constant.

**QUANTUM**—The smallest quantity into which energy can be subdivided.

**RADIOMETER**—An instrument for the detection and measurement of the intensity of radiant energy by means of its heating effect.

**REFLECTION, LAW OF**—The angle between the reflected ray and the normal drawn to the reflecting surface is equal to the angle between the normal and the incident ray, and more-over both rays and the normal lie in the same plane.

**REFRACTION**—The bending of light rays as they pass from one medium into another having a different index of refraction, that is, into one in which the velocity of light is different.

**RESOLUTION**—The ability of an optical system to reproduce fine details in the image of an object.

**SNELL'S LAW**—The laws of reflection and refraction that state: The incident ray, the normal to the surface at the point of incidence of the ray at the surface, the reflected ray, and the refracted ray all lie in a single plane. The angle between the incident ray and the normal is equal in magnitude to the angle between the reflected ray and the normal. The ratio of the sine of the angle between the normal and the incident ray to the sine of the angle between the normal and the refracted ray is a constant.

**SPECTROGRAPH**—An instrument for producing a photographic record of the spectrum. The picture of the spectrum is called a spectrogram.

**SPECTROMETER** — A spectroscopy capable of measuring the angular deviation of radiation of different wavelengths. The spectrometer can be used to measure refractive indices of materials and also to determine wavelengths of radiation.

**SPECTROSCOPE**—In a general sense, any one of a class of instruments used for dispersing radiation, visible or invisible, into its component wavelengths and for observing or measuring the resultant spectrum. In a restricted sense, the instrument is capable of being used only for visual observation of the spectrum.

**SPECTROSCOPY**—A branch of optics pertaining to radiations which lie in the infrared, visible, ultraviolet, and vacuum ultraviolet regions of the spectrum.

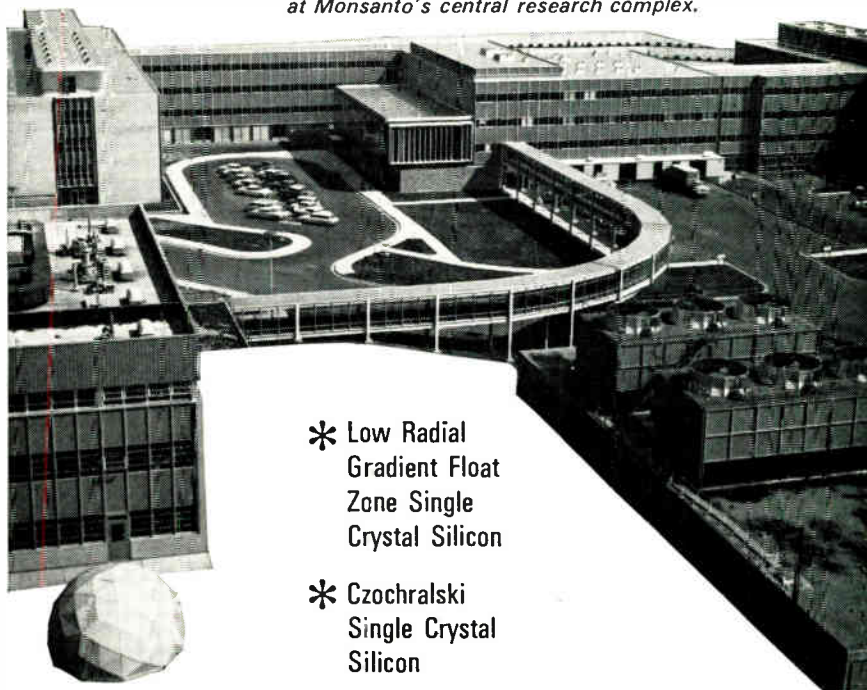
**TALBOT**—A unit of luminous energy, equal to one lumen-second.

**THRESHOLD, LUMINANCE, ABSOLUTE**—A term indicating the lowest limit of luminance necessary for vision to take place.

**TRANSMITTANCE**—The ratio of the flux transmitted by a substance to the incident flux. The term is applied to both radiant and to luminous flux.

**ULTRAVIOLET**—That invisible region of the spectrum of radiant energy lying between the wavelengths of approximately 4,000 and 40 angstroms.

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The Klein Plier Catalog illustrating and describing the complete Klein line of pliers is available on request.

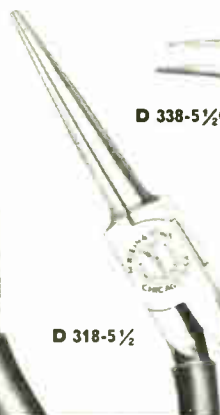
D 326-5



D 310-6



D 338-5½C



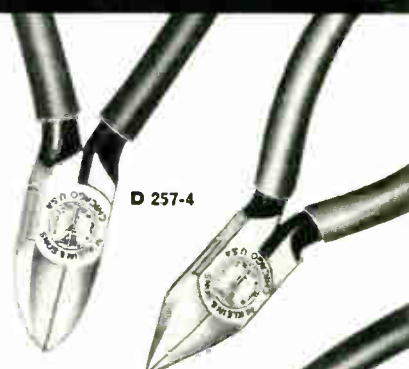
D 318-5½



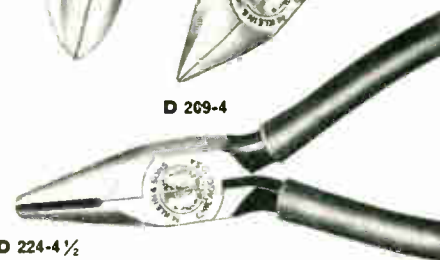
D 230-4C



D 257-4



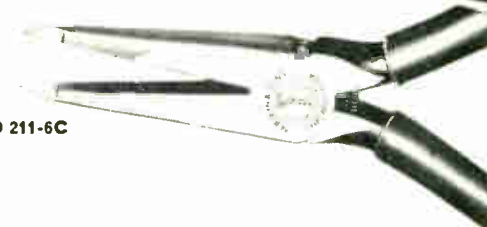
D 269-4



D 224-4½



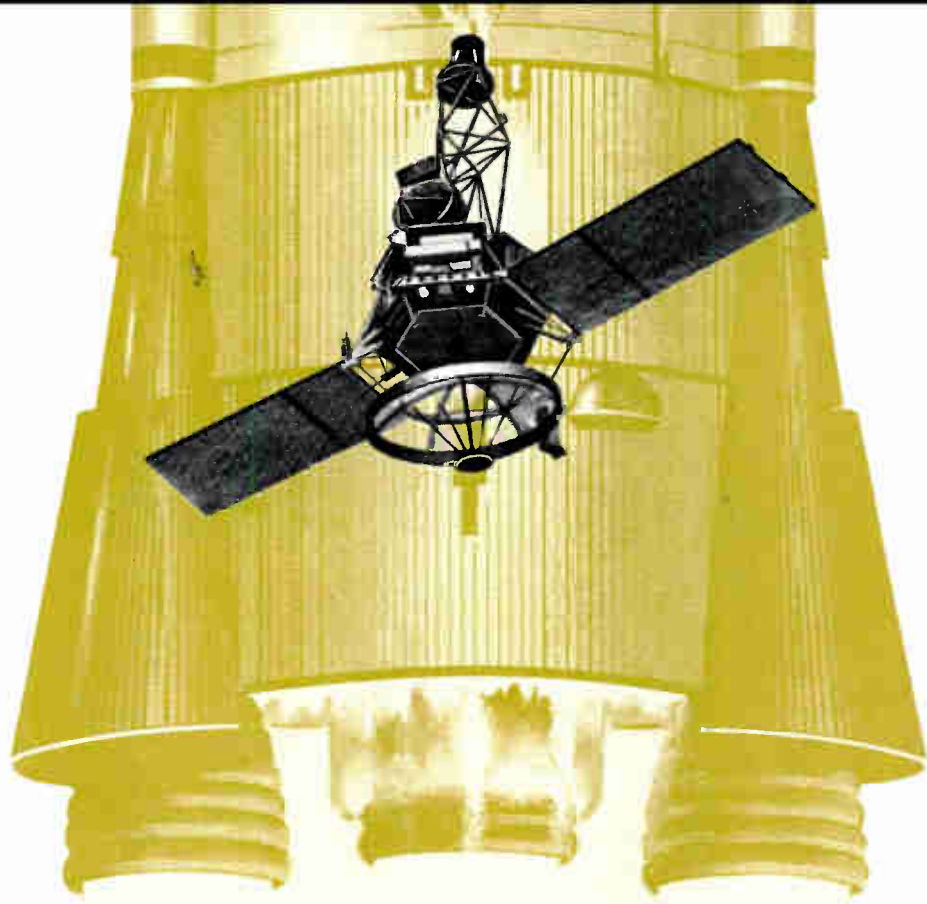
D 211-6C



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*See reverse side for complete data . . .*



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for the design and production of  
**METAL PARTS**

## HYDROFORMING

KAUPP offers special service to design and development engineers with simpler tooling, faster set-ups and improved quality. Hydroforming combines economical unit cost with fast delivery.

## DEEP DRAWING

From carbon steel to "space age" alloys, KAUPP technicians have the knowledge of metals, and the equipment necessary, to hold work to closest tolerances and maintain uniformity throughout production.

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Specify KAUPP for unusual components for rockets, missiles, aircraft and radar. Complete service includes piercing, notching, embossing, annealing, spotwelding and fabricating.

## PROTOTYPES

KAUPP "know how" solves unusual design problems. Our engineering department is fully conversant with the problems involved in producing unusual shapes and sizes to exact requirements.

## WELDING

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Minimum tooling requirements save time and money on development pieces, sample parts and short production runs. KAUPP offers years of experience in this method of metal forming.

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Selected raw materials and expert metal craftsmanship combine to produce high accuracy metal components at economical cost. KAUPP engineers are thoroughly familiar with the techniques required for forming modern alloys. KAUPP precision metal parts are used in electronics, nucleonics, chemical processing and governmental space and research projects.

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BRASS CARBON STEEL  
INCONEL MULTIMET®  
ALUMINUM HAYNES® No. 25  
COPPER STAINLESS STEEL  
SILVER HASTELLOY® X  
NICKEL MAGNESIUM  
NIMONIC WASPALLOY

Our engineers will recommend the best method of production for your specific components. Estimates on your metal parts will be supplied on receipt of your blueprints or specifications.

\*Union Carbide Corporation  
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### HYDROFORMS

1 8" PRESS 1 12" PRESS  
2 19" PRESSES

### PRESSES

1 BLISS NO. 4A SINGLE CRANK DOUBLE ACTION  
1 BLISS NO. S-100—100 TON 10" STROKE PNEUMATIC CUSHION 15 TON  
1 BLISS NO. 305 90 TON 10" STROKE PNEUMATIC CUSHION 15 TON  
3 NIAGARA NO. H 3 1/2A—45 TON  
2 NIAGARA NO. H 2 1/2—25 TON  
1 BLISS NO. 20B—32 TON  
3 BLISS NO. 18 HORN  
2 BLISS NO. 18 INCLINABLE  
3 BLISS NO. 18C INCLINABLE  
1 CONSOLIDATED NO. 72 PNEUMATIC CUSHION—5 TON  
1 LOSHBOUGH & JORDAN NO. 2 SPECIAL  
1 LOSHBOUGH & JORDAN NO. 3 SPECIAL  
1 ZEH & HANNEMAN NO. 4  
1 ZEH & HANNEMAN NO. 2 INCLINABLE

### SPINNING LATHES

1 HAAG GAP LATHE 26 to 48  
1 GRABO GAP LATHE 24 to 60  
1 PRYBIL LATHE 26  
1 GRABO LATHE 26  
1 HAAG LATHE 22  
3 GRABO LATHES 22  
1 GRABO LATHE 16

### LATHES

1 MONARCH—12 x 30  
1 MONARCH—16 x 54  
2 LE BLOND—17 x 54  
1 SOUTH BEND—14 x 36  
2 SOUTH BEND—10 x 36  
2 SOUTH BEND—9 x 36  
1 CINCINNATI—26 x 60  
1 LE BLOND—22 x 48

### MILLING MACHINES

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2 BRIDGEPORT 1/2 HP  
2 CINCINNATI TOOLMASTERS  
3 BRIDGEPORT 1 HP  
1 SIMMONS HORIZONTAL PRODUCTION

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1 CINCINNATI UNIVERSAL 14 x 36 INTERNAL EXTERNAL HYDRAULIC  
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1 THOMPSON—6 x 12 x 18 SURFACE HYDRAULIC  
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1 NEVEN BENCH GRINDER COMPLETE WITH DIAMOND WHEEL  
1 MONOSOT TOOL & CUTTER GRINDER

### SAWS

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2 GROB BAND DIE CUTTING  
1 MARVEL POWER 6 x 8  
1 MARVEL POWER 10

### JIG BORER

1 PRATT & WHITNEY 1 1/2 B

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1 NIAGARA SQUARING SHEAR 6"  
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One of the industry's most modern tool and die departments is maintained by KAUPP to assure the efficient production of all dies, punches, jigs and fixtures. There are practically no delays waiting for tools.

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1 GOULD & EBERHARDT UNIVERSAL SHAPER 14"  
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1 BUFFALO 16" DRILL PRESS  
4 WALKER TURNER 14"  
1 DROP HAMMER 200 LB.  
2 ATLAS LATHES PROD. WORK TRIM  
1 WALKER TURNER 10" TILTING ARBOR TABLE SAW  
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METAL CRAFTSMEN SINCE 1924

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## IRON OXIDE REAGENTS



### Pure Synthetic Iron Oxides for the Magnetics Industries

Columbian has had well over 50 years experience in the business of manufacturing *Pure Synthetic Iron Oxides*. They can be produced by several practical procedures to give a variety of characteristic particle shapes and particle-size ranges. The methods by which MAPICO® Pure Iron Oxides are manufactured were chosen because they enable careful control of preselected characteristics.

#### MAPICO PURE IRON OXIDES

- (a) are strictly uniform from shipment to shipment
- (b) are reactive at the high temperatures customarily used in the ceramic industry
- (c) are available in three different particle shapes any of which may be had in several ranges of particle size
- (d) are of high purity and free from harmful impurities
- (e) give controlled shrinkage
- (f) give controlled electronic characteristics
- (g) are produced in ample supply by a large, modern, technically staffed plant

| MAPICO PRODUCTS        | COMPOSITION          | PARTICLE SHAPE | PREDOMINANT PARTICLE SIZE (Microns) | SURFACE AREA |        |                       | Apparent Density      |            | TYPICAL CHEMICAL ANALYSIS   |                  |                       |                    |                    |                   |                                  |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
|------------------------|----------------------|----------------|-------------------------------------|--------------|--------|-----------------------|-----------------------|------------|-----------------------------|------------------|-----------------------|--------------------|--------------------|-------------------|----------------------------------|--------------|------|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|
|                        |                      |                |                                     | S.V.†        | Tapped | Gms./CM. <sup>3</sup> | Gms./CM. <sup>3</sup> | % PURITY   | % MOISTURE (Loss at 105° C) | LOSS ON IGNITION | % WATER SOLUBLE SALTS | % SiO <sub>2</sub> | % TiO <sub>2</sub> | % SO <sub>3</sub> | % Al <sub>2</sub> O <sub>3</sub> | % Cu         | % Mn |                   |      |      |      |      |      |      |      |      |      |      |      |      |
|                        |                      |                |                                     |              |        |                       |                       |            |                             |                  |                       |                    |                    |                   |                                  |              |      | E <sup>2</sup> /B | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
|                        |                      |                |                                     |              |        |                       |                       |            |                             |                  |                       |                    |                    |                   |                                  |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Yellow Light Lemon 100 | ferric oxide hydrate | acicular       | 0.4-0.8                             | 22.4         | .14    | .35                   | 98.8<br>99.2          | .30<br>.50 | 11.5<br>12.0                | .04<br>.08       | .05<br>.15            | .002<br>.004       | .20<br>.60         | .001<br>.002      | .03<br>.05                       | .015<br>.025 |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| EG-1*                  | magnesium ferrite    | acicular       | 0.4-1.2                             | 4.7          | .18    | .40                   | 99.3<br>99.6          | .10<br>.20 | .05<br>.10                  | .35<br>.45       | .05<br>.10            | .002<br>.004       | .10<br>.30         | .001<br>.002      | .02<br>.04                       | .015<br>.025 |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| EG-2**                 | zinc ferrite         | acicular       | 0.4-1.2                             | 3.5          | .27    | .59                   | 99.5<br>99.7          | .10<br>.20 | .05<br>.10                  | .05<br>.10       | .10<br>.20            | .002<br>.004       | .02<br>.04         | .001<br>.002      | .02<br>.04                       | .010<br>.015 |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| EG-3                   | gamma ferric oxide   | cubical        | 0.3-1.2                             | 8.7          | .39    | .71                   | 98.0<br>99.0          | .10<br>.20 | .80<br>1.20                 | .10<br>.15       | .02<br>.03            | .15<br>.20         | .002<br>.005       | .002<br>.004      | .10<br>.20                       |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 110-2              | alpha ferric oxide   | cubical        | 0.3-1.2                             | 5.4          | .33    | .67                   | 99.1<br>99.4          | .05<br>.10 | .25<br>.35                  | .10<br>.15       | .02<br>.03            | .10<br>.15         | .002<br>.005       | .002<br>.004      | .08<br>.15                       |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| EG-60                  | alpha ferric oxide   | cubical        | 2.0-4.0                             | 2.8          | .45    | 1.00                  | 99.3<br>99.6          | .05<br>.10 | .20<br>.30                  | .10<br>.15       | .02<br>.03            | .10<br>.15         | .002<br>.005       | .002<br>.004      | .06<br>.10                       |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red H.P.               | alpha ferric oxide   | cubical        | 2.0-4.0                             | 2.8          | .45    | 1.00                  | 99.7<br>99.8          | .02<br>.05 | .07<br>.15                  | .02<br>.04       | .005<br>.03           | .03<br>.06         | .002<br>.005       | .002<br>.004      | .04<br>.06                       |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| EG-80                  | alpha ferric oxide   | cubical        | 3.8-5.9                             | 1.3          | .85    | 1.74                  | 99.4<br>99.7          | .05<br>.10 | .10<br>.20                  | .10<br>.15       | .02<br>.03            | .05<br>.10         | .002<br>.005       | .002<br>.004      | .06<br>.10                       |              |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 297                | alpha ferric oxide   | spheroidal     | 0.3-0.8                             | 8.4          | .30    | .59                   | 99.3<br>99.6          | .05<br>.20 | .30<br>.60                  | .08<br>.20       | .05<br>.15            | .001<br>.003       | .05<br>.25         | .01<br>.02        | .001<br>.003                     | .01<br>.02   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 347                | alpha ferric oxide   | spheroidal     | 0.3-0.9                             | 7.4          | .32    | .61                   | 99.4<br>99.7          | .05<br>.20 | .20<br>.50                  | .05<br>.20       | .05<br>.15            | .001<br>.003       | .05<br>.20         | .01<br>.02        | .001<br>.003                     | .01<br>.02   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 387                | alpha ferric oxide   | spheroidal     | 0.3-1.1                             | 6.5          | .33    | .69                   | 99.4<br>99.7          | .05<br>.20 | .20<br>.50                  | .05<br>.20       | .05<br>.15            | .001<br>.003       | .05<br>.15         | .01<br>.02        | .001<br>.003                     | .02<br>.03   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 477                | alpha ferric oxide   | spheroidal     | 0.4-2.0                             | 5.9          | .36    | .74                   | 99.5<br>99.8          | .05<br>.15 | .15<br>.45                  | .04<br>.15       | .05<br>.15            | .001<br>.003       | .05<br>.10         | .01<br>.03        | .001<br>.003                     | .02<br>.04   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 567                | alpha ferric oxide   | spheroidal     | 0.4-2.6                             | 4.9          | .37    | .74                   | 99.5<br>99.8          | .05<br>.15 | .15<br>.45                  | .04<br>.15       | .05<br>.15            | .001<br>.003       | .05<br>.10         | .01<br>.03        | .001<br>.003                     | .03<br>.06   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 617                | alpha ferric oxide   | spheroidal     | 0.4-3.7                             | 3.9          | .39    | .74                   | 99.5<br>99.8          | .05<br>.10 | .15<br>.35                  | .04<br>.10       | .05<br>.15            | .001<br>.003       | .05<br>.10         | .01<br>.03        | .001<br>.003                     | .03<br>.10   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Red 516-M              | alpha ferric oxide   | acicular       | 0.3-1.0                             | 26.4         | .14    | .32                   | 97.0<br>98.3          | .10<br>.30 | 1.0<br>2.2                  | .10<br>.30       | .10<br>.20            | .002<br>.004       | .20<br>.40         | .001<br>.002      | .03<br>.05                       | .015<br>.025 |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |
| Black†                 | synthetic magnetite  | cubical        | 0.2-0.8                             | 6.7          | .34    | .71                   | 99.0<br>99.2          | .05<br>.20 | .70<br>.90                  | .05<br>.10       | .03<br>.06            | .02<br>.04         | .03<br>.06         | .002<br>.004      | .002<br>.004                     | .20<br>.25   |      |                   |      |      |      |      |      |      |      |      |      |      |      |      |

\*MgO (as MgO.Fe<sub>2</sub>O<sub>3</sub>) 18.7-19.2%—U.S. Patent 2,502,130  
 \*\*ZnO (as ZnO.Fe<sub>2</sub>O<sub>3</sub>) 32.6-32.8%—U.S. Patent 2,904,395  
 \*\*\*As determined by nitrogen adsorption

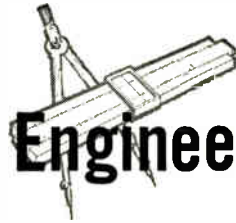
†FeO (as FeO.Fe<sub>2</sub>O<sub>3</sub>) 21-22%.  
 ††Scott Volumeter

Samples are available on request and our trained technicians who are continually conducting ferrite research concerned with the use of Mapico Iron Oxides are at your service whenever desired.

## COLUMBIAN CARBON COMPANY MAPICO IRON OXIDES UNIT

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# Engineering facts and figures

**Construction**—Chassis-Trak Slides are made of hard, cold-rolled steel for maximum strength and wearing qualities and are cadmium-plated for extra corrosion resistance. (Special stainless steel slide—Model C-357—also available.) Smooth operation is achieved by means of Poly-Chem's MS-75 dry film lubricant which becomes increasingly slick with use. This permanent formulation is dust-repellent and withstands pressure loading of more than 50,000 psi at 25 ft./min. Finish has passed JAN 100-hour salt spray test and is approved for military use.

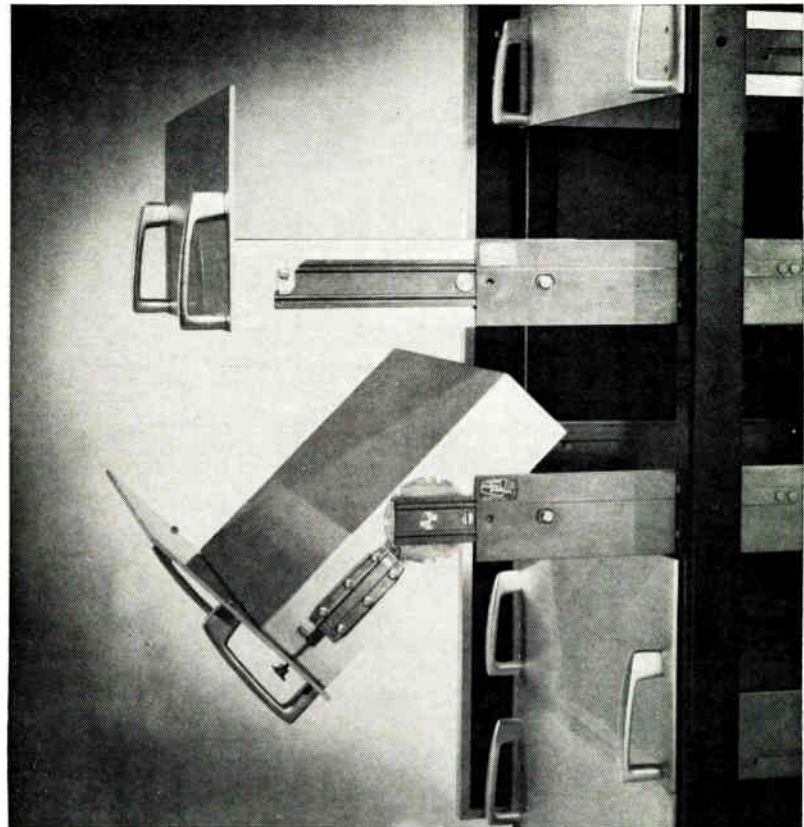
**Installation**—"Pencil thin" Chassis-Trak design permits installation of standard 17" chassis in standard 19" panel racks without modification. Standard slides bolt to front rail and rear of cabinet. On most models, a prefabricated gusset assembly can be furnished for use where load does not exceed 100 lbs. Gusset automatically aligns slides and permits mounting at front rail only. Templates, rear mounting brackets and all hardware furnished together with complete assembly instructions.

**Operation**—Chassis-Traks are available in non-tilt, tilt, and tilt-detent models. Slides with "B" in the model designation tilt upward only; "D" models tilt and lock in seven different service positions. Choice of solid bearing or roller bearing operation. Roller bearings are recommended for equipment requiring frequent service. Chassis of any length can be fully extended without disconnecting rear cables. Pushbutton spring mechanism releases chassis for convenient slip-out, slip-in servicing.

| ROLLER BEARING SLIDES | Model | SLIDE LENGTH |    |    |    |    |    |    |    | LBS. MAX. LOAD |
|-----------------------|-------|--------------|----|----|----|----|----|----|----|----------------|
|                       |       | 10           | 12 | 14 | 16 | 18 | 20 | 22 | 24 |                |
| Basic                 | CTRB  | X            | X  | X  | X  | X  | X  | X  | X  | 175            |
| Detent                | CTRD  |              | X  | X  | X  | X  | X  | X  | X  | 175            |
| Cradle Track          | CTEZ  |              |    | X  | X  | X  | X  | X  | X  | 125            |
| Heavy Duty Basic      | CTHRB |              |    | X  | X  | X  | X  | X  | X  | 275            |
| Heavy Duty Detent     | CTHRD |              |    | X  | X  | X  | X  | X  | X  | 275            |
| Lightweight           | C-357 |              | X  | X  | X  | X  | X  | X  | X  | 150            |
| Circulating Ball      | CB    | 16" to 60"   |    |    |    |    |    |    |    | 1000           |

| SOLID BEARING SLIDES | Model | SLIDE LENGTH |    |    |    |    |    |    |    | LBS. MAX. LOAD |
|----------------------|-------|--------------|----|----|----|----|----|----|----|----------------|
|                      |       | 10           | 12 | 14 | 16 | 18 | 20 | 22 | 24 |                |
| Basic                | CTB   | X            | X  | X  | X  | X  | X  | X  | X  | 175            |
| Detent               | CTD   |              | X  | X  | X  | X  | X  | X  | X  | 175            |
| Lightweight          | CTL   |              |    | X  | X  | X  | X  | X  | X  | 100            |
| Heavy Duty Basic     | CTHB  |              |    | X  | X  | X  | X  | X  | X  | 250            |
| Heavy Duty Detent    | CTHD  |              |    | X  | X  | X  | X  | X  | X  | 250            |
| 1 3/4 Inch           | C-300 | X            | X  | X  | X  | X  | X  | X  | X  | 50             |
| Light-Duty           | C-300 | X            | X  | X  | X  | X  | X  | X  | X  | 50             |
| Aluminum             | D-600 | X            | X  | X  | X  | X  | X  | X  | X  | 125            |
| Utility              | C-230 |              | X  | X  | X  | X  | X  | X  | X  | 100            |



Chassis-Trak aluminum slides, only 3/8" in width, are ideal for mounting of utility chassis since they fit the smallest panel increment of 3 1/2", and weigh only 4 1/2 lbs.



For additional engineering information, accessories hardware catalog, and prices, write:

525 South Webster Ave., Indianapolis 19, Ind.



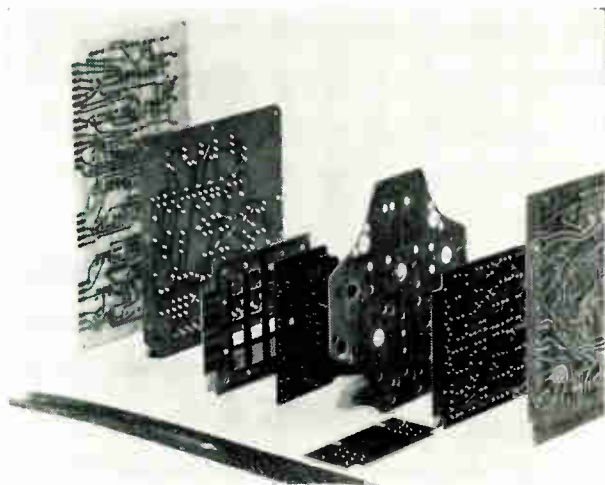
From the use of plastics for lasers to gaseous dielectrics for arc-quenching, chemicals are making significant contributions to the electronic arts. Chemical substances are used to make and process semiconductors, electroplate circuit boards, encapsulate components, clean systems and circuits. Here are the electronic chemicals and their uses.

DURING THE LAST DECADE the Chemical Processing Industry (CPI) has become a full-time partner with the Electronic Industry. Chemical products and processes are now used so much in electronics that this industry has become a leading chemical market. Uses of chemicals in electronics range from cyanides, sulfates and fluoroborates for electroplating to fluorinated gases for electrical insulation; from metallic oxides and carbonates for ferrites to alkyls, epoxy resins and silicones for encapsulation; from tungsten filaments and inert gases for indicator light bulbs to synthetic rubies for lasers; and from organic coatings for wire and cable to hyper-pure alloys for superconducting magnets.

In keeping up with rapidly changing technology in electronics, the CPI shares with its customers major R&D costs. Often research projects are undertaken between the CPI and Electronic Industry. Fruits of this R&D are reaped by both, but more by the latter. The following examples are cited:

1. Quality and uniformity of semiconductor metals has increased steadily as their methods of pro-

Several chemical processes were used to make these circuit boards. These included molding and lamination of the boards, followed by masking, plating, stripping, etching and finishing.



## CHEMICALS IN THE ELECTRONIC INDUSTRY

duction (basically chemical processes) have been refined. Producers of silicon and germanium, as well as the newer intermetallics, have improved production processes to obtain both higher purity and lower variability.

2. Semiconductor processing chemicals have been improved in quality and uniformity with the net result to semiconductor makers of larger device yields, simpler manufacture, better use of raw materials and lower cost.
3. Potting and encapsulation problems have been eased by the development of specialized alkyl molding compounds, epoxy resins, silicones and additives for these systems to tailor them to specific electronic uses.
4. Gaseous dielectrics of high insulating value, low toxicity and good arc-quenching ability have been developed to allow improvement of circuit breakers, wave guides and radars.

### Fluoride Insulators

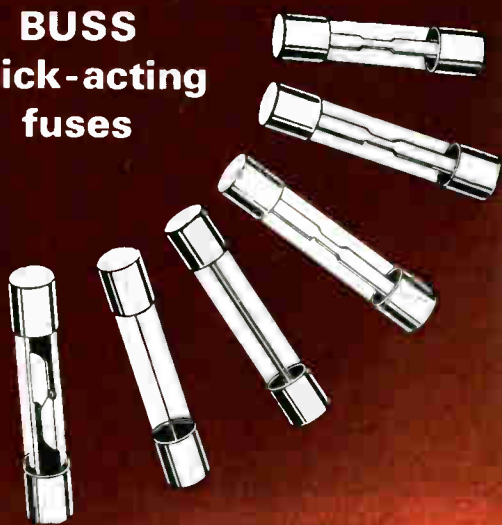
In research carried out by Allied Chemical Corp., experience was acquired in "passivating" various metals by exposure to elemental fluorine, thus creating an inert fluoride coating. While this work is still experimental, it has been found possible to coat copper, aluminum and other metals to provide insulation at temperatures near the melting point of the conductor. These coatings offer high dielectric strength, good ductility and small volume. As a wire

By **JAMES W. SWAINE**

Vice President  
General Chemical Division  
Allied Chemical Corporation  
Morristown, N.J.



## BUSS quick-acting fuses



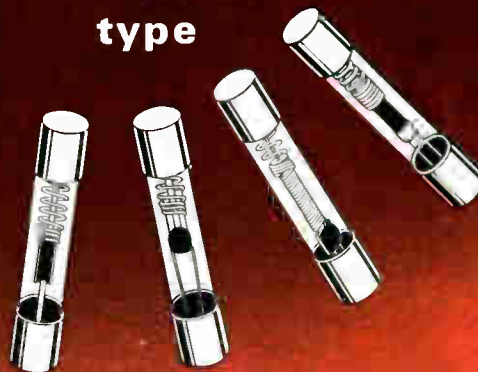
"Fast Acting" fuses for protection of sensitive instruments or delicate apparatus; — or normal acting fuses for protection where circuit is not subject to starting currents or surges.

# BUSS

Write for BUSS  
Bulletin SFB.

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.

## FUSETRON dual-element fuses time-delay type



"Slow blowing" fuses for circuits where harmless surges occur. These fuses prevent needless outages by safely holding starting currents or surges, — yet they provide safe, positive protection against short-circuits or continued overloads.

# BUSS

Write for BUSS  
Bulletin SFB.

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.

## BUSS : the complete line of fuses .

### CHEMICALS (Continued)

insulation, such fluoride coatings could result in improved electronic devices.

#### Electroplating Solutions

Development of specialized electroplating solutions is another chemical contribution to electronics. High plating speeds of copper fluoroborate baths and the good solderability of deposits from lead-tin alloy fluoroborate baths have solved problems in the mass-production of circuit boards. Moreover, these baths have been developed to also provide: ease of bath make-up, simplified control, reduced maintenance, good anode corrosion and excellent stability.

#### Cleaning Solvents

Producers of electronic components, precision instruments and missile systems need an almost residue-free solvent for final-stage cleaning. Existing halocarbons (refrigerant gases) were modified and refined to meet this demand. Genesolv® "D" Electronic Grade and its equivalents can be used. Residues less than 1 ppm, resistivity of  $5.0 \times 10^{18}$  ohm-cm. and

low dielectric constants make these ideal solvents for cleaning electrical systems.

#### Specialized Plastics

Another contribution is in the field of specialized plastics. Electronic firms consume millions of pounds of plastics, chiefly for encapsulating or packaging. Combinations of small, fragile parts are enclosed in plastic, compressed and cured in a mold. The resulting hard block holds the parts in place, protects them from impact damage and moisture, and insulates them from each other and the outside. Also, each encapsulated unit is of uniform size, weight and shape so that automated handling is simplified.

Many plastics, such as alkyd molding compounds, are used for encapsulation. Alkyds have good dielectric strength and high impact resistance. Modular units of nylon are available with molded-in slots and holes.

A REPRINT OF THIS ARTICLE CAN BE OBTAINED  
by writing on company letterhead to  
The Editor  
ELECTRONIC INDUSTRIES  
Chestnut & 56th Sts., Phila. 39, Pa.



## CHEMICALS (Continued)

Epoxy resins for encapsulating or packaging have an important place in electronics. By varying the quantity and type of anhydride hardeners and other additives, a wide range of useful properties can be obtained in the package. Large parts such as toroidal transformers, as well as many small parts, are encapsulated with epoxys.

Plastics are also used in wire covering. Here again there are many types, such as nylon, polyethylene, polypropylene and fluorocarbon polymers. In addition to insulation, plastics provide resistance to corrosion and wear.

Because of high dielectric strength, impermeability to fluids, wide useful temperature range, and chemical inertness the fluorocarbon polymers enjoy widespread use. These polymers include polychlorotrifluoroethylene (Halon®, Kel-F), and polytetrafluoroethylene (Teflon, Halon® TFE).

### Semiconductor Production

The advent of mass semiconductor production created an increasing demand for high-purity chemicals. Quickly adapting to this demand, the CPI not only produced the needed chemicals but also solved

problems in quality control, packaging and logistics. Quality of such critical chemicals as hydrofluoric acid, nitric acid, hydrogen peroxide, acetone, methanol, germanium, silicon, gallium arsenide and phosphorous pentoxide has steadily improved. The higher efficiencies and greater yields enjoyed by device producers today is a result of process sophistication and these improvements in raw material quality.

### Dielectric Gases

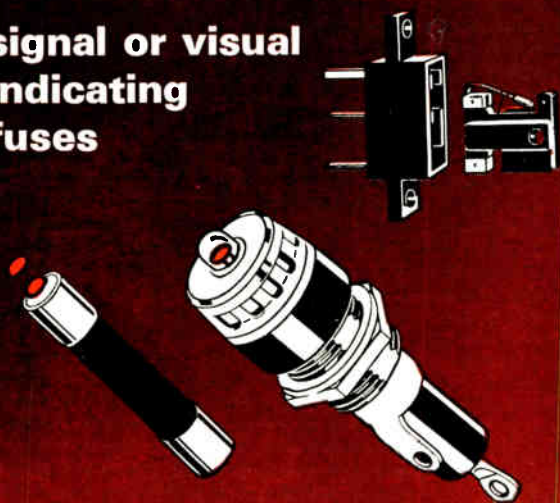
Many gaseous dielectrics have been developed to replace air, nitrogen and transformer oils, simplifying the design of electronic equipment. Sulfur hexafluoride ( $SF_6$ ), perfluoropropane ( $C_3F_8$ ) and octafluorocyclobutane ( $C_4F_8$ ) are examples of these. Once again the inertness and thermal stability of fluorine find direct use in electronics. Characterized by very high dielectric strength, these fluorine derivatives will be used increasingly in transformers, circuit breakers, wave guides and radar.

### Laser Developments

RCA's announcement of a plastic laser is bound to result in a rapid development of this area. As the laser finds more and more uses, needs for pure materials, from  $Al_2O_3$  (derived from various aluminum

..... of unquestioned high quality

### signal or visual indicating fuses



Indicating fuses provide quick, positive identification of a faulted circuit. There are fuses that give a visual signal; fuses that activate an alarm; — and fuses that give a visual signal and activate an alarm.

# BUSS

Write for BUSS  
Bulletin SFB.

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.

### If you should have a special problem in electrical protection ...



... we welcome your request either to quote or to help in designing or selecting the special type of fuse or fuse mounting best suited to your particular conditions.

Submit description or sketch, showing type of fuse to be used, number of circuits, type of terminal, etc. If your protection problem is still in the engineering state, tell us current, voltage, load characteristics, etc. Be sure to get the latest information BEFORE final design is crystallized.

At any time our staff of fuse engineers is at your service to help solve your problems in electrical protection.

# BUSS

Just call  
or write:

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis 7, Mo.





Alkyd molding compounds come in 2 shapes: "rope" slugs (1) and "putty." These compounds are used for encapsulation because of their dielectric strength, high resistance to impact, moisture.

producers fall into two main categories: services directly related to sales and those which are not. The former include location of producing plants, packaging facilities and stocking points near electronic centers (e.g., Boston, San Francisco and Los Angeles).

The other category includes such services as in-plant training programs for electronic workers in proper methods of handling, storing, mixing and applying chemicals and in waste disposal. Many such services are available from chemical suppliers. As an example, General Chemical Div. of Allied Chemical has developed a safety presentation dealing with the problems of semiconductor firms. This presentation has been given 36 times at 27 plants. Chemical waste disposal experts and corrosion engineers are employed by most chemical producers and are available for assistance on specific customer problems.

There is no question but that the Chemical Processing Industry has a major stake in the future of the Electronic Industry. A partnership has developed between the two which has been in large part responsible for the rapid strides made in electronics. Continued progress can be assured by a concerted attack by the two on its mutual problems.

## CHEMICALS (Concluded)

salts) to special plastics and dopants, will have to be filled.

### Service Contributions

As challenging as the technical problems of new product introduction and quality improvement are, the contributions of the CPI are not limited to such tangibles. Intangible services offered to electronic

# ENGRAVED PARTS

by WM. A. FORCE

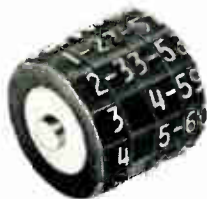
—a source with over 85 years of experience.

For the finest engraved components, manufactured with precision, delivered on time—try Force. Engraving that's bound to be superior because engraving is our business. Companies that require engraved parts for electronic scanning, numbering, recording, dating, timing or coding rely on Force for quality production.

Examples of just a few Force engraved units:

### CHARGE-A-PLATE DATING UNIT

With internal retainers, engraved in reverse to print from bottom to top.



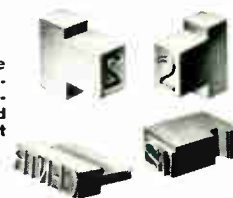
### WHEELS

Engraved, ready for assembly with gears and ratchets. Mounting holes and internal broaching included as specified.



### ENGRAVED TYPE

Many styles of type for printing, embossing and indenting. Holder and auxiliary equipment also available.



### DATING ASSEMBLIES

Designed for many uses. In style illustrated, wheels are convex for printing at right angles to rotating direction of the printing head.



Write for more information, brochures, samples or a visit from a Force representative.

WM. A. **FORCE** & CO., Inc.  
216 Nichols Ave.  
Brooklyn 8, N.Y.

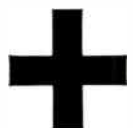


# Use the "PLUS VALUES" of Armco Magnetic Materials for lowest cost and maximum performance

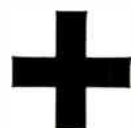
For the expanding range of electronic apparatus, Armco produces magnetic materials that enable you to meet specific design and fabrication requirements. They offer "PLUS VALUES" that help you produce units that cost less and perform to the maximum.



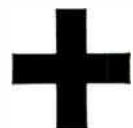
**Selectivity** — a full range of nickel-iron alloys, Armco 48 Ni, 48 Orthonik, and 4-79 plus Armco Thin Gage Silicon Steels in oriented and non-oriented grades, gives you selectivity that enables you to design more precisely. Each material is available in the thicknesses and forms you need.



**Consistently Uniform Quality** — Special processing controls, plus 60 years' experience in producing magnetic materials, assure uniform high quality magnetic properties.



**Design Data** — Detailed design manuals — Armco Nickel-Iron Magnetic Alloys and Armco Thin Electrical Steels — provide you with necessary design curves, information on annealing and other pertinent data.



**Technical Assistance** — The extensive experience of Armco engineers and metallurgists is available to assist you in material selection or with problems in design or production.

Make full use of all these "PLUS VALUES" by using Armco Magnetic Alloys in your products. Just write us for complete information on either Thin Electrical or Nickel-Iron Alloys. **Armco Division, Armco Steel Corporation, Dept. A-1483, P. O. Box 600, Middletown, Ohio.**



**Armco Division**

strips  
in a  
breeze  
with  
one  
quick  
squeeze

even tough Teflon\* covered wire... for precise electronic production required to pass high-confidence level inspections

\*TEFLON: REG. TRADE MARK OF DUPONT



## IDEAL CUSTOM *Stripmaster*®

Strip solid or stranded wire easily — with no wire nicks, insulation scratches — no waste or rejects. Unique matched blades, drilled to exact wire size on watchmaker's equipment, plus colleting action, help you meet high-confidence standards even on toughest insulation. Three models — for Type E Teflon, Type EE Teflon and general purpose plastic and fibre-glass insulation. Sizes for 10 to 14, 16 to 26, or 26 to 30 wire. Optional transparent wire stop adjusts to strip exact insulation length. Send coupon for full information.

**IDEAL INDUSTRIES, Inc.**  
5127-F Becker Place, Sycamore, Ill.

Please send me my free copy of  
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SOLD THRU AMERICA'S LEADING DISTRIBUTORS  
In Canada: IDI Electric (Canada) Ltd.,  
Ajax, Ont.

Name \_\_\_\_\_

Company \_\_\_\_\_

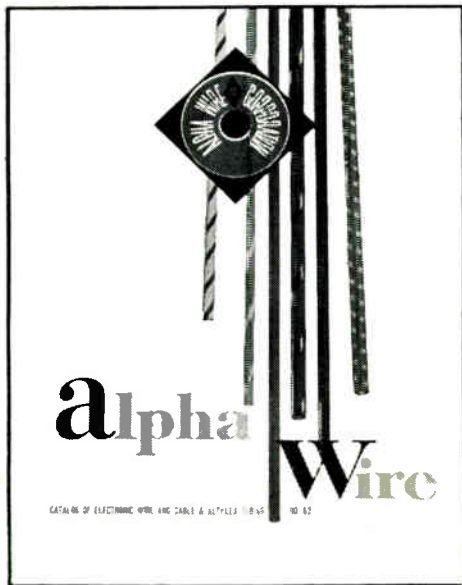
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Authoritative reference data from the industry's leading wire, cable and tubing manufacturer

## ALPHA ENGINEERING CATALOGS TELL YOU



### COMPREHENSIVE 52-PAGE WIRE AND CABLE CATALOG

Complete with all specifications, this descriptive and illustrative catalog details over 6000 electronic wire, cable and tubing products. A wealth of valuable and helpful data featuring...

- a 6-page complete selection of MIL-W-76B Plastic Wire
- a 5-page complete selection of MIL-W-16878C Plastic Wire
- 13 pages on audio and hook-up wire and cable
- Teflon wire, cable and tubing
- Retractable coil cords and extension cord sets
- Shielding and braiding
- a complete section describes Alpha's complete prime manufacturing capabilities plus the special facilities for custom services such as stripping, cutting, stripping, tinning, coloring of cable jackets, and short run cables.

Whatever your needs in wire, cable and tubing, you can depend on Alpha for...

- the most extensive manufacturing and custom facilities
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- the latest engineering reference data

So — whether your requirements are for

- mass production
- prototypes
- short runs
- or anything in the unusual



Manufacturers of  
electronic wire, cable, and tubing.

## HOW TO SPECIFY ELECTRONIC WIRE, CABLE & INSULATING MATERIALS



### ALL-NEW 24-PAGE 1963 TUBING GUIDE

Complete engineering information, featuring the most exciting innovation in tubing insulation today... irradiated heat shrinkable tubing — the versatile insulation that shrinks skin-tight to a predetermined size... then stops!

- A complete 11-page "how to" section on FIT™ shrinkable tubing, replete with descriptions, engineering data and applications — featuring:
- Shrinkable PVC tubing, ideal for cable jacketing • all-purpose polyolefin tubing in colors and clear • semi-rigid polyolefin tubing in colors and clear • wire termination caps for splices and cables • 4-way markers for wire and cable identification

Also included in this comprehensive book are sections on...

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- Teflon extruded tubing
- Zipper tubing
- Plastic impregnated fiberglass tubing
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- RF shielding tape

we suggest you do as hundreds of leading OEM manufacturers do — lean on Alpha for *thorough reliability... from original concept to final production.*

All 6,000 Alpha Wire products in these guidebooks are **IN STOCK** and available from Alpha or your local electronic parts distributor. Write today for your free copy of these 2 guidebooks.

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**41 YEARS OF APPLIED ENGINEERING KNOW-HOW AT YOUR SERVICE!**

# NEW TECH DATA

for Engineers.

## Polyethylenes

This brochure outlines recent achievements in insulation technology, including the development of vulcanizable, semi-conductive, and cellular polyethylenes. Included are typical property summaries on compounds for primary insulation, cellular uses, TV lead-in wires, vulcanizable wire, ocean cable, cable jackets, line wire covering, spacer cable, and semi-conductive uses. Union Carbide Plastics Co., 270 Park Ave., New York 17, N. Y.

Circle 225 on Inquiry Card

## Laser Mounts

Tech. data is available on a series of solid-state laser mounts designed to provide a broad range of flash tube and reflector configurations as well as output power. Each of the 6 mounts includes a high-velocity air blower for flash lamp cooling and air or liquid nitrogen-cooled crystal chuck. Crystal sizes accommodated are up to  $\frac{5}{8}$  in. in dia. by 6 in. long. Electro Powerpacs, Inc., 5 Hadley St., Cambridge 40, Mass.

Circle 226 on Inquiry Card

## Spray Compounds

Aerosol spray compounds for precision grinding, buffing, and lapping are available. The spray compounds solve many grinding and buffing problems, such as metal finishing, lapping compound for tool and die work, glass and mirror finishing, optical finishing, plastic lens finishing, lapidary grinding and polishing. Norco Div., The Normand Co., 314 S.W. 8th St., Miami, Fla.

Circle 227 on Inquiry Card

## Solder-Flux Preforms

Information is available on 2 new paste solders for use as solder-flux preforms. These materials, designated Paste-Form, consist of a blend of pre-alloyed solder powder and flux. Paste-Form is intended for use where it is desired to pre-place solder and flux in an assembly before heating. It may be applied by brush or applicator and heated by any of the usual methods. Alpha Metals, Inc., 56 Water St., Jersey City 4, N. J.

Circle 228 on Inquiry Card

## Aluminum Services

Brochure describes Mideast Aluminum Corp. and its services. Firm specializes in extrusion shapes for the electronic and electrical industries. Facilities for polishing, bending, machining and anodizing are described. Mideast Aluminum Corp., U.S. 130, Dayton, N. J.

Circle 229 on Inquiry Card

## R-F Test Equipment

"R-F Test Equipment for Quantitative Measurements," Short Form Catalog IP-C-002, 4 pages, covers wideband, wide-plus-narrow, and ultra-flat sweep signal generators, slow-speed sweep driver, general purpose sweep generators, video sweep generators, r-f precision log amplifier, and marker generators. Also described are a high-speed coax. switch, wide-band comparator, direct-reading tuned r-f voltmeter, variable and fixed attenuators, r-f post amplifiers and r-f bridges. Photos., specs. and prices are included. Industrial Products Div., Jerrold Electronics Corp., 15th & Lehigh Ave., Phila. 32, Pa.

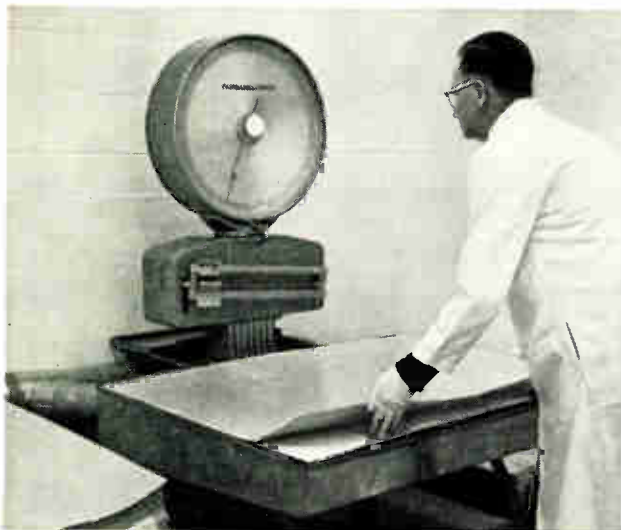
Circle 230 on Inquiry Card

## Where does your particular interest lie in high-

... in filament wound structures? These weigh only one-quarter as much as steel of the same tensile strength (150,000 psi). Other properties can be engineered into the structure as required.



... in high quality copper-clad laminates? These are widely used for printed circuits, but composites can be produced of a number of different metal foils, clad or sandwiched, for many other applications.





# NEW TECH DATA

for Engineers.

## Wire Test Report

Flex Test Report is available on true concentric vs. unilay stranded wire construction. In this 8-page report, the average number of flexures before complete rupture is in tabulated and graph form. International Wire Products Corp., 300 Greenwood Ave., Midland Park, N. J.

Circle 231 on Inquiry Card

## Welding Technique

Digital Sensors, Inc., 6443 Tujunga Ave., No. Hollywood, Calif., has information available on a new ribbon cable harness welding technique which is said to increase reliability through elimination of breakage at point of connections.

Circle 232 on Inquiry Card

## Carbon Brushes

A 20-page bulletin on carbon, graphite and metal-graphite industrial brushes, "Carbon Brushes" (Catalog Section B-1100) supplements regular brush catalogs. Available from National Carbon Co., 270 Park Ave., New York 17, N. Y.

Circle 233 on Inquiry Card

## Generator Control Device

Bulletin 4200-PRD-279 describes a quick, correct and safe method for synchronizing ac generators. The E-M Synchronator accomplishes synchronizing without jolt or voltage dip. It is a packaged device using static type components to operate a generator switch. Sensing is automatic and foolproof. The package includes a cubicle for wall mounting. Electric Machinery Mfg. Co., Minneapolis 13, Minn.

Circle 234 on Inquiry Card

## Duobinary Data Transmission

An 8-page pamphlet describes new 26B data transmission system, which uses a duobinary technique. The duobinary concept extends the theoretical max. rate of binary signaling for a given transmission medium from 2 to 4 bits/sec. for each cycle of bandwidth. The 26B pamphlet includes, in addition to complete performance figures and block diagrams, a description of duobinary coding and a unique error detection scheme. No. 26B-P4. Dept. M90A, Lenkurt Electric, San Carlos, Calif.

Circle 235 on Inquiry Card

## Liquid-Level Instruments

A new design spec. bulletin, on liquid-level instruments, No. DS-5200, covers design features, construction materials, level ranges, safe working pressures and temps., and dimensions. Using buoyant floats, a series of 3 standard range level chambers is designed for use with any of 5 interchangeable head assemblies. These include pneumatic or electrical transmitters, indicators, and indicating or non-indicating alarms. Brooks Instrument Co., Inc., Hatfield, Pa.

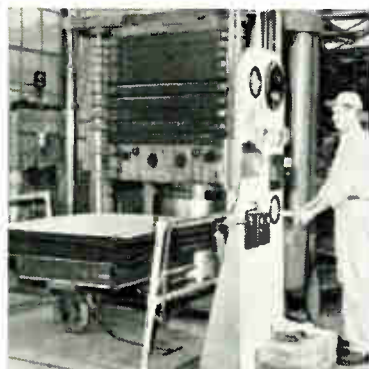
Circle 236 on Inquiry Card

## Digital Signal Simulator

Data Sheet 14 describes Model 510 digital signal simulator. Model 510 is a solid-state unit that handles all major formats, including Saturn, Minuteman, Titan II and OAO. Completely programmable coded output meets all digital signal needs in laboratory and field. The instrument simultaneously generates 3 different word lengths, from 2 to 33 bits. Telemetrics, Inc., 12927 So. Bullong Ave., Gardena, Calif.

Circle 237 on Inquiry Card

## integrity engineered reinforced plastics?



... in reinforced plastic materials? Impregnated materials for aerospace applications that excel in low thermal conductivity, erosion and char characteristics. Also reduce weight.

... in laminated plastics? Composite materials which can be varied to emphasize desired electrical, mechanical, physical, chemical and thermal properties to suit the application.

Taylor offers all these materials. Standard grades are available. However, more important to you, we will cooperate in the design and development of custom-engineered materials to exactly fit your requirements. Our latest catalog gives advantages, typical applications, general information, and physical, mechanical and electrical properties. Write for your copy today.

... in vulcanized fibre? A low-cost design material with high tensile, compressive, shear and impact strength, plus excellent arc resistance.

# Taylor corporation

ENGINEERED PLASTICS

FORMERLY TAYLOR FIBRE CO.  
VALLEY FORGE 53, PA.  
WEST COAST PLANT: LA VERNE, CALIF.



# NEW TECH DATA

for Engineers.

## Chemically Resistant Resins

A 32-page booklet describes General Electric's complete line of Methylon® resins for chemically resistant coatings. Designated CDC-418, this guide includes product descriptions, handling information, test results, and coating formulations. Suggested formulations include those for Methylon resin alone or blended with epoxy, alkyd, vinyl acetal, and amine resins. Chemical Materials Dept., General Electric Co., 1 Plastics Ave., Pittsfield, Mass.

Circle 404 on Inquiry Card

## Magnesium Coatings

An 8-page brochure, "Custom Application of Anodic Coatings on Magnesium," describes 4 processes, all applied with special equipment. They are: galvanic anodize (Dow 9), Dow 17 anodize, HAE anodize, and fluoride anodize. Reasons for anodizing, properties, characteristics, typical uses, and coating colors are detailed for each process. Illustrations include actual workpieces and a chart on the treatments, their developers, and the applicable U. S. Government specs. Brooks & Perkins, Inc., 1950 W. Fort St., Detroit 16, Mich.

Circle 406 on Inquiry Card

## Cable Isolators

This brochure gives performance and dimensional data on cable isolators. Guide allows the selection of the correct isolator system for the cable's size, weight, natural freq., isolation efficiency, and vibration and shock input. Systems are referenced by basic natural freq. and isolated package mass. Mounting dimensions and dynamic deflections are given for each case, making it possible for the engineer to design mounting hardware and space envelope after specifying the isolator system. Aeroflex Laboratories, Inc., S. Service Rd., Plainview, L. I., N. Y.

Circle 408 on Inquiry Card

## Ceramic Standards

The ACMA Standards Book and 2 new 4-page data supplements, are available. One supplement, E2-63, for electrical and electronic uses, lists for 3 high alumina content grades such properties as apparent specific gravity, flexural strength, impenetrability, dielectric strength, volume resistivity, dielectric constant, heat dissipation factor and loss factor at 25°C. The other supplement, M1-63, lists mechanical properties for each grade. Diamonite Products Mfg. Co., Shreve, Ohio.

Circle 405 on Inquiry Card

## Machine Tools

Use of machine tools in metal forming is covered in this 8-page bulletin. Advantages of using these tools for economical sizing, shaping and forming of cylindrical, rectangular and polysided metal parts are presented. Uses, tooling and design are discussed. The construction and features of the tools are shown in detail. Grotzies Machine Works, Inc., 5454 N. Wolcott Ave., Chicago 40, Ill.

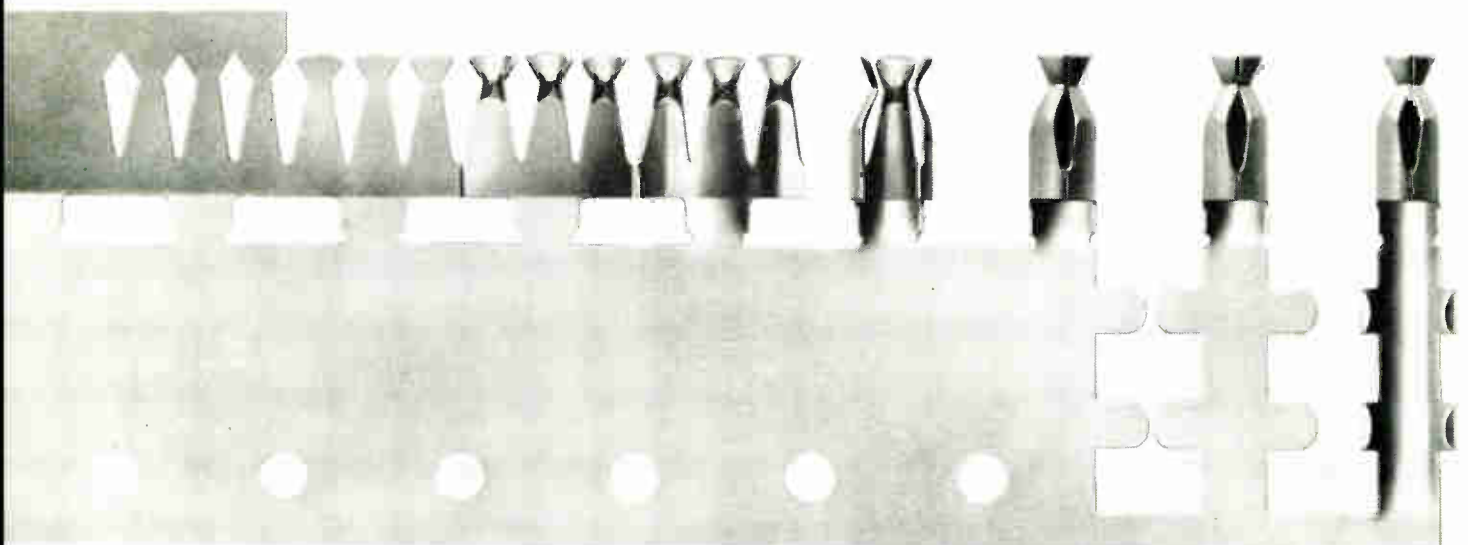
Circle 407 on Inquiry Card

## Micro-Component Coating

Complete specs. on HumiSeal Type 1F19 micro-component protective coating and the HumiSeal protective coating properties chart are available. Type 1F19 protects vapor or cermet-deposited micro-electronic components on ceramic or glass substrates. Columbia Technical Corp., 24-30 Brooklyn-Queens Expressway W., Woodside 77, N. Y.

Circle 409 on Inquiry Card

## *Brush Duo-Metal...the best connection you can make*



# NEW TECH DATA

for Engineers.

## Magnet Material

Tech. data 52-168 describes highly oriented ceramic permanent-magnet material, Westro beta, which has a high coercive force, and provides magnet-design flexibility. Characteristics and graphs are given. Westinghouse Materials Mfg. Div., P. O. Box 128, Blairsville, Pa.

Circle 410 on Inquiry Card

## Resins

A data file on diallyl phthalate molding compounds contains complete test data on Acme's D-A-P line, including newly developed compounds. General information on electronic and electrical uses is given. Acme Resin Corp., 1401 Circle Ave. Forest Park, Ill.

Circle 411 on Inquiry Card

## Cable Ties, Clamps

Nylon hand or tool-installed cable straps and clamps are illustrated and described in Bulletin SS-2. Hand and automatic pneumatic powered installation tools are also included. Panduit Corp., 17301 Ridgeland Ave., Tinley Park, Ill.

Circle 412 on Inquiry Card

## Laminated Plastic

Properties of new glass-phenolic laminated plastic (Grade 723) which will withstand continuous operating temperatures up to 500°F and has other good properties are given in Technical Data Bulletin No. 3-5-3. Taylor Corp., Valley Forge, Pa.

Circle 413 on Inquiry Card

## Compression Terminals

Bulletin TCT-62-102, containing a full-color chart, describes and aids in selection of glass-to-metal tubular single lead compression terminals. Available from Electrical Industries, 691 Central Ave. Murray Hill, N. J.

Circle 414 on Inquiry Card

## Single-Unit Seals

A 16-page color catalog, 359C, describes single-unit, high-pressure seals and fasteners for industrial and military uses. APM-Hexseal Corp., 41 Honeck St., Englewood, N. J.

Circle 415 on Inquiry Card

## Gold Plating Paper

Latest developments in gold plating are discussed in this 6-page technical paper. It briefly reviews the beginnings of the art and details the effect of additives on gold electrodeposits. The paper lists structure and hardness of different gold deposits, compares gold baths and their additives. Acid gold plating, a relatively new and previously undocumented development, is discussed. Illustrations and graphs are included. Sel-Rex Corp., Nutley 10, N. J.

Circle 416 on Inquiry Card

## Foil Service

Information is available on "Foil Service Center" offering fast, round-the-clock national service. Foil will be slit or sheeted to customer specs. with no additional charge for 24 to 36 hr. shipment. Center was set up in cooperation with The Aluminum Co. of America and offers Alcoa foils in gauges from 0.0003 through 0.0059 in widths from 1/2 through 40 in. in 1/16 in. increments. Available from American Lamotite Corp., 2914 E. 81st St., Cleveland 4, Ohio.

Circle 417 on Inquiry Card

**FIRM GRIP**  
**EASY CRIMP**

On one end, high ductility. The brass tang is easily crimped around a wire.

On the other end, exceptional strength. The beryllium copper barrel has more resistance to relaxation, more pin-gripping power than any other copper-base material.

This connector is typical of electronic parts better formed from new Duo-Metal\*—Brush's single uniform strip product which joins side by side, for the first time, properties of two copper-base alloys.

Duo-Metal strip is now ready for use as two-ribbon combinations of yellow brass with high strength Brush 190 or 25 Alloy beryllium copper. It is rolled in widths from one-half to four inches, thicknesses from 0.003 to 0.032 inch. And the weld is stronger than the brass.

Write to us for full information about new Duo-Metal. Brush is the best connection you can make to make the best connections.

\*Duo-Metal is a trademark of The Brush Beryllium Company

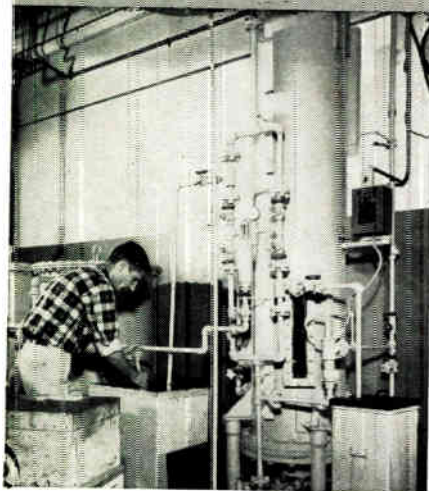
THE

**BRUSH *B* BERYLLIUM COMPANY**

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**B** CONTAMINATED  
WATER PROBLEM  
SOLVED AT  
GLASS-TITE  
INDUSTRIES



with **BARNSTEAD**  
**MIXED-BED**  
**DEMINERALIZER**  
SAND AND  
**CARBON FILTER**

Manufacturing hermetic seals and terminals for the electronics industry is tricky, painstaking business. And when it comes to washing and rinsing these parts, things can really get complicated . . . impure or poorly processed water . . . causes rejects to get out of hand.

Ordinarily, sand and carbon filters and mixed-bed demineralizers are "standard equipment" for this work. But when there's an organic removal problem, as at Glass-Tite Mfg. Division, then special equipment is called for. Barnstead's organic removal equipment was installed along with other units . . . and the result, continuous production of pure water free of organics, with high electrical resistance for washing and rinsing operations. RESULT: minimum rejects . . . faster production.

Plant officials at the Glass-Tite Mfg. Division report that these Barnstead Pure Water Units have been in operation for over a year, and have required no maintenance of any kind other than regenerating the resin. Regeneration usually takes place after 20,000 gallons of purified water has been produced.

Since 1878 Barnstead has been helping all kinds of businesses with water purification problems. Perhaps we have the right answer for you. Write today for Catalog #160 on Demineralizers and related pure water equipment.

**Barnstead**  
STILL AND STERILIZER CO.  
51 Lanesville Terrace, Boston 31, Mass.  
Circle 166 on Inquiry Card

# NEW TECH DATA

for Engineers.

## Sealing Data

Information on use of stainless steel as the metal in glass or ceramic-to-metal seals to meet the high environmental standards of Mil-C-26500 has been released. The seals can reportedly withstand temps. from  $-423^{\circ}\text{F}$  to  $+1000^{\circ}\text{F}$ . Networks Electronic Corp., Chatsworth, Calif.

Circle 478 on Inquiry Card

## Tubing Catalog

Catalog 63, 20 color pages, lists data on Polyvinylchloride plastic tubing, Teflon® extruded tubing, zipper tubing, and fiberglass tubing, which conform to Mil-specs. Included are applications and properties tables. Alpha Wire Corp., 200 Varick St., New York 14, N. Y.

Circle 479 on Inquiry Card

## Wire & Cable Catalog

Catalog 863 contains a complete listing of thousands of wires and cables for industrial use. One such product listed is a 60K vdc coaxial high-voltage cable. Included is a wall chart which helps in cable selection. Belden Mfg. Co., 415 S. Kilpatrick, Chicago 44, Ill.

Circle 480 on Inquiry Card

## Dust-Free Cabinet

Data sheet describes Sterilshield® dust-free workspace, a functionally designed cabinet for work requiring clean atmosphere. Equipped with new view screen, bigger than that found in older models, and stainless steel air diffuser. Baker Instruments, Inc., P.O. Box 597, Chandler, Ariz.

Circle 481 on Inquiry Card

## Electronic Welding Brochure

A new 4-page brochure describes accessories for electronic welding systems. Included are descriptions of push button weld heat selectors, fully automatic programmable controls, electrode force gages, tensile testers and complete hookup and installation accessories. Hughes Welders, 2020 Short St., Oceanside, Calif.

Circle 482 on Inquiry Card

## Cleaning Solvent

Tech. Bulletin 957-R describes an improved pressurized electrical cleaning solvent for in-place cleaning of electrical and electronic equipment. Improvements result from a change in the pressurizing material from halogenated hydrocarbons to carbon dioxide. Montgomery Chemical Co., Jenkintown, Pa.

Circle 483 on Inquiry Card



## It stands alone

You can't buy HYDRAZINE-ACTIVATED FLUX\* or Core Solder under any other brand name. Fairmount is the sole producer.

Hydrazine-Activated Flux and Core Solder offers an exclusive combination of advantages:

- High wetting properties for good "bite."
- Non-corrosive connections.
- Residues removed by heating or water rinse.
- No change on aging.

These performance characteristics were confirmed in a recent evaluation of leading fluxes used in the fields of printed wiring and etched circuitry.

No one flux is best for all purposes. TEST HYDRAZINE FLUX AND CORE SOLDER FOR YOURSELF. The liquid permits pre-fluxing, is useful for soft-soldering a wide range of copper and copper-based alloys. The core solder flows at an ideal rate, leaves a minimum of soldering residues. Write for samples of either, or technical literature.

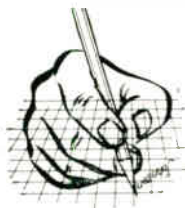
\*U.S. Patent No. 2,612,459 and others

Available only from Fairmount and its sales agents.

**Fairmount**  
CHEMICAL CO., INC.  
136 Liberty St., N. Y. 6, N. Y.

Circle 167 on Inquiry Card





## Time after time engineers specify Johnson sockets!

Whatever the choice . . . a miniature 7-pin steatite wafer or a low-loss Kel-F socket for high power transmitting tubes . . . time and time again design and development engineers specify Johnson tube sockets! All sockets have been categorized under a socket standardization program, reducing the number of variations in each socket type. Standardization and immediately available stock shortens delivery cycles—permits fast selection of a Johnson socket for almost any application!

**Standard:** Commercial grade for general requirements. Bases are glazed porcelain or steatite. Etched aluminum shields or bayonet shells.

**Industrial:** Superior in quality to "Standard" Grade. Glazed steatite bases, DC-200 treated. Phosphor bronze or beryllium copper contacts .0005 silver-plated. Aluminum shells and shields are iridite No. 14 treated. Fungus resistant cushion washers under contacts.

**Military:** Top quality to meet military requirements. Glazed L-4 steatite bases, DC-200 treated. Phosphor bronze or beryllium copper contacts heavily silver-plated. Hot tin dipped solder terminals. Brass bayonet shells .0003 nickel-plated. Aluminum shells and shields are iridite No. 14 treated. Fungus resistant cushion washers under contacts. Wafer sockets protected for 200 hour salt spray test.



**E. F. JOHNSON COMPANY**

3021 TENTH AVENUE S.W. • WASECA, MINNESOTA

**KEL-F SERIES**—Molded of low dielectric loss-factor Kel-F plastic—designed for use with a wide selection of high power transmitting tubes such as: 4X150A; 4X150D; 4X250B; 4CX250B; 4X250F, 7034; 7035. Basic sockets are available in several designs—with or without screen grid by-pass capacitors, mounting saddles, or steatite chimney to direct air flow through tube cooling fins. Control grid contact "guide" is machined for greater alignment accuracy, and tapped for 6-32 machine screw. All contacts are low resistance silver-plated beryllium copper. Tube pin contacts are heat treated to provide positive contact pressure as well as extended life. Annealed soldering tabs may be easily bent or formed.

**BAYONET TYPES**—Includes Medium and Heavy Duty Medium, Jumbo and Super Jumbo 4-pin types. For use with tubes such as: 866A or 811A, E.I.A. Base No. A4-10; 872A, 211, and others with E.I.A. Base No. A4-29; and tubes such as: 8008, 5C22, FG104, GL146 and others with E.I.A. Base No. A4-18.

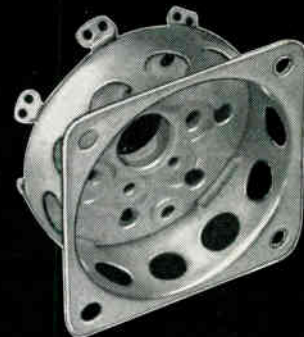
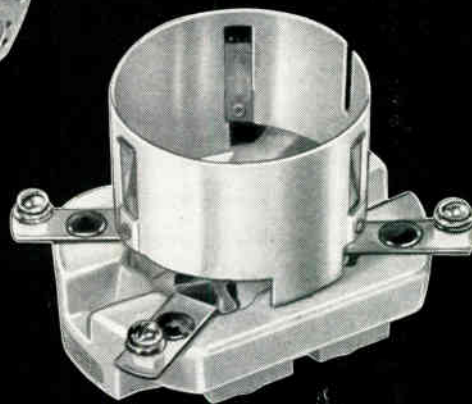
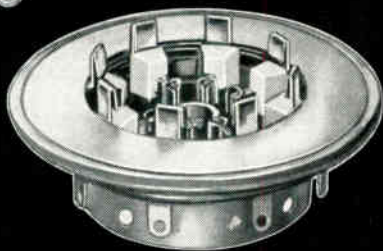
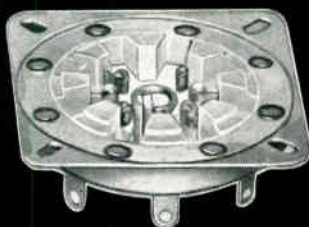
**STEATITE WAFER TYPES**—Available in 4, 5, 6, 7, and 8-pin standard socket types, as well as Super Jumbo 4-pin for tubes with E.I.A. Base Nos. A4-15, A4-16, and A4-18. Giant 5 and 7-pin models for tubes with E.I.A. Base Nos. A5-19 and A7-17. Septar Sockets for tubes such as the 7094 with E.I.A. Base No. E7-2; and VHF Septar Sockets for tubes such as: 5894, 6524, 6252 with E.I.A. Base No. E7-20; and 826, 832, 4D32 with E.I.A. Base No. E7-2.

**MINIATURE TYPES**—All steatite, available in Standard Wafer Type or Shield Base Type for 7-pin miniatures such as the: 1RS, 1S5, 6CB6, etc., with E.I.A. Base No. E7-1.

**SPECIAL PURPOSE TYPES**—Includes sockets for special purpose tubes such as the: 204A and 849; the 833 and 833A; 152TL; 304TL; 750TL; 1500T; 2-2000A; 5D21, 705A and others.

**NOTE:** Detailed specifications on all Johnson tube sockets have been prepared for engineering department use in Socket Standardization Booklet 536. Should you wish a copy—please make your request on company letterhead.

# STANDARD, INDUSTRIAL, MILITARY TUBE SOCKETS

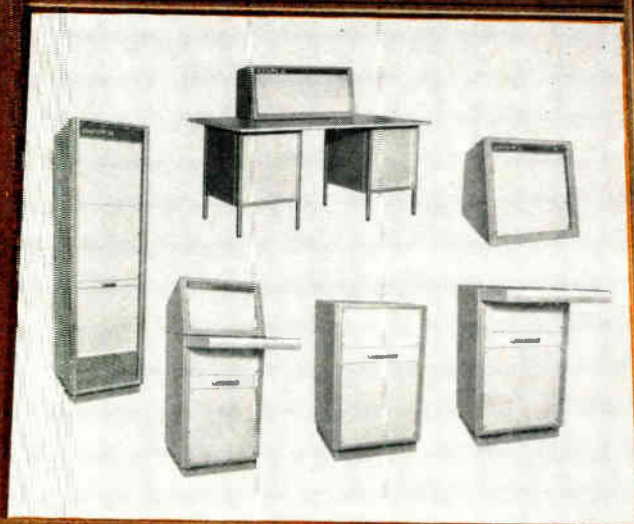


**DETAILED COMPONENTS CATALOG AVAILABLE—Write today on company letterhead**

• CAPACITORS • TUBE SOCKETS • CONNECTORS • PILOT LIGHTS • INSULATORS • KNOBS AND DIALS • INDUCTORS • HARDWARE



## EMCOR II



# EMCOR® II Modular Enclosures hold the answer to your enclosure problems

Your imagination creates the custom look for your equipment with EMCOR II Modular Enclosures. EMCOR II Enclosures have basic points of modification which provide each customer with product individuality. Select recessed, flush or extended panel mountings; choice of trim or grillwork extrusions; nameplate style variations, double width frames, pontoon bases and side panels—all designed to give you custom type enclosures without the cost of custom fabrication. A few of the many EMCOR II Enclosure configurations are shown above. Contact your local Ingersoll Products Sales Engineering Representative or write for full details.

REQUEST NEW  
EMCOR II  
LITERATURE



**BORG-WARNER**

EMCOR—The Original Modular Enclosure System By  
**INGERSOLL PRODUCTS**  
Division of Borg-Warner Corporation  
1000 W. 120th ST. • DEPT. 1245 • CHICAGO 43, ILL.

Ingersoll Products Sales Engineers also represent McLean Blowers for enclosures  
VISIT US AT NEP/CON Booth 3108-3208

Circle 169 on Inquiry Card

G46

## NEW TECH DATA

### Electronic Hardware

Catalog 34, 32 pages, illustrates Microdot's "Lerco" line of electronic hardware. Outline drawings and dimensions of standard terminals, insulated terminals, terminal boards, handles and hardware, eyelets, and control knobs are included. Microdot Inc., 220 Pasadena Ave., So. Pasadena, Calif.

Circle 531 on Inquiry Card

### Organic Flux

Alpha #709 soldering flux is recommended for electronic and electrical uses where rosin fluxes are too inactive and inorganic fluxes too corrosive. This water-soluble, spatter-free flux is ideal for printed-circuit boards, hermetically-sealed units and similar uses. Alpha Metals, Inc., 56 Water St., Jersey City, N. J.

Circle 532 on Inquiry Card

### Ceramics Chart

Chart No. 631, includes new ceramics in both beryllia and alumina plus comprehensive data on dielectric constant, dissipation factor and loss factor at various temps. and freqs. It is a valuable tool for any engineer using ceramics. American Lava Corp., Manufacturers Rd., Chattanooga 5, Tenn.

Circle 533 on Inquiry Card

### Sorting "Exotic" Metals

An interesting 8-page booklet describes the sorting and grading of "exotic" metals such as tantalum, titanium, molybdenum, tungsten and zirconium. Entitled "Specialists in Specialties," it is available from Max Zuckerman & Sons, Music Fair Rd., Owings Mills, Md. Booklet describes firm's manufacturing facilities.

Circle 534 on Inquiry Card

### Polycarbonate Resin

Technical report CDC-413 discusses thermoforming of Lexan® polycarbonate resin. The report details techniques; molds, including materials, design, mounting and lubricants; and sheet thermoforming, including drying, temps., gage variations, drape speeds and ring assists. Applications are included. General Electric Co., 1 Plastics Ave., Pittsfield, Mass.

Circle 535 on Inquiry Card

### Color Filters

New glass color filters for use in instruments and switches are described in a brochure available from Corning Glass Works, Public Relations Dept., Corning, N. Y. It lists advantages of the filters as precisely controlled color, uniform brightness, dimensional stability, color stability and variety, design flexibility and heat resistance. Applications include electronic switching, pilot lights, indicator lights, split-screen color projection, and 2 to 4 color switching.

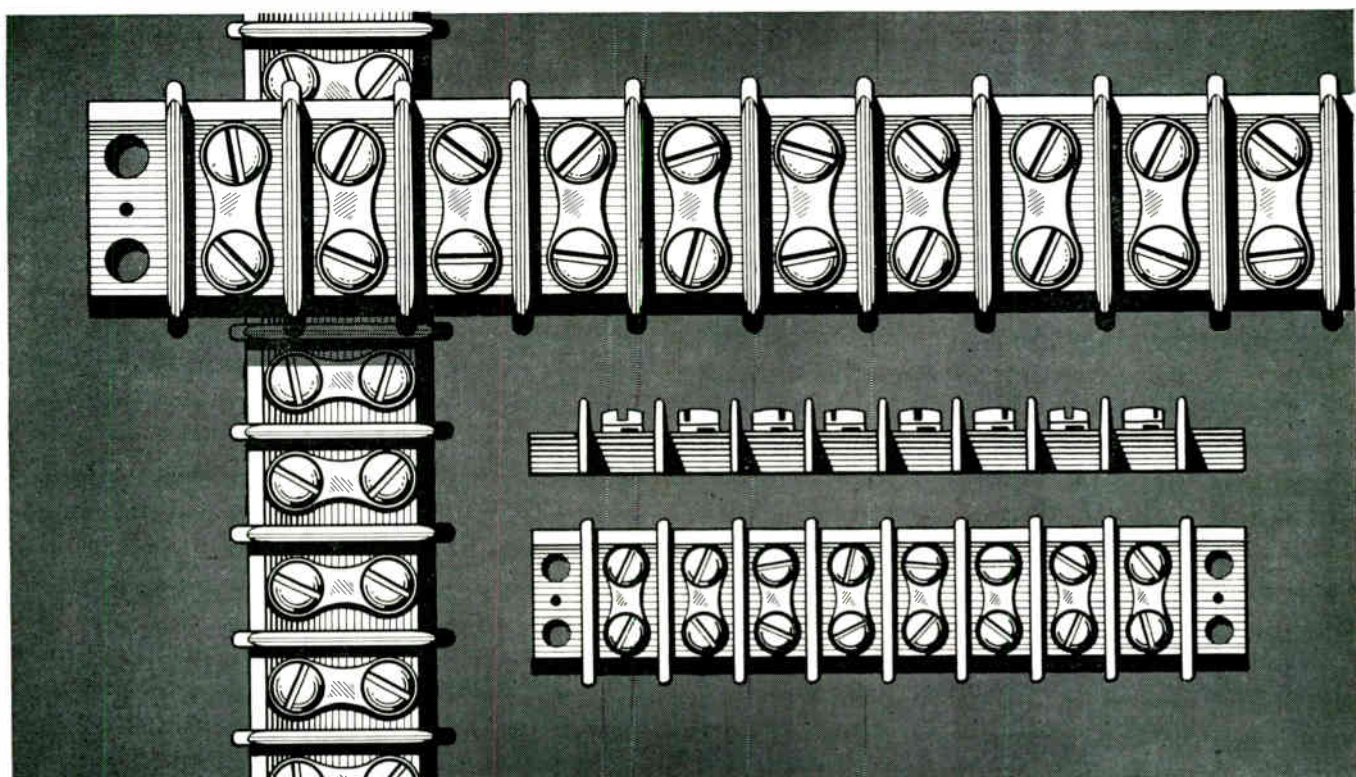
Circle 536 on Inquiry Card



# NEW GEN-PRO 700 SERIES INDUSTRIAL TERMINAL BOARDS

ALL SIZES AVAILABLE NOW FOR  
TIMED DELIVERY AS NEEDED

*Superior features • Competitively priced • Conveniently packaged*



When you need terminal boards for any application, rely on Gen-Pro's great new 700 Series for the quality and interchangeability you want—on Gen-Pro's unique timed delivery for prompt as-needed shipments. Greater length—up to 46 terminals—permits a larger number of connections than ever before possible. Thicker, stronger barriers with rounded corners reduce breakage—creepage path is longer—saddle plates available for more secure mounting. All sizes and variations in number of stations—packaged in lots of 5, 10 and 20. The boards of your choice are delivered from stock in the quantities you require—when you need them. All types of hardware and special molding compounds are available in addition to standard-purpose phenolic. Write today to Dept. SMMD for illustrated literature.

#### Your assurance of quality.

700 Series terminal boards are subject to the same rigorous quality control procedures as Gen-Pro's famous 400 Series — the finest commercial terminal boards available anywhere today.

#### 700 SERIES TERMINAL BOARDS

| Model No. | Voltage, RMS | Terminals |
|-----------|--------------|-----------|
| 740       | 1200         | 1-46      |
| 741       | 1600         | 1-39      |
| 742       | 2500         | 1-30      |
| 764*      | 1600         | 1-46      |

\*32 screws



**GENERAL  
PRODUCTS  
CORPORATION**

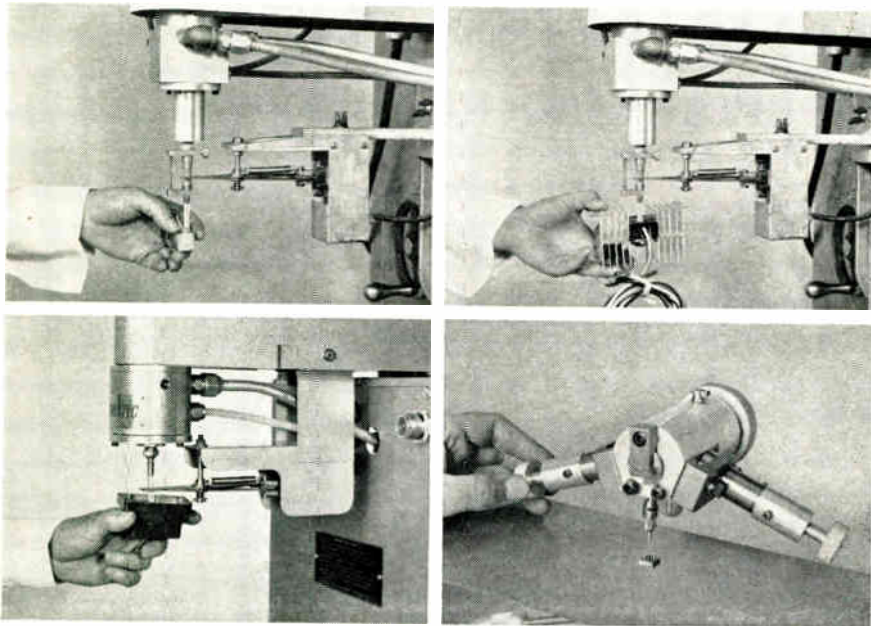
UNION SPRINGS, N.Y.

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Phone: (area code 315) TT9-7367



# RELIABLE 'PRODUCTION' POTTING AND ENCAPSULATING

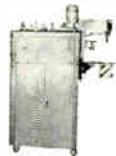


## With High-Grade Epoxies and Fully Automatic Dispensers From One Experienced Supplier



### EPOCAP® EPOXY COMPOUNDS

Hardman Epocap®, along with Epoweld®, Epolast® and Eposet® have long records of success in many industries. Available in a wide range of viscosities, fillers, curing-times, work-life and degrees of hardness and flexibility, Hardman epoxies are tightly quality-controlled, feature excellent electrical and physical characteristics and are easy to use. All Hardman epoxy compounds are specially formulated for dispensing from TRIPLEMATIC machines.



### TRIPLEMATIC® DISPENSING MACHINES

The most widely used equipment of its kind in the world, TRIPLEMATIC machines automatically proportion, mix and dispense metered quantities of multi-component resin systems. A full range of models dispense from precise micro-miniature shots (down to 0.05 ml) to a continuous flow (up to 40 pounds per minute). TRIPLEMATIC equipment will handle heavily filled compounds accurately for hand or conveyor feeding at rates up to 30,000 dispensed shots per shift.

### ONE SOURCE — ONE RESPONSIBILITY

Every user of Hardman equipment has available Hardman's highly qualified service staff of engineers and technicians to assure maximum production efficiency and minimum equipment down-time. Hardman engineers and chemists also provide counsel on proper epoxy ratios and viscosities for your needs as related to the equipment.

Consult H. V. Hardman for the most efficient potting, bonding and encapsulating production "package" available. Write today for complete literature.

## H. V. HARDMAN CO., INC.

Industrial Adhesives Since 1906

583 Cortlandt Street • Belleville 9, N. J. • Phone (201) 759-3700



## NEW TECH DATA

### Tools and Instruments

Catalog No. 25, 96 pages, gives a complete listing of precision measuring tools and instruments. A quick index on the inside front cover gives page numbers of the 9 major sections. Alphabetical and numerical indexes at the back of the catalog permit fast reference and location of any item. A separate 34-page consumer price list is also available. Scherr-Tumico, Inc., 301 Armstrong Blvd. N., St. James, Minn.

Circle 537 on Inquiry Card

### Instrument Housings

Bulletin 407G, 28 pages, contains engineering design information. It offers many standard solutions to the problems of housing instruments and construction; finishes and environmental specs. are compiled for easy design reference. TA Mfg. Corp., 4607 Alger St., Los Angeles 39, Calif.

Circle 538 on Inquiry Card

### Machinery Capabilities

Attractive brochure describes firm's ability to machine-make screws. Brochure contains specs., photos of jobs performed. Work described covers runs from 32 to 285,000. Materials used included inconel, nickel, hastelloy C, molybdenum and A.I.S.I. Type 304 stainless. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Garden City, L. I., N. Y.

Circle 539 on Inquiry Card

### Plastic Tie

These plastic ties are inexpensive, easy to use, and require no tools. Wire tie resembles a bead chain with an enlarged section or "key-slot" lock on one end. There are 2 holes in the lock—one big enough for the tie to pull through; the other is smaller to hold the tie at the desired point. Holub Industries, Inc., Sycamore, Ill.

Circle 540 on Inquiry Card

### Ceramics and Plastics Saw

Con-O-Saw cuts precious metals and ceramics with little waste, no burrs and no distortion. It uses abrasive wheels for fast, clean, burr-free cutoff of such materials as case-hardened steel, tungsten, wood, plastics and glass. The saw operates on 115v. and weighs 14 lbs. Continental Sensing Inc., 1960 Ruby St., Melrose Park, Ill.

Circle 541 on Inquiry Card

### Dowel and Pin Folder

A condensed "in-stock and data" folder concerning stainless steel dowel and taper pins is available. This folder supplies valuable information and latest specs. on commercial, precision and military requirements in easy-to-use format. Allmetal Screw Products Co., Inc., 821 Stewart Ave., Dept. D, Garden City, L. I., N. Y.

Circle 542 on Inquiry Card



Rewirable—Control Cable



High Temperature—1500°F.—Cable



Heavy Duty—Ground Support Cable



Benseal—Missile Control Cable



Fabric Braided—Aircraft and Missile Control Cable



Metal Braid—Aircraft and Missile Control Cable



High Temperature—Radiation Resistant Cable



High Temperature—Lightweight—Missile Cable



"Wet Wing" Aircraft Fuel Cell Cable

## We're strong in special-purpose cable systems.

Our specialty is producing complex cables for unusual applications to meet our clients' specifications. And we've made some pretty weird looking cables.

A few of the more spectacular types are pictured here. They include metal conduit types available in a variety of metal braids and inner core designs; fabric and metal braid which practically defies limited-space applications; radiation resistant cables; hydrostatic assemblies for critical undersea

## You can be too.

service; flexible or rigid sealed thermocouple types which operate from  $-65^{\circ}$  to  $1500^{\circ}$ .

We've found that the best way to sell cable is to have one of our engineers call on a customer and help him solve his particular problem. You know the problem; we know the cable. So why not call us even before you need us. We can be reached at Santa Ana, California, or Sidney, New York. In the meantime, send for our catalog.



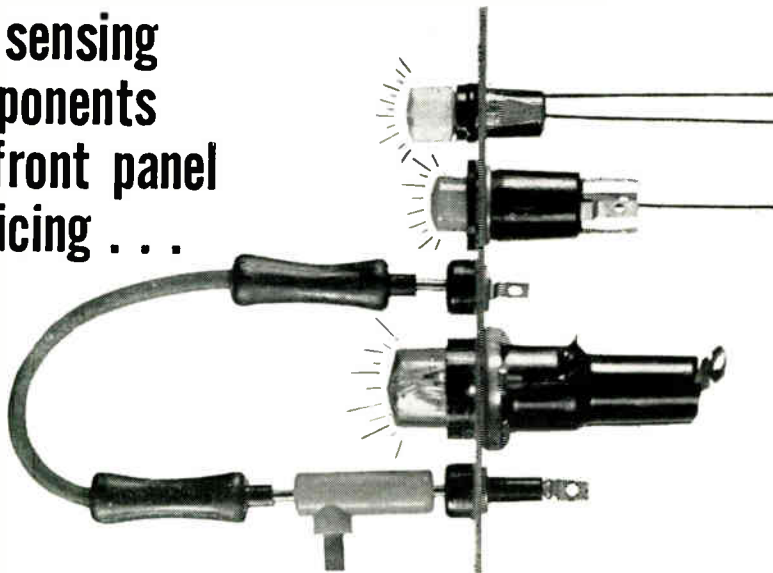
**Scintilla Division**



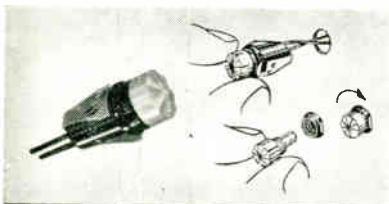
Circle 172 on Inquiry Card  
World Radio History



# Sub-miniature test and sensing components for front panel servicing . . .



These tiny "tell-tales" for every piece of equipment make servicing and troubleshooting simple. Use them to monitor electrical and mechanical functions — tell operator when malfunction occurs — help spot source of trouble — simplify checking — adjustments — protect costly components.



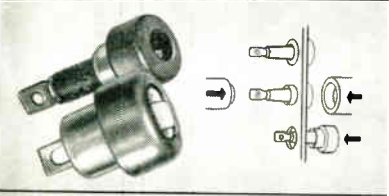
### THE ALDEN PAN-I-LITE

3 times greater light efficiency • 1/6 the size of miniature bayonet bulbs • Easier mounting, snap in • Quick and easy to replace from front of panel • Visible from any angle, any distance • Non refracting • No bulky focusing or refracting devices • Variety of colors and voltages (6v, 12v, 28v incandescent, 110-220v Neon).



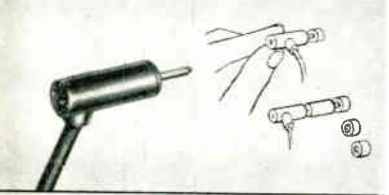
### THE ALDEN PAN-I-LITE SWITCH

Tiny push-button, snap-in indicator gives positive indication — 180° visibility • one-piece replaceable bulb lens • use as press-to-test indicator or remote control switch • In 6, 12, 28v incandescent blue, red, green, white, yellow • Quick snap-ring mount.



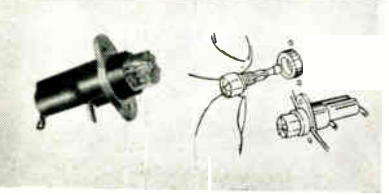
### ALDEN STAK-IN TEST JACKS

Exclusive molded-in eyelet permits fast, low-cost machine assembly • No nuts, washers, sleeves • Won't vibrate loose, turn, or fall out • Rugged Nylon insulation • Reliable 360° Beryllium contact.



### ALDEN STACKING AND PATCH CORDS

Miniaturize your computer with tiny cord sets • stack and patch for positive interconnections • reliable integrally molded units take any standard .080" test prod • resilient contact • lead length to your specs is covered in flexible rubber.



### ALDEN FUSE-LITES

Here's a compact panel-mounting fuseholder that indicates when fuse is blown. Fuse blows — lite blows. Takes standard 1/4" x 1/4" fuse. Protect your equipment with Alden Fuse-lites. For 6, 12, 28, 110 and 220 volts, 15 amps to 110 volts, 7.5 amps at 220 volts.

# ALDEN

6123 N. Main St., Brockton, Massachusetts

Write for Vest Pocket Guide and Samples:



## NEW TECH DATA

### Powder Metal Products

This brochure provides information on the application and use of powder metal components. Featured are stainless steel acoustical filters for communications, sound and sonar equipment. Other powder metal specialty components are also discussed. It provides complete information on the basic design advantages of powder metallurgy. Gilman Engineering & Mfg. Co., 305 W. Delavan Dr., Janesville, Wis.

Circle 543 on Inquiry Card

### Lubricant

Hi-T-Lube is a permanent lubricant for easing the action and extending the cycling life of switches, relays and other electrical devices with moving parts. Comprised of several different metals, it uses the lubricating qualities of precious metals and rare metallic oxides. It has a 0.03 coefficient of friction compared to 0.08 for oil lubricants. General Magnaplate Corp., 331 Main St., Belleville, N. J.

Circle 544 on Inquiry Card

### Tools Catalog

This catalog describes and illustrates over 800 items including bench tools, epoxy systems, optical production tools, numerous highly-specialized precision tools, comparators, cutters, fabrication tools, microscopes and magnifiers, ultrasonic cleaning equipment, white-room equipment, etc. Request on company letterhead to Micronics Corp. of America, Dept. P-5, 8116 Old York Rd., Elkins Park, Pa.

Circle 545 on Inquiry Card

### Tubing Brochure

New 4-page, illustrated brochure on Tungsten-26% Rhenium seamless tubing features physical, thermoelectric and mechanical property data. Tubing is used for cladding for fuel elements, special thermocouple constructions, other parts and components operating in 3000°-5500°F range. Hoskins Mfg. Co., 44455 Lawton Ave., Detroit 8, Mich.

Circle 546 on Inquiry Card

### Semiconductor Guide

This guide presents information on the operating characteristics of a complete line of npn and pnp transistors, power diodes, power rectifiers, and high-speed switching transistors. Hundreds of components are listed in easy-to-read tabular form. Bendix Semiconductor Div., Holmdel, N. J.

Circle 547 on Inquiry Card

### Semiconductor Polisher

A portable machine for lapping and polishing semiconductors and other materials is described in information available from the Westinghouse Scientific Equipment Dept., P. O. Box 868, Pittsburgh 30, Pa. Called the Mazur, it laps and polishes wafer-thin to bar-sized items.

Circle 548 on Inquiry Card





**Molded  
Nylon  
SCREWS  
and  
NUTS**

**DELIVERED  
FROM  
STOCK**

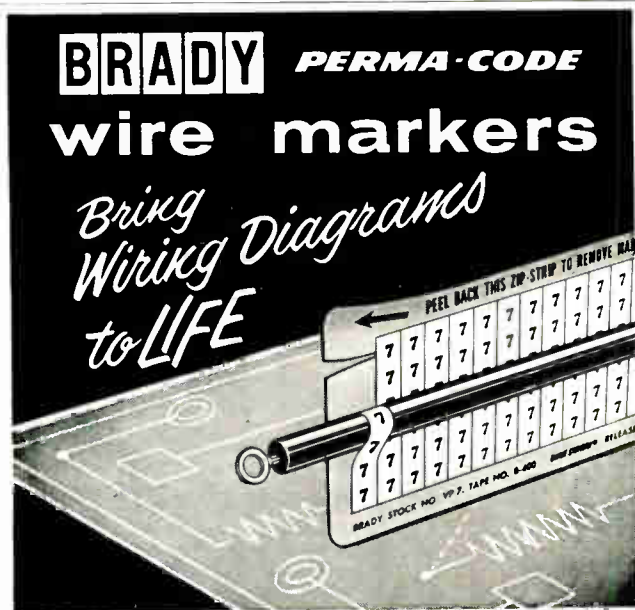
- FASTEN and INSULATE WITHOUT BUSHINGS
- CORROSION RESISTANT
- NON-MAGNETIC
- HIGH DIELECTRIC STRENGTH

Round, flat, and fillister head screws . . . slotted headless set screws. Hex and slotted cap nuts. Thread sizes 2-56 to 1/4-20. Black or Natural.

*Write for free samples to fit your production*

**Weckesser COMPANY, Inc.**

5711 Northwest Highway • Chicago 46, Illinois  
Circle 174 on Inquiry Card



Brady self-sticking Wire Markers tell which wire goes where, permanently . . . *directly*. The number on the wire list is the number on the wire. No confusing colors and tracers to convert. Brady stocks thousands of standard legends in five different sizes — four job-tested materials. Dispenser card mounted for fast application.

*Write for new bulletin and testing samples. FREE!*

**W. H. BRADY CO.**, 751 W. Glendale Ave., Milwaukee 9, Wis.  
EST. 1914

Manufacturers of Quality Pressure-Sensitive Industrial Tape Products, Self-Bonding Nameplates, Automatic Machines for Dispensing Labels, Nameplates, Masks and Tape.

Circle 175 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963

**ELECTRONIC  
AND ELECTRICAL  
COMPONENTS**

HAVING AXIAL LEADS  
(such as capacitors, diodes,  
fuses and resistors)

**ORGANICALLY  
FINISHED**

at rates of up to

**12,000  
per  
HOUR**

**CM**

**Model HD-3**

Completely  
automatic

**REMOTE  
MASKING  
SPRAY  
COATER**

Applies a solvent and abrasion-resistant clear coating that protects color coding and labeling or a light-tight seal for silicon diodes. Coating is confined to desired area while racks, loaded with diodes move continuously through spray station. The diodes, while in the racks, are spun so as to assure an even coating and remain in the racks for both spraying and baking operations.



**CM Model PR-1  
POWDERED RESIN  
COATING MACHINE**

Automatic Feed and Control  
Adjustable Speed.

★  
**CM Model TL-1  
AUTOMATIC TRAY  
LOADING MACHINE**

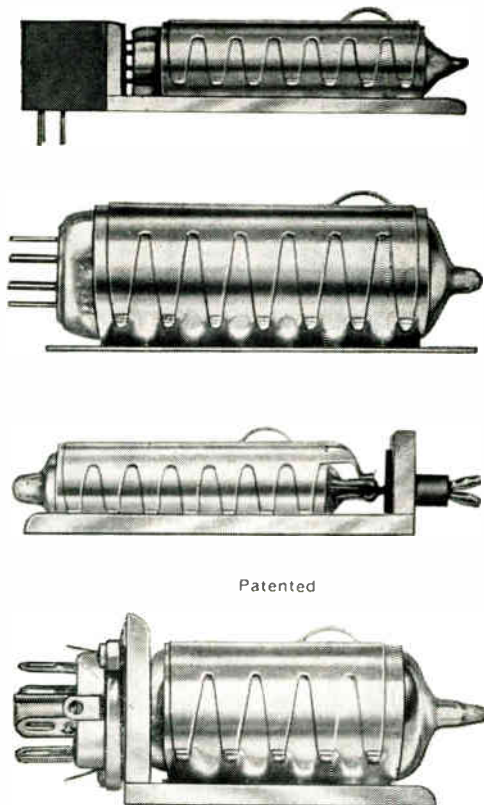
★  
**CM Model ML-1  
MAGAZINE-LOADER**

★  
Send for literature.

**CONFORMING  
MATRIX  
CORP.**

839 NEW YORK  
AVENUE  
TOLEDO 11, OHIO

Circle 176 on Inquiry Card

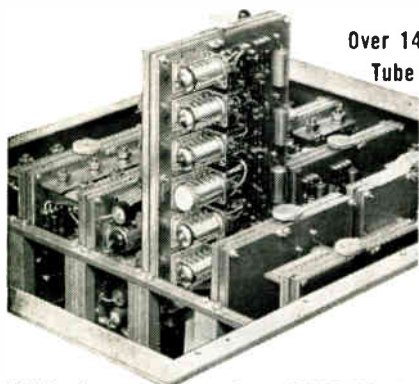


Patented

## COMPLETE THERMAL DESIGN IS A TUBE SHIELD MATTER, TOO!

Thermal design in tube-circuited equipment, to be complete, needs IERC Heat-dissipating Tube Shields. They assure maximum cooling, 2 to 12 times longer tube life and reliability. Equipment buyers want IERC Tube Shields—recognized as a sign of perceptive thermal design engineering in the equipments they buy.

**IERC**  **D I V I S I O N**  
**INTERNATIONAL ELECTRONIC RESEARCH CORPORATION**  
 135 West Magnolia Boulevard, Burbank, California • Victoria 9-2481  
 Foreign Manufacturers: Europelec, Paris, France. Garrard Mfg. & Eng. Co., Ltd., Swindon, England



Over 1400 sizes and types of IERC Heat-dissipating Tube Shields to meet every design requirement!

IERC Horizontal Hardmount Series Shields are shown in a combination printed circuit and heat sink modular application by Remanco, Inc., Santa Monica, California. Excellent thermal control from maximum heat transfer in space-saving arrangement is obtained on eleven back-to-back modules in Remanco's Radar Target Simulator.

Write for complimentary IERC Heat-dissipating Tube Shield Catalog today!

Circle 179 on Inquiry Card

## NEW TECH DATA

### Phenolic Laminate

Data is available on a new paper phenolic laminate for flame retardant printed circuitry. FR-200 (NEMA grade FR-2) meets properties of Mil-P-3115C, combines flame retardance with high flexural strength, good insulation and cold punching properties. Solder blister resistance is high. Comes in standard sheet sizes, copper clad and unclad. Formica Corp., 4614 Spring Grove Ave., Cincinnati 32, Ohio.

Circle 554 on Inquiry Card

### Silicone Protective Coating

Data sheet describes new silicone surface coating which maintains high surface resistivity in printed circuits even after prolonged high-humidity and temp. cycling from  $-65^{\circ}\text{C}$  to  $+250^{\circ}\text{C}$ . Also used to protect memory planes of computers and circuitry of precision instruments and in other similar ways. Specs., data on uses, and properties of cured films are supplied. Dow Corning Corp., Midland, Mich.

Circle 555 on Inquiry Card

### Laboratory Kiln

Product Information Bulletin describes Bickley 2150 Laboratory Kiln. Bickley 2150 is a general-purpose, semi-muffle kiln for temps. as high as  $3200^{\circ}\text{F}$  in less than 5 hrs. It permits laboratories to explore the high temp. field at min. cost. Any commercial fuel gas can be used, and no bottled oxygen is required. A complete line of accessories, including safety devices and pyrometer equipment is available as an integrated firing system. Bickley Furnaces, Inc., 550 State Rd., Philadelphia 14, Pa.

Circle 556 on Inquiry Card

### Environmental Cabinet

A bulletin describes the Tenney-Jr., a new, compact, mechanically refrigerated bench model high-low temp. precision test chamber, is available from Tenney Engineering, Inc., Union, N.J. The unit, with 14 x 10 x 10 in. work space, was designed specifically for small batch, small unit testing of semiconductors and other electronic components to Mil Specs., as well as for testing medical and consumer products.

Circle 557 on Inquiry Card

### Colored Filters

SiliKrome™ silicone rubber-colored filters fit over clear miniature incandescent lamps, thus providing a choice of colors. The filter caps slip over lamps of lighting panels, switch indicators, instrument lights and console panels. They conform to Mil-C-25050 for yellow, red, blue, green and lunar white including instrument lighting red per Mil-L-25467, and instrument lighting white per Mil-L-27160A. SiliKrome Div., APM - Hexseal Corp., 41 Honeck St., Englewood, N. J.

Circle 558 on Inquiry Card

# HOW TO CUT KNOB COSTS in Electrical-Electronic Equipment



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RB-999-700-SK  
DuoI-Control



RB-115

Select from Wide Variety of Exclusive Designs  
From Stock Molds—No Tool Charge—Fast Delivery



Molded of thermosetting materials Rogan offers a wide range of stock molded knobs . . . designed by Rogan . . . available *only* from Rogan. Many to MIL specs. Special markings can be branded on knobs at extremely low cost. Get details on the complete Rogan Knob line. Do it NOW!

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Circle 181 on Inquiry Card



**MIL-C-3432B**

Power & Control Cable, Flexible & Extra Flexi-  
ble, 300 and 600 volts

**MIL-W-7139B**

Wire, Polytetrafluoroethylene, 600 volt, 400°F

**MIL-W-8777B**

Wire, Silicone Rubber, 600 volt, 400°F

**MIL-C-3702**

Cable, Ignition, High Tension

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Radio Frequency Cable, High Temperature  
Version Only

**MIL-C-13486A**

Cable, Vehicle, 30 Volt, Heavy Duty, Single &  
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Antenna Cable, Corona Free

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Non-hosing Cables Only



Also designs and manufactures cables to  
customers' specs, using natural, synthetic, butyl,  
neoprene and silicone rubber insulating and  
jacketing materials. Applications requiring radia-  
tion, heat, cold, ozone, abrasion, moisture and  
fungus resistant cables can be met. High volt-  
age, low noise, low capacity and medium-  
strength cables also available. Write for general  
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**Boston Insulated Wire & Cable Co.**  
81 Bay Street, Boston 25, Mass.

Circle 182 on Inquiry Card



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- high molecular weight
- low condensation temperature
- high compressibility
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- odorlessness
- non-toxicity
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**SF<sub>6</sub>** offers all of the above. This dielectric gas has found successful application in heavy electrical units, miniaturized electronic devices and X-ray equipment. If the unusual properties of sulfur hexafluoride suggest other potential applications to you, mail the coupon for our 22-page technical bulletin.

E1-63

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**GENERAL CHEMICAL DIVISION**  
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Title \_\_\_\_\_

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City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

Circle 183 on Inquiry Card

## NEW TECH DATA

### Relay Headers

Information is available on a line of standard and custom multiple lead headers for the relay industry. Headers include the standard rectangular and oval shapes as well as 5 and 14-pin sq. headers. In addition, special types can be designed based on customer needs. Terminations include straight, plug in, hook, flat and pierced or lug types. All headers are offered in a number of finishes conforming to applicable military specs. Glass-Tite Mfg. Div., Glass-Tite Industries, Inc., 725 Branch Ave., Providence, R.I.

Circle 559 on Inquiry Card

### Molded-Laminated Parts

Data is available on molded-laminated and molded-macerated parts for mechanical, electrical and industrial uses. Molded-laminated parts are almost like similar parts machined from sheet stock in such properties as tensile strength, moisture resistance, specific gravity and dielectric strength. Three advantages claimed for molded laminated over machined are: the molded-laminated angle needs less machining; it has better appearance; it has greater strength. The molded-macerated process is used when parts of intricate shape or of a design that prohibits production by machining from standard forms are required. Synthane Corp., Oaks, Pa.

Circle 560 on Inquiry Card

### Pre-Tinned Stainless Strip

Information on a new item which makes automated soldering of stainless steel parts practical is available from American Silver Co., a div. of Sherman Industries, 36-07 Prince St., Flushing 54, N.Y. This new product, known as Stainless Steel ASCO-TIND, is available in most types of stainless steels in the 200, 300 and 400 series. The stainless steel is clad with a metallurgically bonded layer of pure tin, solder or other low melting alloy.

Circle 561 on Inquiry Card

### Clean Room Uniform

This clean room uniform catalog, "Packaging People to Protect Products," illustrates an enlarged line of fabrics and garments engineer-designed to prevent physical and chemical contamination of sensitive devices. A new multiplex nylon fabric, Nydura, has superior resistance to abrasion, high absorbency, as well as good opacity and drape. It is featured in a coverall, frock, cap, boots, and wiping cloth. A "Buying Guide for Synthetic Uniform Fabrics" is included in the catalog. Angelica Uniform Co., Box 466, St. Louis 66, Mo.

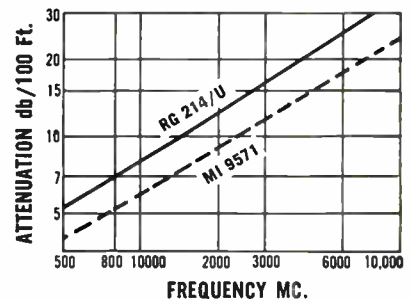
Circle 562 on Inquiry Card



## cable on a diet

Weight and attenuation are reduced through the new, more efficient outer conductor design applied to this type of Times special coaxial cable. Attenuation is reduced at least 20% at all frequencies from 40mc to 10gc.

### LOSS CHARACTERISTICS



With 100 feet of cable at 3gc, (see graph), this reduction in attenuation will provide better than 3 times the power output of its RG counterpart. Shielding effectiveness is slightly improved. Weight averages 20% less than comparable cable with conventional braid. And these improvements are achieved at no significant increase in cost. These techniques are applicable to most RG cable. Prove it to yourself! Write or wire today for a "Cable on a Diet Kit." Dept. EI 36



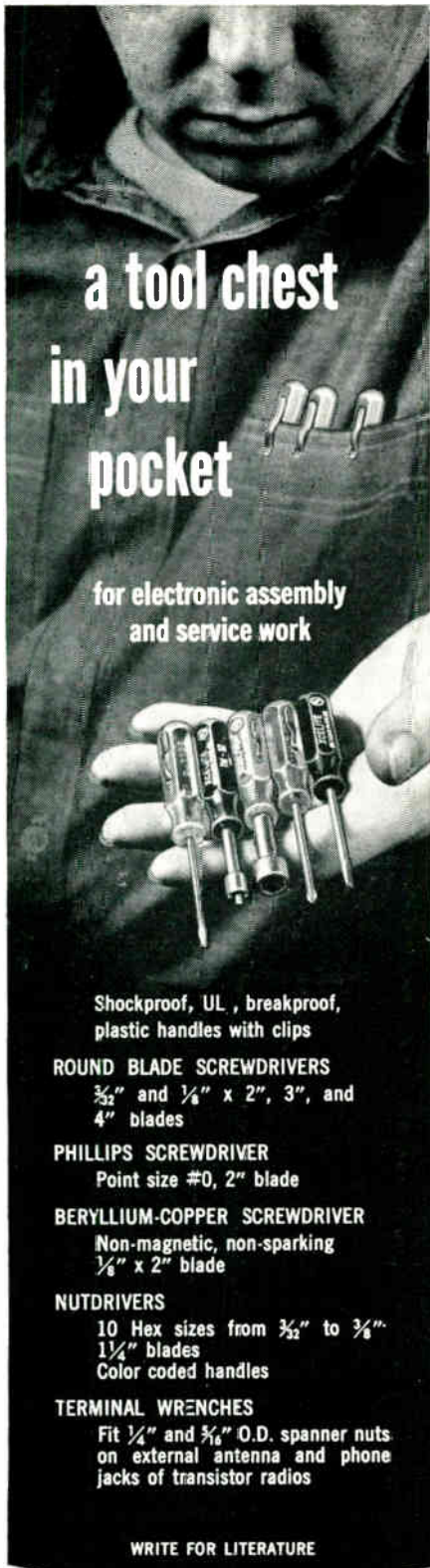
CABLE ON A DIET KIT



## TIMES WIRE AND CABLE

Division of The International Silver Company  
 Wallingford, Connecticut

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a tool chest  
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Shockproof, UL, breakproof,  
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$\frac{3}{32}$ " and  $\frac{1}{8}$ " x 2", 3", and  
4" blades

**PHILLIPS SCREWDRIVER**

Point size #0, 2" blade

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Non-magnetic, non-sparking  
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**NUTDRIVERS**

10 Hex sizes from  $\frac{3}{32}$ " to  $\frac{3}{8}$ "  
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Fit  $\frac{1}{4}$ " and  $\frac{3}{8}$ " O.D. spanner nuts  
on external antenna and phone  
jacks of transistor radios

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**PROFESSIONAL  
POCKET TOOLS**

XCELITE, INC., 28 Bank St., Orchard Park, N. Y.

Canada: Charles W. Pointon, Ltd., Toronto, Ont.

Circle 185 on Inquiry Card

# NEW TECH DATA

## Hi-Temp. Furnaces

Bulletin KSK 63 describes 16 standard models of kilns and furnaces using Kanthal-Super heating elements. Uses include ceramic, diffusion, glass melting, atomic research, metallurgical, crystal growing and chemical synthesis. A variety of atmospheres from oxidizing to reducing can be used. W. P. Keith Co., Inc., 8305 Loch Lomond Dr., Pico Rivera, Calif.

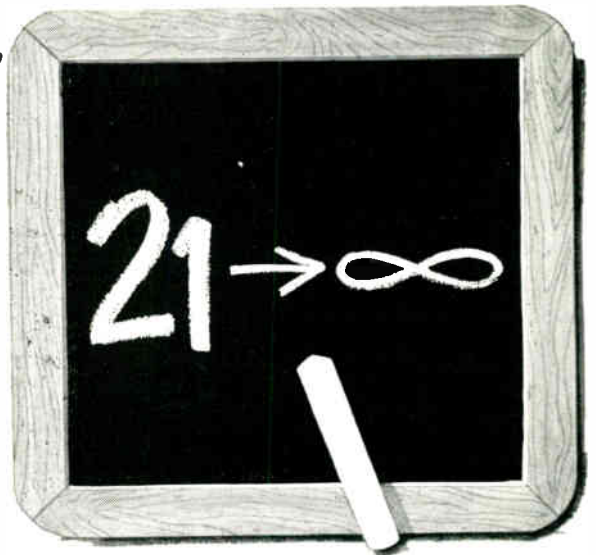
Circle 584 on Inquiry Card

## Cleanroom Hand Coverings

Bulletin A-4 describes complete line of white-room hand coverings. These encompass latest fabrics and styles used in white-room assembly and production. Bulletin describes nylon gloves, disposable gloves, PVC gloves, finger cots and other accessories inherent to the "tight-tolerance" manufacturing specs. to give complete contamination protection. Techni-Tool, Inc., 1216 Arch St., Phila. 7, Pa.

Circle 585 on Inquiry Card

*A Practical  
Lesson in  
P.W. Board  
math--*



**OR  
PUTTING  
THESE  
SYMBOLS**

**INTO WORDS:** Only 21 sizes of United Standard Electronic Eyelets will handle an almost infinite range of your single-side and double-sided PW board eyeletting needs! As a result, you'll save engineering and specifying time and costs, simplify your purchasing procedures and reduce your inventories. Fewer sizes of setting tools will be needed, so you'll reduce tool costs too.



FOR COMPLETE INFORMATION on United Standard Electronic Eyelets (and Eyeletting Machines), ask today for your copy of Bulletin E-107—and for full details on the new Standard Electronic Eyelet Selection Kit, which contains generous samples of all 21 sizes. Phone the United Office in your area... or write direct to Fastener Division, United Shoe Machinery Corp. 1658 River Road, Shelton, Connecticut

## United Eyelets

FASTENER DIVISION

United Shoe Machinery Corporation  
SHELTON, CONNECTICUT

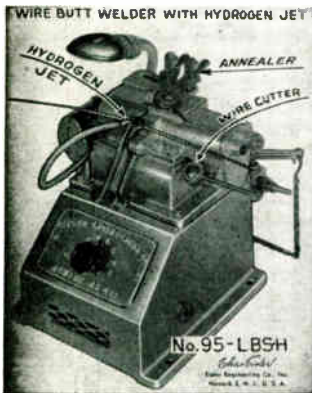
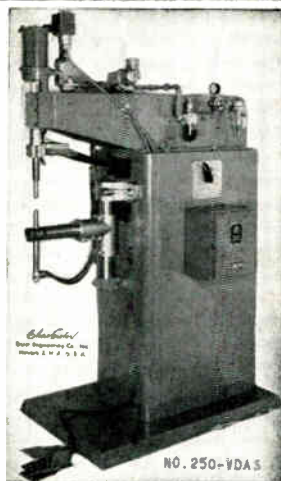


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Circle 186 on Inquiry Card



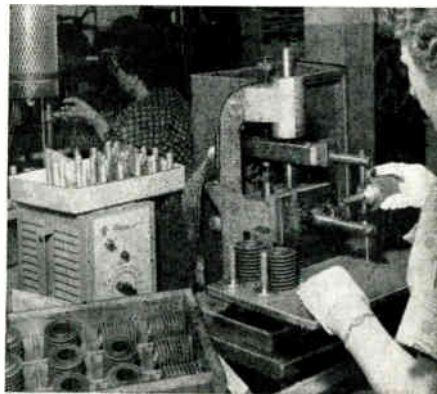
**EISLER** manufactures a complete line of resistance butt welders, band saw welders, spot welders, soldering & brazing machines, bench or pedestal type, foot or air operated . . .



We also carry in stock welding tips, holders and other welding accessories.

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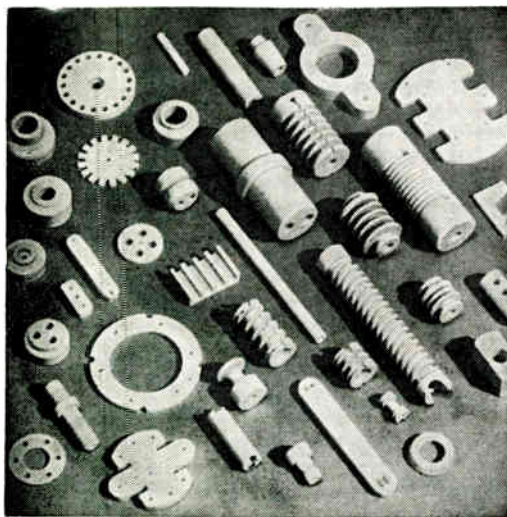
Write for full details



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**steatite, alumina,  
ceramic & lava  
insulators**



**for  
electrical  
and  
electronic  
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Custom-molded, extruded or machined to close tolerances to meet your exact specifications. Prompt delivery at low cost on large or small orders. Over half a century of service is your guarantee of complete satisfaction.

**FIND OUT TODAY.** Illustrated bulletin with complete technical data will be sent on request.

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## NEW TECH DATA

### Moldings Guide

Brochure No. 1018 describes the design advantages of automatically molded, small-precision thermoplastic parts. A special section describes and illustrates several case histories in which value analysis and value engineering were used to improve product performance while reducing costs. It contains an up-to-date comparison chart giving significant characteristics of important engineering thermoplastics: nylon, acetal, polycarbonate, ABS, fluorocarbon, polypropylene, and polyethylene. Gries Reproducer Corp., New Rochelle, N.Y.

Circle 586 on Inquiry Card

### Titanium Manual

This comprehensive manual summarizes the physical and mechanical properties of the 20 titanium metal grades in commercial production. It illustrates the typical strengths of titanium from cryogenic temps. to temps. up to 1000°F. Also included for each grade are annealing times and temps. and tips on fabrication. Titanium Metals Corp. of America, 233 Broadway, New York 7, N. Y.

Circle 587 on Inquiry Card

### Resilient Material

Data sheet #3641 introduces Elasticone, a helically wound flat ribbon of resilient material formed into a hollow, truncated cone. It can be used for a wide range of OEM or replacement uses, including heat shields, collapsible antennas, electrical contacts, constant rate lift devices, collapsible covers to protect precision components, etc. Central Safe Equipment Co., Elasticone Div., 6601 Marsden St., Philadelphia 35, Pa.

Circle 588 on Inquiry Card

### Permalloys

The Advanced Materials Div. of Materials Research Corp., Orangeburg, N.Y., is now producing pure permalloys by means of electron-beam refining techniques. These alloys are currently used in the communications field where their magnetic properties permit more rapid transmission and detection of small signals. The pure permalloy rods can be fabricated into wire, sheet, ribbon and foil in quantities to meet the needs of research or production.

Circle 589 on Inquiry Card

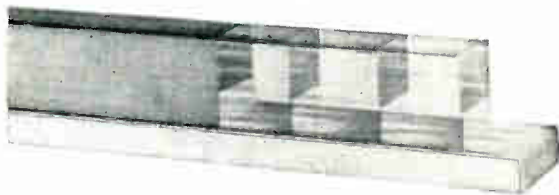
### Coaxial Cable

Complete engineering data on Foamflex coaxial cable is detailed in a new 36-page bulletin. Uses, electrical and mechanical characteristics, attenuation and power rating performance curves are included. Foamflex is a semi-flexible, air dielectric coax. cable available in 5 impedances and 7 diameters. Bulletin FF-3. Phelps Dodge Electronic Products Corp., 60 Dodge Ave., North Haven, Conn.

Circle 590 on Inquiry Card



# SLIDING SURFACES MOVE MORE FREELY ON FLUOROLIN\* TAPE



**SLIPPERY ON THE FRONT (it's Teflon®)**  
**STICKY ON THE BACK (it's pressure-sensitive)**

Wherever moving parts must slide with the lowest possible friction—product components, production lines, feed chutes, sliding chassis assemblies—there's a Joclin Fluorolin Teflon Tape to make the sliding easier... No complex mechanisms or lubrication needed—and it's less expensive.

These rugged pressure-sensitive tapes install in seconds and are available in a wide range of widths and types for any application. Resistant to fuel and chemical action, they stick fast from -100 to +500 F.

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SINCE 1931  
 EXTRUDERS  
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ACE is one of America's leading suppliers of precision plastic parts for thousands of different uses. Any shape, form or color. Any type of plastic. Small runs or large runs. Many items in stock. Quick, low-cost service on specials. Ace also supplies a huge variety of plastic extrusions and seamless balls. Write, wire or call for samples, prices and technical bulletins.

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**VARFIL**  
 Sleeving and Tubing...

*and get those 5 BIG Advantages*

- HIGHER DIELECTRIC RETENTION
- GREATER FLEXIBILITY
- MORE HEAT RESISTANCE
- AVAILABLE IN COILS
- CAN BE AFTER-TREATED

Even under the most severe operating conditions, Varfil Sleeving and Tubing retains its average dielectric strength. Twist it, tie it, bend it, wrap it, knot it. Remains just as pliable as when you started. Won't crack, peel or suffer dielectric loss. Heat Varfil 2000 hours at 110° C.—1,000 hours at 125° C.—and even for extensive periods at 150° C. It won't break down. Can be after-treated in baking and varnishing operations. Reacts better than other oleoresinous materials and synthetic coated tubings. Available in handy coils so you can cut the exact lengths you need... no waste. Standard colors. Wide range of sizes. Exceeds or meets all A.S.T.M. specifications.

AVAILABLE IN FOLLOWING NEMA CLASSES

- CLASS B-A-1 7000 VOLTS AVERAGE
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 Makers of Electrical Insulating Tubing and Sleeving

SEND TODAY FOR FREE SAMPLE FOLDER

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ELECTRONIC INDUSTRIES • June 1963

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# NEW

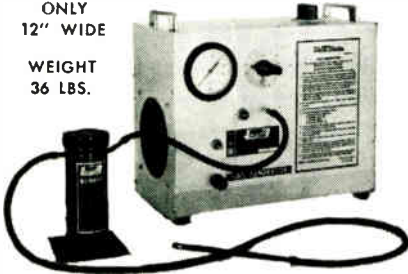
MODEL "V"

## Water Welder\*

WITH VARIABLE  
VOLTAGE DIAL AND  
GAS PRESSURE GAGE

ONLY  
12" WIDE

WEIGHT  
36 LBS.



### DIAL THE FLAME SIZE YOU WANT

The new model "V" Water Welder is our second oxy-hydrogen gas generator with self-contained power supply and electrolytic reactor. It operates with distilled water as its primary fuel, but with 100% increased capacity it handles a wider range of metal working operations. And it meets more miniature and sub-miniature electronic requirements of space age technology. It will even butt-weld exotic metal wires as fine as three ten-thousandths diameter up to 1/10 inch diameter. For welding, annealing, brazing, glass polishing, and silver soldering its performance is unequalled when correctly operated. Also welds stainless steel in the 300-400 series and other nickel base alloys. Produces temperatures over 6000°F where needed. Plugs into any 110-120 V.A.C. outlet. Uses only one oz. distilled water per hour. Operating cost only a few cents a day. Write for bulletin V-1 giving complete specifications and technical information.

Write for Bulletin V-1

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Electronics Division

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Phoenix 34, Arizona

Canadian Dist:

Canadian Curtiss-Wright Ltd., Toronto

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Circle 193 on Inquiry Card

## NEW TECH DATA

### Flexible Resin

Data is available on Isochemrez 407, a new unusual flexible resin that acts as a diluent and a flexibilizer. Non-shrinking, it brings lower viscosity to most epoxy systems, will not get spongy under heat, can be used in formulations of bisphenol epoxy-peracetic and novalacs to improve the formulations without degradation. Works with all epoxy hardners. Isochem Resins Co., 221 Oak St., Providence 9, R.I.

Circle 634 on Inquiry Card

### Plastics Bulletin

New uses of ABS plastics in the field of communications are reviewed in this new product news bulletin. Products reported range from miniature microphones for space uses to magnetic memory devices for busy executives. Other new developments include the latest in portable 2-way radios, 2 slide-projector designs, and an electronic camera that takes the guesswork out of photography. Marbon Chemical Div., P. O. Box 68, Washington, W. Va.

Circle 635 on Inquiry Card

### Material Fabrication

A brochure describing facilities for hard material fabrication, sapphire, quartz, spinel, stearite, zircon, alumina, has been published by INSACO Inc., Box 422, Quakertown, Pa. The brochure shows INSACO's capabilities, ranging from the simple modification of prototypes to volume production of precision parts. Uses shown include sapphire windows, lenses, bearings, needle valves and insulators; complex ceramic orifice plates, support discs and helix support rods.

Circle 636 on Inquiry Card

### SPE Transistors

A new line of Silicon-Planar Epitaxial Transistors includes military types, high-voltage amplifiers, small signal and low-level amplifiers, general-purpose amplifiers and switches, high-speed saturating switches, UHF and VHF amplifiers, low-level choppers and industrial types. Ampere Electronic Corp., Semiconductor & Receiving Tube Div., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 637 on Inquiry Card

### Panels and Indicators

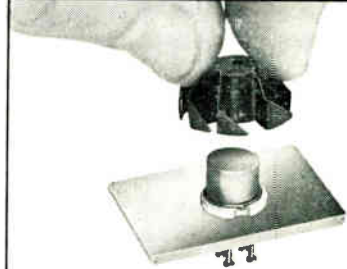
This brochure describes edge-lighted panels, indicators, dials and knobs. Panels and indicators meet or exceed Mil Specs. P-7788B, L-25467 and L-25050. Panels shown are typical of the types that can be obtained. Their simplicity makes extensive modification or design changes easy. Panels are for standard airborne equipment. Felsenthal Instruments Co., 7450 Wilson Ave., Chicago 31, Ill.

Circle 638 on Inquiry Card

# AUGAT

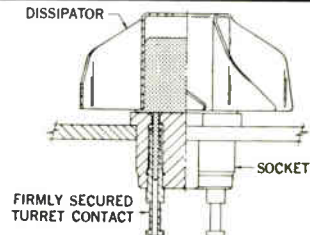
## HEAT DISSIPATOR SOCKET ASSEMBLIES

A COMPLETE  
MOUNTING PACKAGE



Augat makes it possible to buy socket assemblies with mating heat dissipators and Teflon sockets from one dependable source.

HERE'S WHAT YOU GET . . .



OR SEPARATE UNITS  
AS YOU NEED THEM!



Series 9017, 9018 Heat Dissipators

Series 8058 Sockets for  
T0-5 (3 pin) or T0-12 (4  
pin) Transistors



Series 8060 Sockets for T0-18 (3  
pin) Transistors

Sockets are manufactured for "Push-Fit" metal chassis or printed circuit dip solder mounting. "Push-Fit" Sockets are also available for T-3 sub-miniature tubes.

WRITE FOR THE  
COMPLETE STORY

Data Sheet No. 263 describes this mounting package in detail. Write for a copy today.

## AUGAT INC.

39 Perry Avenue, Attleboro, Mass.

†DuPont trademark

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ELECTRONIC INDUSTRIES • June 1963



# the aristo TRANS-LUMINATOR

Replaces Carbon Arcs for Finer Reproduction

- COOL—film cannot warp or shrink.
- EVEN—light is uniform across entire diffusion surface.
- FAST—(White) Approximately equal to two 35 Amp arcs. (Blue) Two times faster.
- QUALITY—tone reproduced exactly as on original.
- CLEAN—No dust, no fumes.
- ECONOMICAL—No carbon costs, use approximately 10% of present power consumption.



and now . . . The Trans-Luminator Features Two New Sources from Aristo For Exposing High Resolution Plates & KPR-KMER

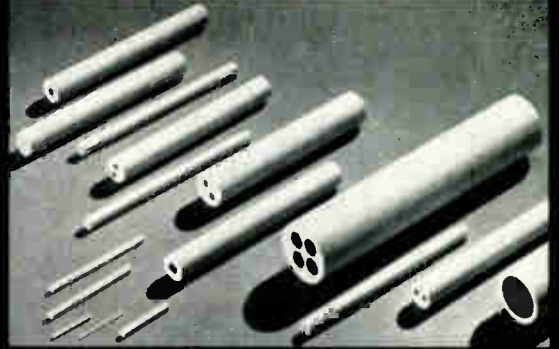
**Aristo FYG-54**—for exposing high resolution plates is a narrow band source peaking at 548mu. This unit gives greater precision and dimensional stability in producing micro photographs and is superior to either conventional or improved sources in speed, accuracy, uniformity, coolness, cleanliness & economy.

**Aristo-B-3642**—for exposing KPR-KMER peaks at 365mu and 420mu matching the sensitivity response of this material. This new lamp provides faster, cooler, cleaner reproductions of printed circuits and micro-miniature circuits. It is from 3 to 15 times faster than conventional sources and consumes only a fraction of their power. For further information write:

ARISTO GRID LAMP PRODUCTS INC.  
65 Harbor Rd., Port Washington No., L.I., N.Y.

Circle 195 on Inquiry Card

# What's the Shape of your High Temp or THERMOCOUPLE TUBING?



STANDARD thermocouple insulators are made from cordierite for use where temperatures do not exceed 2400F. Made in round or oval shape, single hole or multi-bore, to lengths as specified. Many standard sizes are in stock for immediate shipment.

SWAGEABLE thermocouple tubing, extruded from high-purity alumina or magnesia, withstands temperatures as high as 3500F. Materials crush easily to uniform densities. Available in single hole or multi-bore shapes with I.D. sizes from .006".

HIGH TEMPERATURE tubing is made from high alumina compositions, single hole or multi-bore, open or closed ends, in lengths to 60" for temperatures up to 3200F.

Special shapes quoted. Include drawing and quantity, please.

Write on your letterhead for literature and samples.

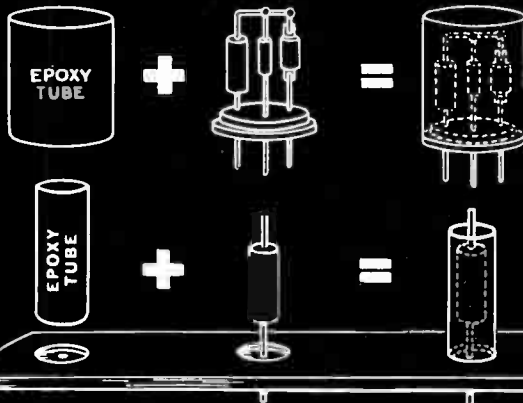


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Resistors • Capacitors • Delay Lines • Molded Coils • Plug-in Components • Transformers • Computer Units • Bushings & Spacers

FIFTY SIZES BETWEEN .143" AND 2.000" O.D.  
ANY WALL THICKNESS .015" AND HEAVIER  
LENGTH 57" OR PRECISION CUT TO SIZE  
AVAILABLE IN COLORS AND COMPOUNDS  
LARGER O.D. SIZES AVAILABLE

## RESDEL CORPORATION

BOX 21 • RIO GRANDE, NEW JERSEY • 609-522-5643

Circle 197 on Inquiry Card

ELECTRONIC INDUSTRIES • June 1963

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7 SIZES  
1/8" TO 1/2"  
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NEW LOW COST

... much less than other types!

STRONG—toughest plastic clamp made . . . high tensile strength. Tougher 'n' 'ell!

MOLDED to uniform size and shape, smooth edges.

DURABLE—for outdoor or indoor use. Excellent dielectric properties. Resist solvent, grease, oil, etc.

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HOLUB INDUSTRIES, Inc.

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Circle 198 on Inquiry Card

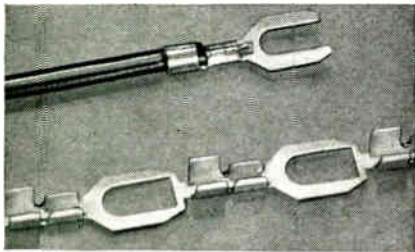
G61



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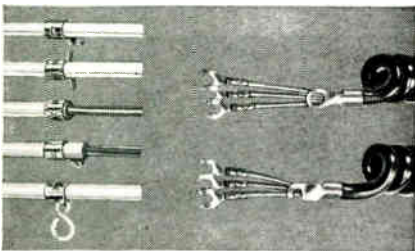
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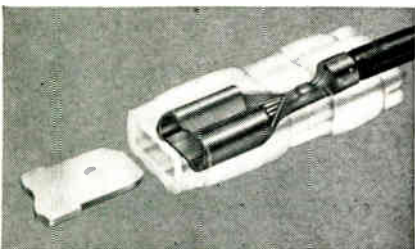
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G62 Circle 199 on Inquiry Card

## NEW TECH DATA

for Engineers.

### Transparent Epoxy

A new, transparent epoxy system with a 7-hr. pot life may be used, unfilled, at temps. of 400°F. The product, Folenco 65, has a dielectric strength of 700v./mil. and a heat distortion point of 300°F. It fills applications for most electronic embeddings and as a structural adhesive for steel, aluminum and copper. Supplied as a 2-component, low viscosity system, Folenco 65 cures in 2 hrs. at 175°F. Foltin Engineering Co., Box 6086, Long Island City 6, N. Y.

Circle 643 on Inquiry Card

### Insulated Cable

Information is available on new pre-conduitized insulated cable. Called Precon, it consists of insulated conductors factory-installed in a flexible, high-density black polyethylene pipe. The product is available in 1, 1¼, 1½, and 2-in. standard pipe sizes. A variety of sizes and types of insulated cable can be installed in the pipe. Reynolds Metals Co., Richmond, Va.

Circle 644 on Inquiry Card

### Fluorocarbon Products

This brochure describes fluorocarbon products and facilities. It outlines the TFE products for electrical, electronic, chemical and mechanical uses, including stock moldings and extrusions, custom machined and molded parts, O-rings, and chemical processing components. Chicago Gasket Co., 1271 W. North Ave., Chicago 22, Ill.

Circle 645 on Inquiry Card

### Defense Capabilities Brochure

A new facilities brochure describes the defense-oriented organization and capability of Philco's Communications and Electronics Div. Brochure covers Government contract work done by Philco and the wide area of defense work in which it is interested. Division has the combined abilities of 2 former operating divisions to provide optimum integration of defense system management. Communications and Electronics Div., Philco Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa.

Circle 646 on Inquiry Card

### Flexible Couplings

A new fact file on Lord Elastomeric Flexible Couplings, Bulletin No. 206, has just been released. Lord provides flexible couplings in both standard and custom designs to handle capacity requirements from in.-oz. to ft.-tons. Elastomeric flexible couplings have no moving parts and no metal-to-metal contact. Lord Mfg. Co., Erie, Pa.

Circle 647 on Inquiry Card

### Gas-Fired Ovens

New 6-page illustrated brochure, Bulletin GOF, gives data on more than 20 standard sizes of ovens. It gives BTU input, inside and outside dimensions, weight and fan motor horsepower for each size. Also given are standard specs., features including optional items, and information on how to select ovens. Trent, Inc., 201 Leverington Ave., Phila. 27, Pa.

Circle 648 on Inquiry Card

### Crystal Oscillators

Two new data sheets on voltage-controlled crystal oscillators are available from Damon Engineering, Inc., 240 Highland Ave., Needham Heights 94, Mass. The first covers a miniaturized VCXO. Model 5114WA, whose freq. can be varied linearly by applying an external dc or ac modulating signal. This data sheet includes a technical description, photo, information on uses, and specs. The second data sheet is a selection guide detailing specs. on a wide variety of VCXOs which can be supplied for individual needs. Standard, multiplier, mixer, and multiplier and mixer types are listed.

Circle 649 on Inquiry Card

### Conductive Paint

Information is available on a temporary silver conductive paint which is useful where a temporary common conductive path is needed for the precious metal plating of "fingers" on a printed circuit board. The silver paint is applied with an artist's or draftsman's pen, air dried, and can later be removed, when necessary, by wiping with xylene. Etchomatic, Inc., P. O. Box 444, Waltham, Mass.

Circle 650 on Inquiry Card

### Bracket Nut

Bulletin 2606 describes a new miniature right-angle bracket nut. Made of heat-treated carbon steel or corrosion-resistant steel, nut was developed for uses where mounting surfaces are parallel to the screw application and limited mounting areas. Kaylock Div., Kaynar Mfg. Co., Inc., Box 3001, Fullerton, Calif.

Circle 651 on Inquiry Card

### Heat-Shrinkable Tubing

This catalog describes a new line of heat-shrinkable tubing products. The tubing is supplied in black, white or transparent irradiated polyolefin, having an expanded dia. to fit easily over the part to be covered. The product is useful for insulating terminals and pigtailed, jacketing wires to form cables, for providing identifying markers, shockproofing tool handles, and leakproofing hydraulic fittings and plumbing. Surprenant Mfg. Co., Clinton, Mass.

Circle 652 on Inquiry Card

# SECTION H

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## MILITARY ELECTRONICS & SPACE SYSTEMS

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### Part One—Military

Military Procurement Directory H2

Government Contract Awards H8

This is an up-to date listing  
of key Air Force,  
Navy and Army procurement  
and other personnel,  
indicating the organizational  
placement of these men,  
many of whom are concerned  
with electronic procurement.

# 1963 MILITARY ELECTRONIC PROCUREMENT DIRECTORY

## U. S. DEPARTMENT OF DEFENSE

The Pentagon Wash 25 DC  
Phone Liberty 5-6700 or dial OX and the extension

|   |       |
|---|-------|
| SECTY OF DEFENSE Hon R S McNamara       | 55261 |
| DEP SECTY OF DEFENSE Hon R L Gilpatric  | 56352 |
| DIR OF DEFENSE RES & ENG Hon H Brown    | 79111 |
| Dir of Electronics J M Bridges          | 57245 |
| ASST SECTY INSTALLATION & LOGISTICS     |       |
| Hon T D Morris                          | 55254 |
| DEP ASST SECTY FOR PROCUREMENT          |       |
| G C Bannerman                           | 78177 |
| Dir of Procurement Management R D Lyons | 56705 |
| Dir of Small Business Policy R W Webb   | 76907 |
| Central Mil Procurement Info Office     | 71481 |
| Dir of Quality Control & Reliability    |       |
| J J Riordan                             | 79263 |

### JOINT CHIEFS OF STAFF

**CHAIRMAN JOINT CHIEFS OF STAFF**  
Gen M D Taylor 79121  
**DIR J-4 LOGISTICS** Maj Gen D F Callahan 52732  
**DIR J-6 COMMUNICATIONS-ELECTRONICS**  
Brig Gen J A McDavid 71998  
Electronics Systems Div Col D S Woods 73029

### DEFENSE SUPPLY AGENCY

Camden Station Alexandria Va  
**DIRECTOR** Lt Gen A T McNamara 8111  
**Exec DIRECTORATE Procurement & Production**  
RADM C A Blick 57951  
Small Business Advisor J F Ross 54758  
Procurement Div Capt J E Harvey Jr 78516

### DEFENSE ELECTRONICS SUPPLY CENTER

1507 Wilmington Pike Dayton 20 Ohio  
Responsibility: Procuring, managing, storing & supplying electrical & electronic materiel used by Army, Navy, Air Force & Marine Corps  
**COMMANDER** Brig Gen W W Veal  
**DEP COMMANDER** Capt R H Northwood  
**DIR OF MATERIEL MANAGEMENT**  
Col R G Kettleson  
**DIR OF PROCUREMENT & PRODUCTION**  
Col K N Smith  
Contract Div C V Evans Chief  
Purchase Div R N Bodda Chief

## U. S. ARMY

### DEPT. OF THE ARMY

The Pentagon Wash 25 D C  
Phone Liberty 5-6700 or dial OX and desired extension

|   |       |
|---|-------|
| SECTY OF THE ARMY Hon C R Vance         | 53211 |
| ASST SECTY for Installation & Logistics |       |
| Hon P R Ignatius                        | 52254 |
| Dir of Procurement                      |       |
| Maj Gen J A Richardson III              | 52647 |
| ASST SECTY for Res & Dev Hon F J Larsen | 56153 |

### ARMY MATERIEL COMMAND HEAD- QUARTERS U S

Tempo T-7 Gravelly Point Va  
Wash 25 D C  
Phone Liberty 5-6700 or dial OX and the desired extension  
**COMMANDING GENERAL**  
Lt Gen F S Besson Jr 59154  
**DEP COMMANDING GENERAL**  
Maj Gen W J Ely 59006  
**Program & Materiel Mangmt Div**  
Col F H Cantrell 72069  
**Communications/Elect Branch**  
J N Montgomery 52465  
**DIR OF PROCUREMENT & PRODUCTION**  
Brig Gen E J Gibson 54471  
**Missiles & Electronics Div** Col P A Nilsson 68382  
**Electronics Branch** C H Butler 68292  
**Missiles Branch** F A Lutze 68385  
**DIR OF RESEARCH & DEV**  
Maj Gen F H Britton 74728

**PROCUREMENT & PROD DIV** W M Livingston  
CINCINNATI OHIO 230 E 9th St Cincinnati 2  
Phone DUnbar 1-2200  
**COMMANDING OFFICER** Col J E McKinney  
Small Business G Wilson  
CLEVELAND O 1367 E 6th St Cleveland 14  
Phone Tower 1-4690  
**COMMANDING OFFICER** Col R M McMahon  
Small Business C A Newell  
DETROIT MICH 1580 E Grand Blvd Detroit 1  
Phone WALnut 3-0100  
**COMMANDING OFFICER** Col W E Besse  
Small Business C M Kaltwasser  
LOS ANGELES CALIF Pasadena Calif 55 S Grand Ave  
Phone SYcamore 6-0471  
**COMMANDING OFFICER** Col B R Painter  
NEW YORK N Y 770 Broadway New York 3  
Phone OREGon 7-3030  
**COMMANDING OFFICER** Col J W Graham  
**CONTRACTOR & INDUSTRIAL RELATIONS OFF**  
S Malsei  
Small Business T M Everett  
PHILADELPHIA PA 128 N Broad St Phila 2  
Phone LOcust 8-0400  
**COMMANDING OFFICER** Col F A Bogart  
Small Purchase Branch J J Smith  
Res & Dev Branch W P Lehman  
Small Business A B Feldman  
SAN FRANCISCO CALIF 1515 Clay St Oakland 12  
Calif  
Phone TEMplebar 4-4121  
**COMMANDING OFFICER** Col J E Johnson  
Small Business F M Mayfield  
SACRAMENTO ARMY DEPOT Sacramento 1 Calif  
Phone Gladstone 6-7841  
**COMMANDING OFFICER** Col L Tamamian  
Small Business Mrs B J Bacsik  
**SIXTH ARMY PURCHASING & CONTRACTING**  
OFFICE Ft Lawton Wash  
Phone ATwater 2-0100  
**CONTRACTING OFFICER** A Radinski

NOTE: To obtain the address and telephone number of local Small Business offices throughout the U.S. see "DEPARTMENT OF DEFENSE SMALL BUSINESS SPECIALISTS" Government Printing Office 0-658747. Price 25 cents.

### HARRY DIAMOND FUZE LAB

Conn Ave at Van Ness St NW Wash 25 D C  
Phone EMerson 2-8000  
**COMMANDER** Lt Col R W McEvoy  
**PROCUREMENT** F T Rainer  
Small Business J R Amato

### FRANKFORD ARSENAL

Bridge and Tacony Sts  
Philadelphia 37 Pa  
Phone JEFerson 5-2900  
**COMM OFF**  
Col George H Pierre Jr X3100/5200  
**DEP CO**  
Col R E Le Roy X6115/6215  
**CIV ADM**  
T C Kempin X4201/4205  
**PROC DIV**  
H J Krusch X4101  
**RESEARCH & DEVELOPMENT GRP**  
C C Fawcett X3101/5140  
**PROCUREMENT & PRODUCTION GRP**  
Col E A Benser X3225/21121  
**SUPPLY & MAINTENANCE GRP**  
Lt Col D H Johnson X4216  
**NATL MISSION IND GRP**  
Deputy D W Hood X22116  
**SMALL BUSINESS SPECLST**  
W Travis Jr X7220

### PROCUREMENT DISTRICTS

**BIRMINGHAM ALA** 2120 N 7th Ave  
Phone FAirfax 3-8011  
**COMMANDING OFFICER** Col R B Sell  
Small Business W B Mathews  
**BOSTON MASS** Boston Army Base Boston 10  
Phone LIBerty 2-6000  
**COMMANDING OFFICER** Col M L Driscoll  
Small Business W A Thorpe  
**CHICAGO ILL** 623 S Wabash Ave Chicago 5  
Phone WE 9-6000  
**COMMANDING OFFICER** Col T W Davils III

### FORT MONMOUTH PROCUREMENT OFFICE, USAEMA

Fort Monmouth New Jersey  
Phone 532-9000  
**MISSION:** The Fort Monmouth Procurement Office procures Research and Development effort for the U. S. Army in the fields of: Ground, Air and Space Communications for Tactical and Strategic Use; Electronic Systems for Air Defense, Air and Space Navigation Surveillance and Detection; Electronic Computers, Photography, Acoustics, Meteorology, and basic and applied research in all fields of science.  
**Commanding Officer** Col D W Langhan 51115  
**Executive Officer** Maj W H Lytle 52049

**Dir Procurement Operations**  
Lt Col W Taliaferro 51602  
**Asst Director Procurement Operations**  
Mr W E Theysohn 51964  
**Chief Management Office** Captain M B Wier 52954  
**Procurement Specialist Group** Mr F J Corio 52244  
**Industrial Security Office** Mr R T Brower 52754  
**Legal Office** Mr J P Hintelmann 51828  
**Business Analysis Office** Mr K Napier 51549  
**Small Business & Industrial Relations Office**  
Mr C Hoyt 51729



# MILITARY PROCUREMENT OFFICES

## WASHINGTON PROCUREMENT OFFICE

Main Navy Munitions Building  
Room 2604  
Washington 25 D C  
Phone Liberty 5-6700

MISSION: As a special mission procurement activity, this office serves agencies located at the seat of government. It does not place production contracts or contracts involving items of military specification. It primarily buys standard commercial communications equipment and materials, installations of fixed-plant communications equipment, and leases equipment.

|  |       |
|--|-------|
| Commanding Officer Major H A Scheibler | 67802 |
| Contract Division "A"                  |       |
| Chief Miss S Thomas                    | 67197 |
| Contract Specialist D Akers            | 65254 |
| Contract Specialist 1/Lt A Stacy       | 67197 |
| Contract Specialist 2/Lt T Dungan      | 65264 |
| Contract Division "B"                  |       |
| Chief R. Kihm                          | 67634 |
| Contract Specialist Mrs J Hensley      | 64044 |
| Contract Specialist C Cummings         | 67634 |
| Contract Specialist F Knight           | 64044 |
| Technical Services Office              |       |
| Attorney E Piggott                     | 67634 |
| Price Analyst E Jensen                 | 67634 |

## U. S. ARMY ELECTRONICS MATERIEL AGENCY (USAEMA)

Headquarters  
225 S 18th Street  
Philadelphia 3 Pa  
Phone Kingsley 6-3200

MISSION: Supply the equipments, maintenance tools and parts required to support the electronics systems of the Army and such federal and foreign establishments as authorized; exercise worldwide and centralized supply control over electronics equipment and maintenance parts; procure materiel and services required for the electronics portion of the Army Supply System; assure that electronics items delivered by contractors meet specified quality standards; plan for maintenance of a production base which will assure an adequate supply of electronics materiel in the event of mobilization.

|  |           |
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| Commanding General                       | Extension |
| Brig Gen Allen T Stanwix-Hay             | 8000      |
| Deputy Commander                         |           |
| Colonel James E Foster                   | 8001      |
| Chief of Staff                           |           |
| Colonel J D Nutt                         | 8002      |
| Small Business and Labor Surplus Advisor |           |
| E J O'Neill                              | 749       |
| Dir, Industrial Preparedness             |           |
| L A Kapust                               | 300       |
| Dir, Materiel Readiness                  |           |
| J G Melvin                               | 200       |
| Chief, Office of Integrated Data Systems |           |
| J Bergman                                | 231       |
| Dir, Quality Assurance                   |           |
| Col F J Coffey                           | 600       |
| Dir, Procurement                         |           |
| S. Rabinowitz                            | 500       |
| Asst Dir, Procurement                    |           |
| A M Schuster                             | 501       |
| Asst Dir, Procurement (Contr)            |           |
| N Creeger                                | 8372      |
| PROCUREMENT MANAGEMENT DIVISION "A"      |           |
| Chief A R Testa                          | 8177      |

## FORT HUACHUCA PROCUREMENT OFFICE, USAEMA

Building 41421

Fort Huachuca Arizona

Phone Gladstone 8-3311

MISSION: Places and administers special equipment contracts and contracts for services and studies as required for performance of the mission assigned to the U. S. Army Electronics Materiel Agency; purchases all equipment, supplies, materials and services and studies as required by the Fort Huachuca Procurement Office units, organizations and activities for which local purchase authority exists; serves in a staff advisory and staff office position in the procurement area as required by the Commanding General, USAERD in providing special procurement services.

|  |      |
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| Commanding Officer Lt Col A E Barnsbee | 3916 |
| Tech Dir V H Hollis                    | 2819 |

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|--|------|
| Procurement Specialist Group F Saunders    | 5938 |
| Legal Office Robert Roubal                 | 2231 |
| Management and Services Office Morris Hill | 2723 |
| Industrial Property Office C K Walker      | 4166 |
| Economics Office F B Laws                  | 5518 |
| Contracts Division Chief Maj C E Crabill   | 2817 |
| Asst V A Suarez                            | 5117 |
| Purchase Branch "A" R Angell               | 5838 |
| Purchase Branch "B" Reed Sevy              | 3131 |
| Purchase Branch "C" Rose Brock             | 4117 |
| Purchase Branch "D" Matt Werth             | 4115 |
| Purchase Branch "E" John Kelly             | 2816 |
| Purchase Branch "F" Maj F W White Jr       | 4128 |
| Small Business & Labor Surplus Advisor     |      |
| J Horstman                                 | 2712 |
| Procurement Engineer W V Record            | 3237 |

## U S ARMY ELECTRONICS COMMAND

Fort Monmouth New Jersey

Phone: 532-9000

|  |       |
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| Commanding General Maj Gen Stuart S Hoff | 23000 |
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| Aide de Camp Capt H E Shelton | 22053 |
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| Deputy Commanding General |  |
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| Brig Gen Walter E Lotz Jr. | 23214 |
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| Chief of Staff Col J E Gonseth Jr | 23700 |
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| Secretary of the Staff Lt Col J G Moses | 23800 |
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| AVIONICS AND NAVIGATION AIDS |  |
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| Commodity Office |  |
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| Chief Maj W W Hall | 52242 |
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| COMMUNICATIONS—ADP |  |
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| Commodity Office |  |
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| Chief Col G P Lerner | 51741 |
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| Deputy Chief Maj A B Evans | 51990 |
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| INTELLIGENCE MATERIEL |  |
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| Commodity Office |  |
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| Chief Lt Col A D Chiarella | 52429 |
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| Deputy Chief Maj H Hoffman | 52429 |
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| RAD—COMBAT SURVEILLANCE |  |
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| Commodity Office |  |
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| Chief Col J P McGovern | 52446 |
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| Deputy Chief Lt Col W W Rossman | 52446 |
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| Technical Director H Goldwag | 52446 |
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| PROJECT MANAGERS |  |
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| AN/USD 2 Col D P Gallagher | 51926 |
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| Lt Col J F Jenkins | 51255 |
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| AACOMS Col C P Reeves | 52853 |
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| Lt Col E D Vaughan | 52815 |
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| AN/VRC 12 AN/PRC 25 Col J H Schofield Jr | 52249 |
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| Lt Col E W Daniel Jr | 52820 |
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| CCIS 70 Lt Col A Q Smith Ft Huachuca | 831 1530 Ext 2718 |
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| Maj F W Giggey | 52119 |
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| PROC BR A-1-2 |  |
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| Radio, TV and related equipment |  |
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| Chief Lt Col G W Hudson | 8198 |
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| Asst J W Robinson | 8197 |
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| PROC BR A-3 |  |
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| Electrical measuring & testing equipment, relays, |  |
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| contacts, solenoids |  |
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| Chief Maj F Stone | 8179 |
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| Asst D Shuman | 678 |
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| PROCUREMENT MANAGEMENT DIVISION "B" |  |
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| Chief J H Schreeter | 409 |
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| PROC BR B-11 |  |
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| Electron tubes, transistors, crystals |  |
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| Chief L Karafin | 470 |
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| PROC BR B-12 |  |
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| Dry, storage & thermal batteries |  |
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| Chief R Miller | 468 |
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| PROC BR B-13-14 |  |
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| Meteorological & photographic equipment & supplies |  |
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| Chief Maj J H Rogers | 467 |
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| Asst Mrs M Regan | 466 |
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| SPECIAL PURCHASES BRANCH |  |
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| Purchases under \$2500, EDPO's |  |
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| Chief C J Harris |  |
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| TECH ASSISTANCE & SPEC PROD PROC BRANCH |  |
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| MWO's Tec Rep program |  |
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| RADA SYSTEM Col J B Corbly | 51550 |
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| Maj J J Hoffman | 51971 |
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| UNICOM/STARCOM Lt Col H F Foster Jr | 51930 |
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| Capt R B Craig | 52491 |
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| ELECTRONIC WARFARE—AIR DEFENSE |  |
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| Commodity Office |  |
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|                      |       |
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| Chief Capt R A Kraus | 51765 |
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| Research Commodity Office |  |
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| Chief Col R K Saxe | 51561 |
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| Deputy Chief Lt Col G D Dean | 52064 |
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| Technical Director A Cohen | 52064 |
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| Special Assistants |  |
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| Chief Engineer A W Rogers | 22901 |
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| Chief Scientist Dr H K Ziegler | 22748 |
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| For Supply John N Montgomery | 21248 |
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| DIRECTOR OF RESEARCH AND DEVELOPMENT |  |
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|                         |       |
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| Director Col B H Glover | 21619 |
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|                               |       |
|-------------------------------|-------|
| Technical Director R McKinley | 21634 |
|-------------------------------|-------|

|                                  |       |
|----------------------------------|-------|
| Programs Div Chief Maj A Wiegand | 22026 |
|----------------------------------|-------|

|                                       |       |
|---------------------------------------|-------|
| Operations Div Chief Maj B L Anderson | 21753 |
|---------------------------------------|-------|

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| Requirements Div Chief Maj W W Chandler | 22702 |
|---|-------|

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| DIRECTOR OF PROCUREMENT AND PRODUCTION |  |
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|                           |       |
|---------------------------|-------|
| Director Col C A Cuphaver | 22736 |
|---------------------------|-------|

|                               |       |
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| Technical Director A J Dalton | 21320 |
|-------------------------------|-------|

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| Procurement Management Div Chief |  |
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|                  |       |
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| Lt Col L C Welch | 22619 |
|------------------|-------|

|                |       |
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| Mrs M G Meikle | 22605 |
|----------------|-------|

|                                 |  |
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| PRODUCTION MANAGEMENT DIV Chief |  |
|---------------------------------|--|

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| Lt Col J T McKiernan | 22436 |
|----------------------|-------|

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| CONTRACTUAL MANAGEMENT DIV Chief |  |
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|            |       |
|------------|-------|
| I Liberman | 23234 |
|------------|-------|

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| QUALITY MANAGEMENT DIV Chief |  |
|------------------------------|--|

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|-----------|-------|
| H Steiner | 22949 |
|-----------|-------|

|                |     |
|----------------|-----|
| Chief C Maurer | 457 |
|----------------|-----|

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| PROCUREMENT MANAGEMENT DIVISION "C" |  |
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|                |      |
|----------------|------|
| Chief H Oakley | 8047 |
|----------------|------|

|                |      |
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| Asst W H White | 8049 |
|----------------|------|

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| PROC BR C 21-24 |  |
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|  |  |
|--|--|
| Telephone & telegraph equipment, wire cable & cord |  |
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|                    |  |
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| assemblies & reels |  |
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|                |     |
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| Chief H Walton | 758 |
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| PROC BR C 22-23-25 |  |
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| Teletype & facsimile equipment, engine & transmis- |  |
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|   |  |
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| sion equipment, mounting hardware, hand & measur- |  |
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|           |  |
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| ing tools |  |
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|                          |     |
|--------------------------|-----|
| Chief (acting) L Karafin | 480 |
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| MISSILE SYSTEMS PROCUREMENT BRANCH |  |
|------------------------------------|--|

|                |     |
|----------------|-----|
| Chief C Fravel | 739 |
|----------------|-----|

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| PEN & FAC PROCUREMENT BRANCH |  |
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|                      |      |
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| Chief Miss L Mizdall | 8059 |
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| Procurement Services Division Chief M Wexler | 452 |
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| Industry & Procurement Analysis Branch |  |
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|                  |     |
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| Chief E A Jolley | 488 |
|------------------|-----|

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| Contractual Program Coordination Branch |  |
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|               |      |
|---------------|------|
| Chief H Loose | 8340 |
|---------------|------|

|                                     |     |
|-------------------------------------|-----|
| Processing Branch Chief Mrs I Scott | 475 |
|-------------------------------------|-----|

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| Economics Div Headquarters Chief H E Moore | 368 |
|--|-----|

|                               |  |
|-------------------------------|--|
| Property & Administrative Div |  |
|-------------------------------|--|

|                  |      |
|------------------|------|
| Chief F J McDams | 8153 |
|------------------|------|

## U. S. AIR FORCE

|   |       |
|---|-------|
| SECTY OF THE AIR FORCE Hon E M Zuckert      | 77376 |
| UNDER SECTY OF THE AIR FORCE Hon B McMillan | 71361 |
| ASST SECTY (MATERIEL) Hon J S Imirie        | 78147 |
| CHIEF OF STAFF Gen C E LeMay                | 79225 |

## AIR FORCE SYSTEMS COM- MAND HEADQUARTERS

Andrews Air Force Base Md

Wash 25 D C

Phone 981-9111 or dial 981 and the extension

RESPONSIBILITY: For research, development, production and procurement required to place a complete aerospace system in operation

|                             |      |
|-----------------------------|------|
| COMMANDER Gen B A Schriever | 6209 |
|-----------------------------|------|

|                                    |      |
|------------------------------------|------|
| VICE COMMANDER Lt Gen H M Estes Jr | 3361 |
|------------------------------------|------|

|   |  |
|---|--|
| OEP CHIEF OF STAFF/PROCUREMENT & MATERIEL |  |
|---|--|

|                      |  |
|----------------------|--|
| Brig Gen G F Keeling |  |
|----------------------|--|

|                                 |      |
|---------------------------------|------|
| CONTRACT MANAGEMENT Maj G Arney | 3367 |
|---------------------------------|------|

|                          |  |
|--------------------------|--|
| Small Business J C Eiden |  |
|--------------------------|--|

## AIR FORCE SYSTEMS COMMAND

RESPONSIBLE: For planning, designing, procedure, installation, checkout and placing in operation Air Force command and control systems

|                                  |  |
|----------------------------------|--|
| COMMANDER Maj Gen C H Terhune Jr |  |
|----------------------------------|--|

|                                 |  |
|---------------------------------|--|
| PROCUREMENT & PRODUCTION OFFICE |  |
|---------------------------------|--|

|                        |  |
|------------------------|--|
| Col R A Scurlock Chief |  |
|------------------------|--|

## AERONAUTICAL SYSTEMS DIVISIONS

Wright-Patterson Air Force Base

Dayton O

Phone 253-7111

MISSION: To procure and manage Air Force aeronautical systems and certain air-to-air and air-to-ground missiles

|                             |  |
|-----------------------------|--|
| COMMANDER Maj Gen R G Ruegg |  |
|-----------------------------|--|

|                                  |  |
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| PROCUREMENT & PRODUCTION OFFICE  |  |
| Col H A Budd                     |  |
| DIRECTORATE OF R & D CONTRACTING |  |
| Col C W Pangborn                 |  |

## SPACE SYSTEMS DIV

Air Force Unit Postoffice

Los Angeles 45 Calif

Phone OR 0-1444

RESPONSIBILITY: For planning, program, procedure, developing and managing space projects and systems

|                            |  |
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| COMMANDER Maj Gen B I Funk |  |
|----------------------------|--|

|                                 |  |
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| PROCUREMENT & PRODUCTION OFFICE |  |
|---------------------------------|--|

|                |  |
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| Col P S Walker |  |
|----------------|--|

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| CONTRACT RELATIONS & SMALL BUSINESS |  |
|-------------------------------------|--|

|           |  |
|-----------|--|
| R Watkins |  |
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## HANSCOM COMPLEX

Laurence G Hanscom Field

Bedford Mass

Phone CRestview 4-6100

# MILITARY PROCUREMENT OFFICES

## AIR FORCE LOGISTICS COMMAND

Wright-Patterson Air Force Base  
Dayton O  
Phone 253-7111  
MISSION: To insure that Air Force combat units are equipped for instant action in any emergency  
COMMANDER Gen M E Bradley Jr  
DIR OF PROCUREMENT & PRODUCTION  
Maj Gen L W Fulton

## MIDDLETOWN AIR MATERIEL AREA

Olmstead Air Force Base  
Olmstead Pa  
Phone Whitney 4-5521  
COMMANDER Maj Gen F H Miller  
DIR OF PROCUREMENT & PRODUCTION  
Col N J Beaudrias

## MOBILE AIR MATERIEL AREA

Brookley Air Force Base  
S Washington Ave  
Mobile Ala  
Phone HEMlook 8-6011  
COMMANDER Maj Gen E B Cassidy  
DIR OF PROCUREMENT & PRODUCTION  
Col W H Harrell

## OKLAHOMA CITY AIR MATERIEL AREA

Tinker Air Force Base  
Oklahoma City Okla  
PErshing 2-7321  
COMMANDER Maj Gen L L Mundell  
DIR OF PROCUREMENT & PRODUCTION Col P J Kuhl

## ROME AIR MATERIEL AREA

Griffiss Air Force Base N Y  
Phone ROME FF6-3200  
COMMANDER Maj Gen C B Root  
DIR OF PROCUREMENT & PRODUCTION  
Col R V Kirkland

## SACRAMENTO AIR MATERIEL AREA

McClellan Air Force Base  
Sacramento Calif  
Phone WA 2-1511  
COMMANDER Maj Gen G E Price  
DIR OF PROCUREMENT & PRODUCTION  
Col F E Oliver  
Small Business Office C O Dudley Jr

## AIR FORCE CONTRACT MANAGEMENT DISTRICT OFFICE

12 & Market Sts  
St Louis 3 Mo  
Phone MAIN 1-8100  
COMMANDER Lt Col L P Money  
Small Business & Contract Relations Office  
K E Kichline

## AIR FORCE CENTRAL CONTRACT MANAGEMENT REGION

## CLEVELAND CONTRACT MANAGEMENT DISTRICT

113 St Clair Ave  
Cleveland 14 O  
Phone 241-7900  
COMMANDER Lt Col E H Brass Jr

## SAN FRANCISCO CONTRACT MANAGEMENT DISTRICT

1069 E Meadow Circle  
Palo Alto Calif  
Phone DA 1-6330  
COMMANDER Lt Col G M Buckles  
Small Business R Quinn

## DIRECTORATE OF PROCUREMENT AIR FORCE COMMUNICATIONS SERVICE

Bld. 1602 Scott Air Force Base III  
Phone Adams 4-4000  
DIR OF PROCUREMENT Lt Col J L Lassandro

## STAFF PROCUREMENT OFFICE AIR FORCE AERONAUTICAL CHART & INFO CENTER

6th Floor Schauer Bldg  
2nd & Arsenal Sts  
St Louis 8 Mo  
Phone Townsend 5-1210  
STAFF PROCUREMENT OFFICER W W Meyers

## OGDEN AIR MATERIEL AREA

Hill Air Force Base Utah  
Taylor 5-5215  
COMMANDER Maj Gen D Coupland  
DIR OF PROCUREMENT & PRODUCTION Col R J Iverson

## SAN ANTONIO AIR MATERIEL AREA

Kelly Air Force Base  
San Antonio Texas  
Phone WALnut 3-5411  
COMMANDER Maj Gen W THudnell  
DIR OF PROCUREMENT & PRODUCTION  
Col R H Terzian

## WARNER ROBINS AIR MATERIEL AREA

Robins Air Force Base  
Warner Robins Ga  
Phone 926-1110  
COMMANDER Maj Gen W T Hefley  
DIR OF PROCUREMENT & PRODUCTION Col R E Lee

## AIR FORCE MISSILE TEST CENTER

Patrick Air Force Base  
Patrick Fla  
Phone Coca Beach UL 7-7545  
DIR FOR PROCUREMENT Col A W James  
BASE PROCUREMENT DIV T V Buchanan  
RANGE PROCUREMENT Maj R W Morrow

## PAN AMERICAN AIRWAYS GUIDED MISSILES RANGE DIV SUPPLY DEPT PROCUREMENT DIV

Patrick Air Force Base Fla  
Phone UL 7-2653  
SUPT W L Overstreet  
SPECIAL PROJECTS PROCUREMENT AGENT A P Crews

## AIR FORCE FLIGHT TEST CENTER

Edwards Air Force Base  
Edwards Calif  
Phone CLifford 8-2111  
COMMANDER Brig Gen I L Branch  
DIR OF PROCUREMENT Lt Col R L Beeler Jr  
Small Business & Contractor Relations Office  
J A Beucherie

# DEPARTMENT OF THE NAVY

The Pentagon Wash 25 D C  
Phone Liberty 5-6700 or dial OX- and the extension  
SECTY OF THE NAVY Hon F Korth 53131

## ASST SECTY OF THE NAVY (INSTALLATIONS & LOGISTICS) OFFICE OF NAVAL MATERIAL

Hon K E Belieu 63213  
Main Navy Bldg 18th & Constitution Ave  
Wash 25 D C  
Phone Liberty 5-6700 or dial OX- and the extension  
CHIEF VAdm G F Beardsley 63168  
PROCUREMENT DIV Capt J B Cline 65811  
Procurement Branch Capt R Cobb 64086

## OFFICE OF NAVAL RESEARCH

Bldg T-3 Wash 25 D C  
CHIEF RAdm L D Coates 64911  
Small Business L O Lincoln 66650  
Procurement Services Cdr H D Moore 65321

## U S MARINE CORPS

Arlington Annex  
Wash 25 D C  
COMMANDANT Gen D M Shoup 42500  
MATERIEL DIV Col K E Martin 42906  
Procurement Branch J W McLain 42583  
Small Business Capt H F Olsen 41083

## OFFICE OF THE CHIEF OF NAVAL OPERATIONS

The Pentagon  
CHIEF Adm G W Anderson 56007  
ANTI-SUBMARINE WARFARE DIV  
Capt J N Shaffer 74783  
COMMAND CONTROL & ELECTRONICS DIV  
Capt M B Freeman 57642  
DEP CHIEF OF NAVAL OPERATIONS (LOGISTICS)  
VAdm J Sylvester 52154

## BUREAU OF NAVAL WEAPONS

Main Navy Bldg Wash 25 D C  
CHIEF RAdm P D Stroop 62465

## ANTI-SUBMARINE WARFARE OFFICE

Capt F E McEntire 65298  
ASST CHIEF FOR CONTRACTS  
RAdm J W Bottoms 62436  
Small Business J F Lenahan 64972  
Purchase Officer Capt K L Jeffery Jr 62905

## BUREAU OF SHIPS

Main Navy Bldg Wash 25 D C  
CHIEF RAdm R K James 62058  
Small Business M Chemsak 63695  
CONTRACT DIV Capt G C Wells 62112  
Electronics Purchase Branch E H Koch 61803  
ASST CHIEF OF BUREAU FOR TECH LOGISTICS  
RAdm R B Fulton 61714  
ELECTRONICS DIV Capt R R Bradley Jr 64586

## BUREAU OF SUPPLIES & ACCOUNTS

Arlington Annex Wash 25 D C  
CHIEF RAdm J W Crumacker 63411  
ASST CHIEF FOR PURCHASING  
Capt T H Bell 62136

# MILITARY PROCUREMENT OFFICES

## U S NAVY PURCHASING OFFICE—WASHINGTON

Bldg Temp-D  
**OFFICER IN CHARGE** Capt C A Appleby 65141  
**Small Business** P E Ferrante 66900  
**Procurement Information** 67477  
**Contract Adm Div** LCdr E H Clark 66960  
**Purchase Div** LCdr M S Anderson 66479

## 3rd NAVAL DISTRICT

90 Church St New York City  
 Phone Rector 2-9100  
**COMMANDANT** RAdm G Wales

## NAVAL PURCHASING OFFICE

29th & Third Ave Brooklyn 32 N Y  
 Phone STerling 8-5000  
**COMMANDANT** Capt G Waters

## 10th NAVAL DISTRICT

San Juan Puerto Rico  
 Phone 722-0080  
**INDUSTRIAL MANAGER** Capt J W Henry

## NAVAL SUPPLY CENTER PURCHASING OFFICE

Bldg 311 Oakland 14 Calif  
 Phone TWin Oaks 3-4224  
**COMMANDING OFFICER** RAdm H C Haynsworth Jr  
**DIRECTOR PURCHASING SERVICE** Cdr M Schuller

## U S NAVY PURCHASING OFFICE

929 South Broadway Los Angeles 55 Calif  
 Phone Richmond 9-4711  
**OFFICER IN CHARGE** Capt R W Cope  
**Small Business** O A Grundwald Jr  
**Purchase Div Officer** Cdr R A Schaffler

## U S NAVY ELECTRONICS SUPPLY OFFICE

Bldg 3400 Great Lakes III  
 Phone DE 6-3500  
**BUYING BRANCH** Lt J B Whittaker  
**Small Business** G O Gifford

## U S NAVAL SUPPLY DEPOT

Mechanicsburg Pa  
 Phone POpular 6-8511  
**COMMANDER** W G Bacon

## U S NAVY AVIATION SUPPLY OFFICE

700 Robbins Ave Phila 11 Pa  
 Phone Randolph 8-1212  
**COMMANDING OFFICER** RAdm H F Kuehl  
**Buying Branch Head** Cdr W A Wilson  
**Electronic Section Head** P Bieg

## U S NAVAL ORDNANCE TEST STATION

3202 East Foothill Blvd Pasadena Calif  
 Phone FRontier 7-7411  
**ASSOC DIRECTOR OF SUPPLY** Cdr C A Cassin  
**CONTRACTING OFFICER** J E Fletcher  
**Purchase Div** K M Thompson  
**Small Business** C V Weaver

## 13th NAVAL DISTRICT NAVAL AIR STATION U S NAVY SUPPLY DEPOT

Pier 91 Seattle Wash  
 Phone ATwater 3-5200  
**PURCHASING OFFICER** LCdr L J Crook

## NAVAL TORPEDO STATION

Keyport Wash  
 Phone ES 3-5011  
**CONTRACT ASST** W M Bennet  
**NOTE:** For list of the names and addresses of Navy SMALL BUSINESS SPECIALISTS located in various cities and for INDUSTRY CORPORATION REPRESENTATIVES write to OFFICE OF NAVAL MATERIAL 18th & Constitution Ave N W Wash 25 D C

# SELECTED GOVERNMENTAL AGENCIES

(Note: For information regarding bids for equipment or services purchased by the Govt. services, subscribe to **COMMERCE BUSINESS DAILY**. Yearly subscription \$20 (reg. mail). Write U S Dept of Commerce, Room 1300, 433 W. Van Buren St., Chicago 7, Ill.)

## FEDERAL AVIATION AGENCY

1711 New York Ave N W Wash 25 D C  
 Phone STerling 3-2100  
**ADMINISTRATOR** N E Halaby

## INSTALLATION & MATERIEL SERVICE

**Procurement Div Procurement Service Branch**  
 Room 2601 Bldg T-5  
 L G Ozier Chief  
 Phone WO 7-4736

## INSTALLATION & MATERIAL DEPOT

P O Box 1082  
 Oklahoma City 1 Okla  
 Phone MUtual 1-2311  
**PROCUREMENT BRANCH** D J Odvody Chief

## U S DEPT OF COMMERCE U S WEATHER BUREAU

**Procurement & Supply Section**  
 B F Lovelass Chief  
 1115 18th St N W Wash 25 D C  
 Phone 965-2400

## U S COAST & GEODETIC SURVEY

**Procurement Branch**  
 E T Peterson Chief  
 1741 Rhode Island Ave N W  
 Wash 25 D C  
 Phone DU 2-3791

## NAT BUREAU OF STANDARDS

Conn Ave & Van Ness St N W  
 Wash 25 D C  
 Phone EMerson 2-4040  
**DIRECTOR** Dr A V Astin  
**SUPPLY DEPT** G B Kefover  
**Procurement Sect** C B Kipps

## ATOMIC ENERGY COMMISSION

Germantown Md  
 Mail: Wash 25 D C  
 Phone HAZelwood 7-7831  
**CHAIRMAN** Dr G T Seabord  
**GEN MANAGER** A R Lueddecke  
**DIV OF HEADQUARTERS SERVICES (Purchasing)**  
 E H Glade  
**DIC OF CONTRACTS** J H Wells  
 (Large amount of contracting is done by numerous field offices. For addresses of these offices write to **CONTRACT DIV** (above) for booklet "SELLING TO THE AEC")

**HEADQUARTERS** Federal Office Bldg No 6  
 Maryland Ave & 4th St SW  
 Washington 25 D C  
 Phone EX 3-3260  
**ADMINISTRATOR** J E Webb WO 2-1271  
**DEP ADMINISTRATOR** Dr H L Dryden WO 2-4504

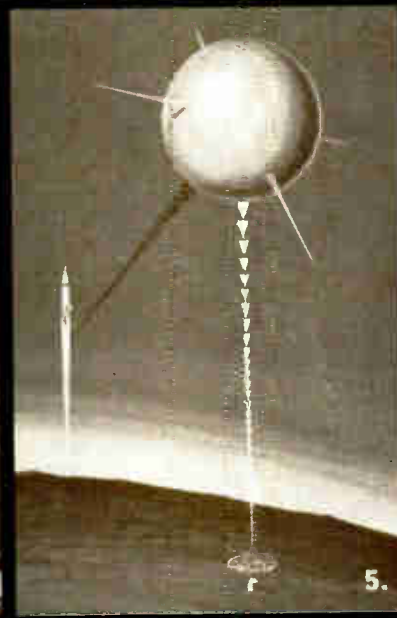
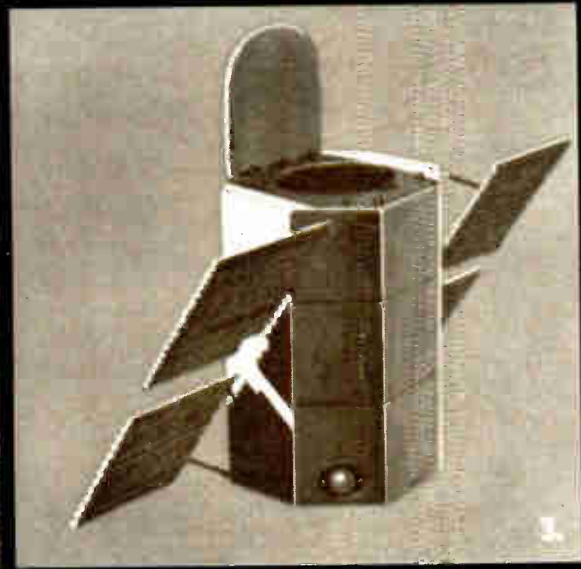
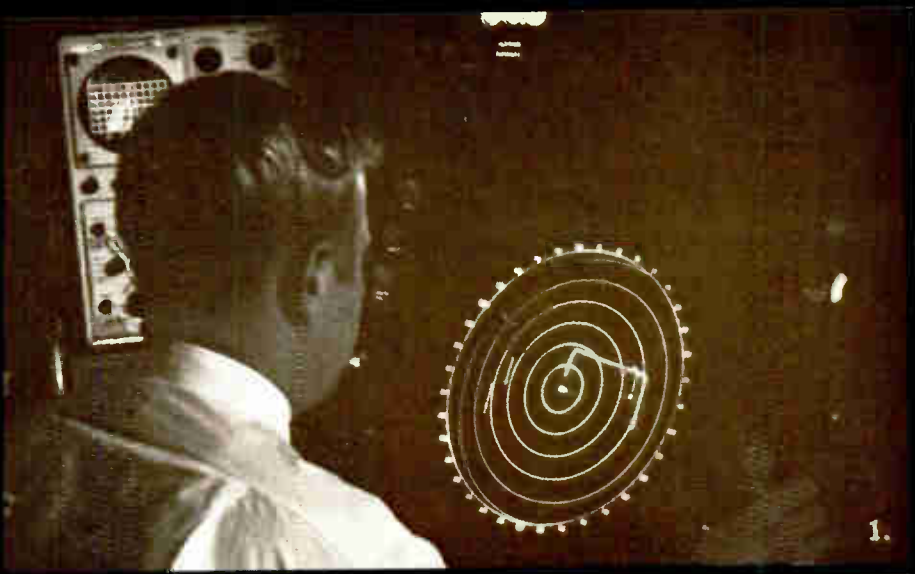
## NASA PROCUREMENT CENTERS:

**NASA HEADQUARTERS**  
 Washington 25 D C  
**DIRECTOR** E W Brackett WO 3-7969  
**Small Business** J M Roey  
**HEADQUARTERS PROC BR**  
 Washington 25 D C  
**PROC CHIEF** A A Clagett WO 2-4017  
**Small Business** E W Quintrell  
**AMES RESEARCH CNTR**  
 Moffett Field Calif  
**PROC CHIEF** A S Hertzog YO 8-9411  
**Small Business** D E Davis  
**LANGLEY RESEARCH CNTR**  
 Langley Field Va  
**PROC CHIEF** S L Butler 722-7961  
**Small Business** J F Braig  
**GODDARD SPACE FLIGHT CNTR**  
 Greenbelt Md  
**PROC CHIEF** G H Tyler GR 4-9000  
**Small Business** H T O'Toole  
**JET PROPULSION LAB**  
 Pasadena Calif  
**PROC CHIEF** T Candee SY 0-6811  
**Small Business** G I Lawrence  
**WESTERN OPERATIONS**  
 Santa Monica Calif  
**PROC CHIEF** E Sample EX 3-9641  
**Small Business** A Mirosov  
**FLIGHT RESEARCH CNTR**  
 Edwards Calif  
**PROC CHIEF** M E Bowling CL 8-2111  
**Small Business** S C Kucharik  
**WALLOPS RESEARCH STA**  
 Wallops Island Va  
**PROC CHIEF** L T Birch VA 4-3411  
**Small Business** H Hammond  
**MARSHALL SPACE FLIGHT CNTR**  
 Huntsville Ala  
**PROC CHIEF** W S Davis 536-8516  
**Small Business** E J Havrilla  
**LEWIS RESEARCH CNTR**  
 Cleveland Ohio  
**PROC CHIEF** E S Hicks Jr 252-7700  
**Small Business** N C Prahst  
**LAUNCH OPER CNTR**  
 Cocoa Beach Fla  
**PROC CHIEF** G A Michaud SU 3-8244  
**Small Business** T M Davis  
**MANNED SPACE CNTR**  
 Houston Tex  
**PROC CHIEF** D W Lang Jr WA 8-2811  
**Small Business** H Christman



# Key Missile & Space Vehicle Contractors

| COMPANY   | ENGINEERING EXECUTIVE   | PERSONNEL DIRECTOR                         |
|---|---|--|
| Aerojet-General Corp.<br>332 Irwindale Ave., Azusa, Calif.                                  | C. C. Ross, V. P. Engineering                                 | L. L. Thompson                             |
| Aeronutronic, Div. of Ford Motor Co.<br>Ford Rd., Newport Beach, Calif.                     | Dr. R. S. Carlson<br>Dir. of Engineering                      | R. F. Fallon                               |
| Avco Corp.<br>201 Lowell St., Wilmington, Del.  | Dr. C. J. Burton<br>V. P. & Dir. Product Dev.                 | E. W. Stupack                              |
| Beech Aircraft Corp.<br>Wichita, Kan.   | J. N. Lew, V. P. Eng.   | J. E. Isaacs                               |
| Bendix Corp.<br>South Bend 20, Ind.   | J. F. Clayton, Dir. Eng. Programs                             | D. L. Kirkpatrick                          |
| Boeing Corp.<br>Seattle 14, Wash.   | L. A. Woods<br>V. P. & Gen. Mgr. Aerospace Div.               | F. Huleen                                  |
| Douglas Aircraft Co.<br>Santa Monica, Calif.  | R. L. Johnson<br>V. P. & Dir. Product Div.                    | L. W. Tixier                               |
| Fairchild Stratots Corp.<br>Hagerstown 10, Md.  | L. L. Farnham, V. P.  | R. A. Newton                               |
| General Dynamics/Astronautics<br>San Diego 12, Calif.                                       | M. Rosenbaum<br>Exec. V. P.                                   | R. M. Smith                                |
| General Electric Co.<br>Valley Forge Space Technology Center<br>P.O. Box 8555 Phila. 1, Pa. | H. W. Paige<br>Gen. Mgr. Missile & Space Div.                 | R. J. Haughton                             |
| General Precision, Inc.<br>Little Falls, N. J.  | R. N. Brown, Exec. V. P.<br>Kearfott Div.                     | P. Kull                                    |
| Goodyear Aircraft Corp.<br>Akron, Ohio  | E. A. Brittenham, Jr.<br>Chief Eng.                           | C. Taylor                                  |
| Gyrodyne Co. of Am., Inc.<br>St. James, L. I., N. Y.  | A. H. Yates, V. P.  | W. J. Aylward                              |
| Grumman Aircraft Eng. Corp.<br>Bethpage, L. I., N. Y.                                       | R. M. Crabtree<br>LEM Sub-systems Proj. Eng.                  | J. G. Galvin, Jr.                          |
| Hughes Aircraft Corp.<br>Culver City, Calif.  | N. I. Hall, V. P.   | S. L. Gillespie                            |
| Lear-Siegler, Inc.<br>Instrument Div.<br>Grand Rapids, Mich.                                | J. M. Walsh, Pres.  | G. Branston                                |
| Ling-Temco-Yought<br>Dallas 22, Texas   | J. R. Clark, V. P. & Gen. Mgr.<br>Astronautics Div.           | M. L. Taylor                               |
| Lockheed Missiles & Space Co.<br>Sunnyvale, Calif.  | R. R. Kearton, V. P. & Gen. Mgr.<br>Space Systems Div.        | R. C. Birdsall                             |
| Martin Co.<br>Martin Marietta Corp.<br>Friendship International Airport 40, Md.             | G. F. Metcalf, V. P. Res. & Eng.                              | D. V. Dorman                               |
| McDonnell Aircraft Corp.<br>St. Louis, Mo.  | B. G. Bromberg, V. P.<br>Missile Eng. Div.                    | W. R. Orthwein, Jr.                        |
| Minneapolis Honeywell Reg. Co.<br>Minneapolis, Minn.  | C. L. Davis, V. P.<br>Military Prods. Group                   | J. S. Gibson<br>A. F. Urbiha               |
| North American Aviation, Inc.<br>El Segundo, Calif.   | B. D. Haber<br>Asst. to the President                         | North Am. Aviation, Inc.<br>Downey, Calif. |
| Northrop Corp.<br>Space Labs.<br>Hawthorne, Calif.  | R. E. Horner<br>Sr. V. P. & Gen. Mgr.                         | J. Richardson                              |
| RCA<br>Moorestown, N. J.  | J. H. Sidebottom<br>V. P. & Gen. Mgr.                         | N. J. Cappello                             |
| Republic Aviation Corp.<br>Farmingdale, L. I., N. Y.  | A. R. Crawford, V. P.   | C. Ketson                                  |
| Raytheon Co.<br>Space & Info. Systems Div.<br>Missile Systems Div.<br>Bedford, Mass.        | D. L. Yates, V. P. & Gen. Mgr.<br>Dr. M. Schilling, Gen. Mgr. | R. C. Story<br>J. C. Enos                  |
| Ryan Aeronautical Co.<br>San Diego, Calif.  | F. W. Fink, V. P. Eng. Prods.                                 | W. Wagner                                  |
| Sperry Gyroscope Co.<br>Great Neck, L. I., N. Y.  | H. Harris, Div. of Eng.                                       | R. Hamlett                                 |
| Thiokol Chemical Corp.<br>Ogden, Utah   | Dr. H. W. Richey, V. P.                                       | J. Lorenz                                  |
| Thompson Ramo Wooldridge, Inc.<br>Space Technology Labs.<br>Redondo Beach, Calif.           | Dr. A. K. Thiel, V. P.  | R. C. Potter                               |
| United Aircraft Corp.<br>Farmington, Conn.  | C. M. Kearns, Pres. & Gen. Mgr.                               | N. B. Morse                                |
| Vickers, Inc.<br>Detroit 32, Mich.  | B. W. Badenoch<br>V. P. & Gen. Mgr.                           | D. M. Norton                               |
| Westinghouse Electric Corp.<br>Astronuclear Labs.<br>Pittsburgh 36, Pa.                     | Dr. A. L. Bethel<br>Dept. Mgr.                                | D. C. Lee<br>Baltimore 3, Md.              |



## Advances from Avco/Electronics: in space, on earth— and more to come!

Tiny radios that tell space vehicles what to do. Radar that pinpoints distant planes. Communications gear to keep operations on the move. These are a few products from Avco's Electronics Division, prime contractor to each of the armed services and NASA.

**1. Air traffic control.** A "predicted paths" system, developed by Avco, assures greater safety. Makes it easier for busy air traffic controllers to see on radarscopes a projected flight path for every aircraft in the area.

**2. Front-line communications.** A new radioreceiver-transmitter, developed by Avco for the U.S. Army, makes it possible to direct by voice: tanks, artillery, aircraft, and troops in a combat area.

**3. The Orbiting Astronomical Observatory,** to study the stars, planets, and the universe, will use satellite receivers and a video detector built by Avco. Instructions from NASA's Goddard Flight Center to OAO and transmissions from the satellite to Earth will be triggered by special radio receivers which Avco has developed under subcontract to Grumman. Avco supplies a variety of space communications equipment to a wide range of NASA and defense contractors.

**4. Three-dimensional display.** A unique Avco/Electronics display makes possible "3-D" tracking of space vehicles, missiles, aircraft, ships, submarines without the use of special optics or viewing lenses.

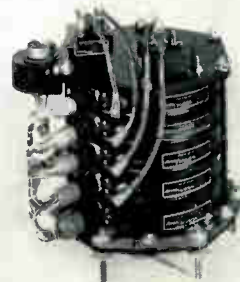
**5. Infrared research.** The uses of infrared are many, and Avco is a leading developer of significant new applications for the future.

**Other projects** that are now underway at Avco/Electronics include: data processing and handling, production recording, and advanced radio communications.

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DIVISION

Mock-up of Avco's satellite receivers and video detector for the Orbiting Astronomical Observatory series of satellites.



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World Radio History

The following list classifies and gives the value of electronic equipment selected from contracts awarded in 1962.

Classified contracts or awards of less than \$25,000 are not listed.

# GOVERNMENT CONTRACT AWARDS

|  |            |                                     |            |   |            |
|--|------------|-------------------------------------|------------|---|------------|
| Accelerators                                   | \$169,644  | Digital system                      | 355,901    | Memory systems                          | 435,000    |
| Accelerometers                                 | 3,897,936  | Digital trainer                     | 134,498    | Meteorological systems, airborne        | 1,072,088  |
| Actuators                                      | 425,661    | Digital X-Ray plotter               | 40,871     | Meters                                  | 11,755,481 |
| Altimeters                                     | 48,396     | Direction finders                   | 44,230     | Microfilm reader-printer                | 158,750    |
| Amplifiers                                     | 18,720,749 | Discriminator                       | 759,376    | Microphone assemblies                   | 47,971     |
| Analog-Digital conversion sys.                 | 370,875    | Discriminator systems               | 72,446     | Microphones                             | 2,200,995  |
| Analyzing systems                              | 69,191     | Display system, remote              | 355,600    | Microscope, electron                    | 30,685     |
| Analyzers                                      | 1,776,742  | Distance measuring equipment        | 47,000     | Microwave, digital, geodetic, subsystem | 750,000    |
| Antenna & systems                              | 16,626,847 | Dosimeters, radiological            | 6,483,279  | Microwave equipment                     | 330,315    |
| Astro tracker                                  | 1,400,750  | Drone system                        | 5,500,000  | Modules digital                         | 38,551     |
| Attenuators                                    | 261,430    | Dummy load, electrical              | 57,798     | Modulator                               | 329,645    |
| Batteries                                      | 5,385,728  | Duplexer                            | 64,343     | Monitors, R-F                           | 76,804     |
| Cable  | 1,371,710  | Dynamic demonstrators               | 99,022     | Monitoring system, radiation            | 46,615     |
| Cable assemblies                               | 1,774,784  | Dynamometers                        | 38,200     | Multicouplers                           | 678,554    |
| Cable, coaxial                                 | 333,826    | Echo sounders, portable             | 166,669    | Multiplex equipment                     | 200,934    |
| Cable, instrumentation                         | 148,425    | ECM equipment                       | 3,075,000  | Noise measuring set                     | 77,622     |
| Cable R-F                                      | 355,287    | Electron guns                       | 46,000     | Navigation equipment                    | 21,946,829 |
| Cable, shielded                                | 74,900     | Electron microscope                 | 32,937     | Oscillators                             | 2,872,774  |
| Cable, special purpose                         | 64,053     | Electronic control systems          | 213,260    | Oscillographs                           | 449,017    |
| Cable, telephone                               | 9,319,224  | Electronic digital voltmeter system | 194,556    | Oscilloscopes                           | 2,948,897  |
| Calibration equipment                          | 839,482    | Encoder system                      | 99,443     | PCM conversion system                   | 55,519     |
| Calibrators                                    | 555,371    | Environmental chamber               | 27,860     | Photoelectric cell                      | 140,804    |
| Capacitors                                     | 478,181    | Equalizer system                    | 58,530     | Plotting System, digital                | 54,960     |
| Cavity assembly                                | 31,520     | Exciter system, vibration           | 81,144     | Power supplies                          | 1,880,076  |
| Cavity, tuned                                  | 48,969     | Facsimile equipment                 | 933,509    | Power system, fuel cell                 | 120,204    |
| Chaff, countermeasures                         | 3,656,862  | File conversion equipment           | 750,937    | Preamps                                 | 48,500     |
| Chopper, electronic                            | 91,644     | Film Analyzer-Recorders             | 51,900     | Print stations, high speed              | 315,580    |
| Circuit boards                                 | 158,017    | Filters                             | 1,886,707  | Printers                                | 253,553    |
| Coder-Decoder group                            | 3,239,672  | Fire control system                 | 6,750,139  | Programmer tape units                   | 75,760     |
| Coil   | 136,177    | Flight trainer                      | 800,000    | Public address system                   | 57,558     |
| Communication satellite mobile ground stations | 5,000,000  | Frequency controller                | 50,280     | Pulse ranging equipment                 | 30,652     |
| Communications equipment                       | 29,600,192 | Fuel cells                          | 89,225     | Radar                                   | 81,335,303 |
| Comparators                                    | 1,761,033  | Gages, thermocouple                 | 35,338     | Radar monitors                          | 56,000     |
| Computers                                      | 36,918,849 | Generators                          | 71,862     | Radiacmeters                            | 369,550    |
| Computer displays                              | 1,315,448  | Generators/Detectors                | 98,298     | Radiac set                              | 1,213,474  |
| Connectors                                     | 4,258,260  | Generators, time code               | 147,327    | Radiac computer, indicator              | 76,608     |
| Control equipment                              | 509,942    | Global tracking network             | 2,715,028  | Radiac equipment                        | 923,909    |
| Control subsystem                              | 1,800,000  | Guidance system                     | 7,500,000  | Radiation monitoring equipment          | 138,748    |
| Control systems                                | 2,146,560  | Gyroscopes                          | 8,021,442  | Radio director finder                   | 1,312,000  |
| Controls                                       | 3,439,732  | Gyroscope equipment                 | 10,347,416 | Radio equipment                         | 3,827,470  |
| Converters, freq.                              | 597,605    | Handsets                            | 1,162,206  | Radio sets                              | 61,092,536 |
| Converters                                     | 7,645,914  | Headsets                            | 3,121,557  | Radiotelephone sets                     | 64,775     |
| Coordinate data set                            | 390,000    | Hydrophones                         | 93,255     | Radio terminal sets                     | 6,320,210  |
| Countermeasures set                            | 8,529,104  | Indicators                          | 7,842,119  | Radio transmitters                      | 41,855     |
| Counter-Timers                                 | 69,391     | Indicators, transducer              | 164,621    | Radiosonde sets                         | 986,846    |
| Counters                                       | 645,699    | Infrared radiometer                 | 284,626    | Radomes                                 | 2,914,622  |
| Couplers                                       | 915,229    | Intercommunication equipment        | 272,309    | Range finders                           | 1,293,858  |
| Coupling units                                 | 1,465,098  | Intercommunications system          | 233,469    | Ranging & recording system              | 34,550     |
| Data conversion systems                        | 2,920,324  | Interrogation sets                  | 1,177,498  | Ratiometer                              | 31,610     |
| Data equipment                                 | 52,580     | Intrusion detection equipment       | 73,301     | Receivers                               | 20,776,004 |
| Data monitoring set                            | 974,253    | Jamming systems                     | 56,507     | Receiving system                        | 1,299,818  |
| Data plotter                                   | 93,645     | Lab equipment                       | 410,000    | Reconnaissance sets                     | 539,861    |
| Data processing equipment                      | 879,350    | Laser                               | 224,914    | Record reproduce mechanism              | 346,155    |
| Data transmission equipment                    | 124,603    | Light indicators                    | 25,740     | Recorders                               | 6,312,808  |
| Delay lines                                    | 43,606     | Loran C                             | 1,278,331  | Recorder/Reproducer                     | 8,244,801  |
| Demodulation equipment                         | 83,984     | Loudspeakers                        | 1,856,525  | Recording oscillograph system           | 37,169     |
| Demodulator                                    | 54,000     | Magnetic core storage               | 117,254    | Recording systems                       | 4,648,914  |
| Detecting set                                  | 1,192,723  | Magnetic detecting set              | 785,517    | Regenerators, time code                 | 99,950     |
| Detection instruments, radiation               | 1,576,480  | Magnetic memory disc files          | 318,600    | Relay armatures                         | 953,906    |
| Detectors                                      | 1,110,724  | Magnetic tape dataplotter sys.      | 52,500     | Relays & assemblies                     | 2,539,849  |
| Dial & wavemeter assy.                         | 26,350     | Magnetic tape memory                | 95,352     | Relay systems                           | 1,518,262  |
| Digital data acquisition system                | 305,955    | Magnetron assy.                     | 181,000    | Reproducers                             | 443,636    |
| Digital data communication control             | 1,738,954  | Magnetron assy., stabilized         | 27,423     | Resistors                               | 2,313,817  |
| Digital data terminal                          | 151,848    | Mapping & survey sets               | 4,116,942  | RFL equipment                           | 39,197     |
| Digital data transmission system               | 174,400    | Measuring systems                   | 9,909,683  | Selector Unit, transmitter              | 342,569    |
| Digital speech system                          | 49,225     |                                     |            | Semiconductors                          | 8,624,493  |



|                                 |            |                              |            |
|---------------------------------|------------|------------------------------|------------|
| Sensing elements                | 58,474     | Test equipment               | 25,023,651 |
| Sequencer                       | 43,750     | Test sets                    | 6,015,986  |
| Servo equipment                 | 887,299    | Thermocouples & accessories  | 735,554    |
| Shelters, electric equipment    | 1,974,409  | Timers                       | 116,515    |
| Shielded enclosures             | 58,383     | Time signal generators sys.  | 515,393    |
| Signal generators               | 6,318,064  | Timing sets                  | 76,039     |
| Simulators                      | 6,063,830  | Tracking equipment           | 106,709    |
| Solar cells                     | 132,768    | Tracking system beacon       | 53,008     |
| Solenoids, electrical           | 77,799     | Trainers                     | 2,899,169  |
| Sonar                           | 13,100,497 | Transceivers                 | 18,439,957 |
| Sonobuoys                       | 37,588,966 | Transducers                  | 2,845,605  |
| Spectrometer system             | 87,307     | Transformers                 | 461,334    |
| Spectrophotometer               | 90,737     | Transmission systems         | 7,879,900  |
| Spectrum surveillance sys.      | 352,581    | Transmitters                 | 9,410,576  |
| SSB equipment                   | 5,078,778  | Transponders                 | 2,276,876  |
| Standards                       | 994,676    | Tuning units                 | 818,197    |
| Switchboard                     | 4,030,145  | Tubes, CRT                   | 94,269     |
| Switches                        | 3,505,694  | Tubes, electron              | 35,050,089 |
| Switching equipment             | 1,307,490  | Tubes, klystron              | 2,031,485  |
| Switching system                | 977,048    | Tube, maanetron              | 6,817,420  |
| Synchronizers                   | 1,012,391  | Tubes, TWT                   | 2,337,094  |
| Synchronizing circuit           | 27,444     | Tuning units                 | 36,876     |
| Synchro equipment               | 1,426,915  | Tuners                       | 188,996    |
| Synthesizers                    | 77,885     | TV equipment                 | 964,075    |
| Tape, magnetic                  | 342,249    | Ultrasonic cleaners          | 61,665     |
| Tape readers                    | 150,000    | Ultrasonic equipment         | 29,930     |
| Tape, recording                 | 2,221,071  | Vacuum equipment             | 147,561    |
| Tape, sound recording           | 290,371    | Vibrators                    | 36,123     |
| Tape transports                 | 51,000     | Video, integrating groups    | 1,400,000  |
| Target detecting device         | 430,090    | Video transmission equipment | 267,530    |
| Target location system          | 133,091    | Viewing set, infrared        | 375,166    |
| Telephone & Telegraph equipment | 8,598,404  | Vocoders                     | 322,125    |
| Telemetry equipment             | 8,790,286  | Voltage dividers             | 28,500     |
| Teletypewriter equipment        | 12,745,264 | Waveguide                    | 125,901    |
| Terminal digital equipment      | 349,303    | Wire & cable                 | 1,535,246  |
| Terminal, telegraph             | 27,617     | X-Ray equipment              | 1,576,395  |
| Test consoles                   | 273,570    | X-Y plotter                  | 118,254    |

**Publications Helpful in Selling to the U. S.**

"Selling To Navy Prime Contractors" (July 1961) p. 89. Helpful suggestions, followed by listing of hundreds of prime contractors. Obtainable from Supt. of Documents, U. S. Govt. Printing Office, Wash. 25, D. C., price 50 cents.

"General Procurement Information" (July 1961) p. 32. Lists hundreds of items from many guided missiles together with the names of their prime contract suppliers. U. S. Govt. Printing Office, price 15 cents or free from Off. Secty. Defense, Information Office, Wash. 25, D. C.

"Selling To The Military" p. 27. General Information. Items Purchased. Location of Military Purchasing Offices, etc. U. S. Govt. Printing Office, price 25 cents.

"Air Force Small Business Specialists" p. 10. A listing of names, addresses and phone numbers. From Secty. of Defense, Information Office, Air Force Desk. free.

"Armed Services Procurement Regulations." Information Office, Sec. of Defense, Wash. 25, D. C., free.

"The Army Procurement Procedure." Information Office, Sec. of Defense, Wash. 25, D. C., free.

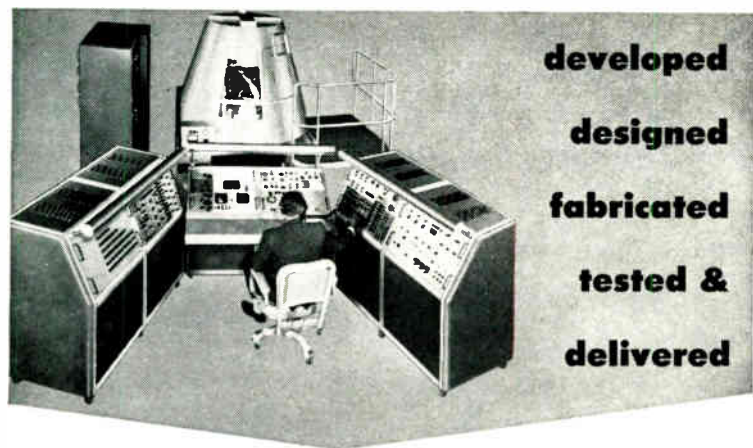
"The Air Force Procurement Procedure." Information Office, Sec. of Defense, Wash. 25, D. C., free.

"Navy Procurement Directives." From U. S. Govt. Printing Office at \$7 per year, subscription.

"Doing Business With The Federal Government" (Jan. 1961) p. 58. Contents: Govt. procurement methods; Military procurement General Services administration; Other civil agencies with supply activities responsibility of the gov't. contractor. Believed available from General Services Administration, Wash. 25, D. C., free.

(Continued on page I-10)

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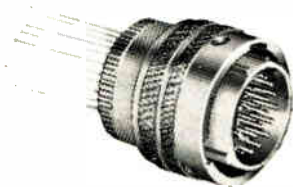
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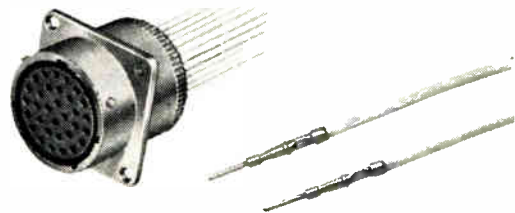
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# SECTION I

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## MILITARY ELECTRONICS & SPACE SYSTEMS

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### Part Two—Space

|  |     |
|--|-----|
| Reliability Trends in Space Electronics  | 1-2 |
| Controlling Stress Increases Reliability | 1-6 |



## RELIABILITY TRENDS (Concluded)

work in which this recognition permeates the organization is essential.

### Manufacturing a Vital Factor

An additional factor of extreme importance in reliability which perhaps has not received universal recognition is the importance of manufacturing processes. The role of manufacturing engineering is normally considered to be of prime importance in large quantity production, when every cent counts, and of minor importance when small quantities were produced. Within the space program quantities are inherently small.

There has been a prevalent attitude that good conceptual engineering plus "tender loving care" was the recipe for success. It is my firm opinion that a radically different approach is essential. Production quantities are small. But each item—whether for test or for flight—must be fabricated under controlled conditions. Only in this way will the results of reliability testing be meaningful. This can be achieved only if manufacturing processes are controlled with extreme rigidity. This requirement for high reliability on the first item—not only on the thousandth—presents a major problem of space electronics and one to which Aeronutronic along with other contractors is devoting top priority.

Like all fundamental problems there is a trade-off in requirements. The system must be flexible enough to accommodate engineering change—for first models have a high probability of change—yet the system must be so rigid that all items are either identical or differ only in known ways. This can be achieved only with close and early integration of development and manufacturing engineering. Furthermore, the cost must be reasonable. Steps toward a solution to this problem are of the greatest importance as a partial solution to the reliability problem.

### Ranger 5 Reliability Example

As an example of electronic design for reliability in space, I would like to describe a program of which we at Aeronutronic are very proud—the transmitter for the Ranger lunar landing capsule.

This 960 mc transmitter was developed by Aeronutronic for the National Aeronautics and Space Administration, and its Jet Propulsion Laboratory, as part of the payload for the Ranger spacecraft program—designed to land a 25 inch capsule on the surface of the moon to gain seismic information.

The requirements on this capsule can be summarized briefly as follows:

- (1) Weight—1.5 pounds
- (2) Power Input—1 watt
- (3) Power Output—50 milliwatts
- (4) Volume—40 cubic inches (with subcarrier electronics)
- (5) Environment—Standard Atlas-Agena booster environment at launch; outer space environment during the trip to the moon; 3,000 g acceleration upon hard landing on the lunar surface; lunar day and night with temperature variations of nearly 500°F—minus 250 degrees at night, and as high as 220 degrees during the lunar day—for at least one month.

These requirements were met with the solid state transmitter shown in an accompanying photo. In the development of this transmitter it was necessary to consider all the factors for reliability. The intended use of the transmitter required a minimum of 5% efficiency to provide one month to 45 days lunar operation with the available battery pack, and a mechanical design capable of withstanding the 3,000 g 3 millisecond landing impact.

### Components Held to Minimum

The design used a minimum number of circuit components in order to enhance the reliability and minimize the power consumption.

Aeronutronic carried out an extensive component qualification program to select components with a high probability of withstanding the 3,000 g impact.

This transmitter was flown on Ranger flight 3, 4, and 5. Its function was to transmit data from the lunar surface. It was also to operate during the approximately 66-hour flight to the moon. Due to malfunctions of the booster or spacecraft, it was not possible to attempt a lunar landing on any of the three Ranger flights.

However, on all Ranger missions, this small transmitter performed as required, and in fact provided the last signal from the spacecraft on all three of the shots.

This demonstration of reliability was, of course, encouraging to us—and is but one small example of the importance of this factor in our U. S. space programs.

As space and electronic systems become even more complex in the ensuing years, there must be intelligent and strong management support of engineering projects if we are to meet the demands of continued reliability in our manned and unmanned program to explore the universe.

Success in space systems depends on many things... individual, yet all somehow related. Weight, power, stress, parameter distribution, all plague the design engineer in his efforts to generate a trustworthy package balanced somewhere between simplicity and redundancy. Will circuit and component innovations be the panacea for reliability troubles? Microminiaturization seems to point the way.

# CONTROLLING STRESS INCREASES RELIABILITY

PROBABLY THE MOST IMPORTANT REQUIREMENT for electronic systems in space is reliability. In recent years engineers have developed techniques to increase electronic system reliability, based on the premise that an object fails when certain stresses exceed the strength of the object.

Space reliability factors for electronic gear are not very different from those in earthbound equipment. Exceptions are: (1) constraints applied to equipment by space environment factors; (2) limitations imposed by minimal weight and power requirements; and (3) limitations on maintenance.

Emphasis was once on electronic equipment designed to operate on earth when and where needed. This emphasis now is quite different from space requirements which call on equipment to operate continuously for a specified time span.

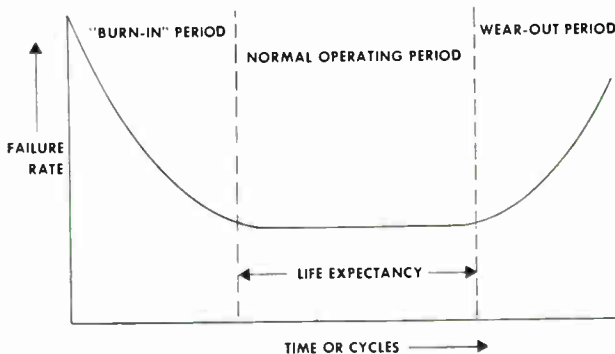
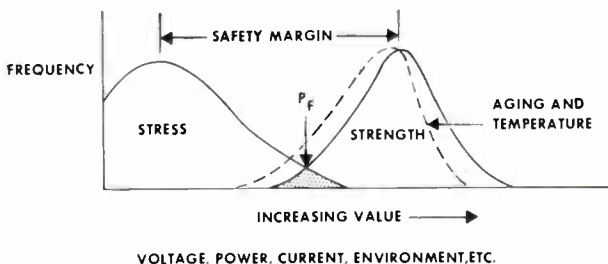


Fig. 1. Classic failure rate curve.

Fig. 2. Relationship of stress and strength distributions determine the probability of failure by the area of overlap.



## Environment Considerations

Stresses taken by a space vehicle will depend on its mission, orbit, and life. Some environment aspects are summarized in Table I.

Other space environments such as magnetic, gravitational and radiation fields have little effect, or, known design factors minimize their importance.

A conclusion to draw from environment factors is that environment has only a small effect on stresses associated with reliability. High-vacuum effects produce some new failure mechanisms such as galling and seizure, electrical breakdown—caused by evaporation or whisker growth—and malfunctions caused by meteor puncture.

However, there is no significant increase in stress values. The hostile environment of space does not materially degrade the reliability of the system.

## Weight and Power Consumption

Severe limits imposed on a system's weight and power consumption has, in many cases, caused components to be operated in overstressed conditions.

To obtain lowest possible failure rate and the highest reliability, materials and electronic parts are selected with great care. In an attempt to meet weight and power goals, however, materials and parts are often overstressed.

Power tubes for transmitting are operated at near maximum output to increase efficiency. Amplifiers are operated near maximum gain. Rectifiers are pushed to near peak currents. All of these strains increase stress and decrease reliability.

By **ROBERT E. HOVDA**  
and **Dr. WILLIAM J. WEST**

Armament Control Advanced Engineering Dept.  
Autonetics Division  
North American Aviation, Inc.

## CONTROLLING STRESS (Continued)

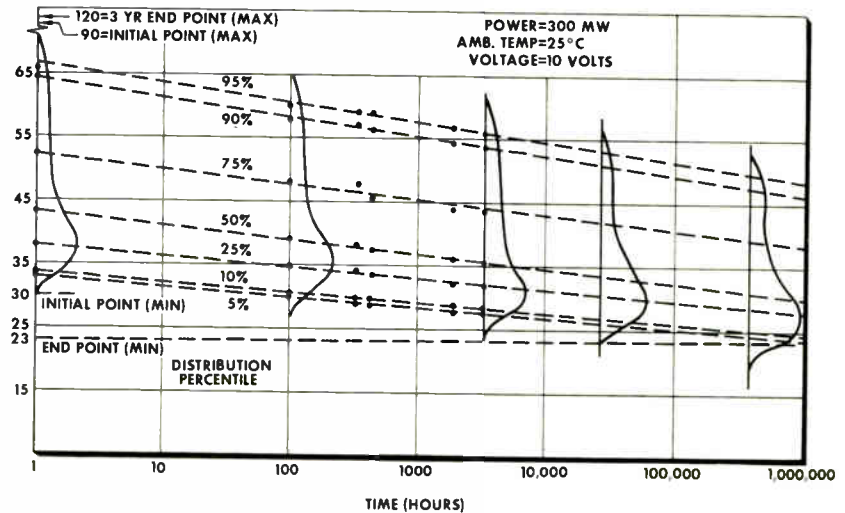


Fig. 3. Measured distribution of transistor life - test parameter ( $I + h_{fe}$ ) for various points in time.

Table 1  
SUMMARY OF SPACE ENVIRONMENT

| ENVIRONMENT                                | EFFECT AND CONTROL   |
|--|--|
| Temperature                                | <b>EFFECT:</b> Thermal energy within vehicle produced primarily by solar radiation and internal heating.<br><br><b>CONTROL:</b> Radiation and conduction heat sinks provide stabilization between 0° and 60°C. |
| Vibration                                  | <b>EFFECT:</b> Not important in space.   |
| Acceleration                               | <b>CONTROL:</b> Equipment designed to withstand transportation, launch handling, and boost will survive in space.  |
| Shock                                      |  |
| High vacuum                                | <b>EFFECT:</b> Sublimation, evaporation of materials; seizure and vacuum welding of materials; corrosion, plating, or chemical reactions.<br><br><b>CONTROL:</b> Selection of materials and lubricants.        |
| Meteorites and micro-meteorites            | <b>EFFECT:</b> Collision damage.<br><br><b>CONTROL:</b> Statistical risk involved.   |
| X-rays and Gamma rays<br>Trapped electrons | <b>EFFECT:</b> Ionization of material; collection of charges.<br><br><b>CONTROL:</b> Protection for externally mounted equipment; provide discharge paths to decrease charge effects.                          |

Table 2  
RENDEZVOUS RADAR ELECTRONICS

|                                   | Radar and Beacon |          | Computer    |          |
|-----------------------------------|------------------|----------|-------------|----------|
|                                   | Solid State      | Micromin | Solid State | Micromin |
| Total circuits                    | —                | 73       | —           | 123      |
| Total components                  | 1,241            | 200      | 2,758       | 123      |
| Resistors                         | 740              | —        | 1,106       | —        |
| Capacitors                        | 354              | —        | 312         | —        |
| Transistor                        | 146              | 146      | 221         | —        |
| Diodes                            | 20               | 20       | 1,119       | —        |
| Connections (welded or soldered)  | 5,332            | 870      | 11,474      | 1,476    |
| Number of manufacturing processes | 43,578           | 1,985    | 65,840      | 1,722    |

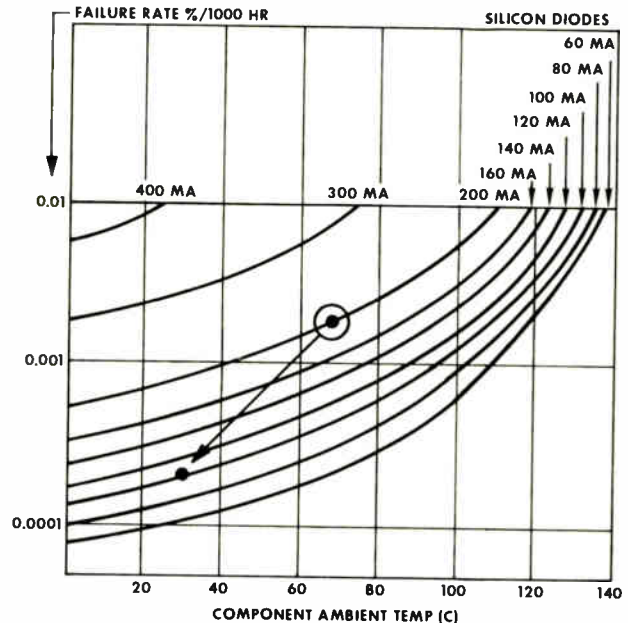
## Maintenance in Space Operations

The maintenance concept in space operations is related to desired operating life. The classic failure rate curve (Fig. 1) illustrates that for a given failure rate, the "burn-in" period must be exceeded, and the wearout period must not be reached.

A 50,000-hour MTBF (Mean Time Between Failures) can be achieved by a component with a statistically predictable failure rate of 2%/1000 hours with a component life expectancy of either 5000 hours or 50,000 hours. The difference is that the 5000-hour life expectancy component must be replaced every 5000 hours, or 10 times more often than the 50,000-hour device.

In earthbound operations, the cost of the 5000-hour component may be low enough to allow for the programmed replacement. Space mission requirements may be such that the 5000-hour life component

Fig. 4. Design engineer may achieve reliability through de-rating by adjusting power loads and environmental stresses.





with a 50,000-hour MTBF will ensure mission success. However, if the life of the mission is extremely long, the 50,000-hour life component will be needed because maintenance is not available.

### Simplicity vs Redundancy

There are two types of redundancy to consider—that of the multiple path circuit, typical of the “majority type circuit” or “quad type circuit,” and that of the multiple subsystem. Component redundancy is not generally accepted, even though it can reach basic circuit reliability to two or three orders of magnitude.

Component redundancy increases requirements on circuit parameters, decreases circuit drive, is slower in propagation time, and uses more voltage and thus more power. These factors make component redundancy undesirable in space environment.

Redundant subsystems, such as identical transmitters, will be used in space applications wherever straight forward control of stresses will not give the reliability required. Absolute control of processes and stresses is the preferred reliability method.

Work accomplished at Autonetics on the Minuteman system has proven that absolute process and stress control offers reliability with simplicity, plus minimum cost and weight. Redundancy is required only where the performance of a given mode is extremely critical, and where confidence limits are low enough to justify power drain and weight penalty.

### Components Must Be Limited

To maintain absolute process control, component part types incorporated into the system must be limited. Because there is only a selected number of parts, the parameter distribution for each component part can be determined as a function of stress. That is, parameter distribution can be determined as a function of voltage, current, power, tem-

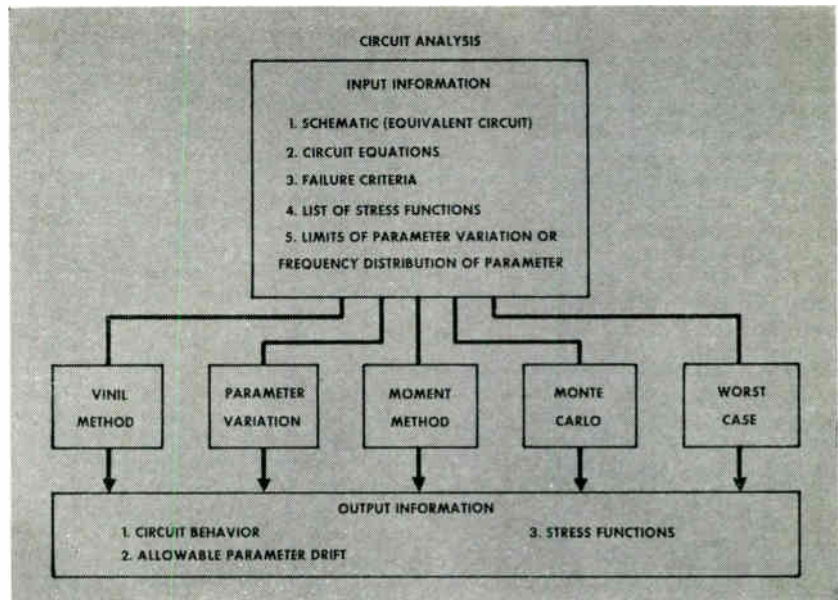


Fig. 5. Information needed, methods available, and some information gained from computer methods of circuit analysis.

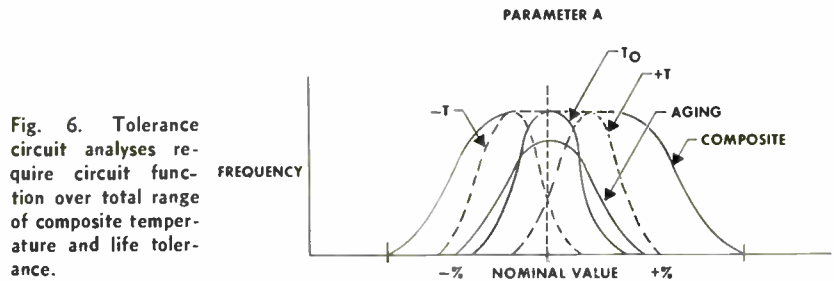
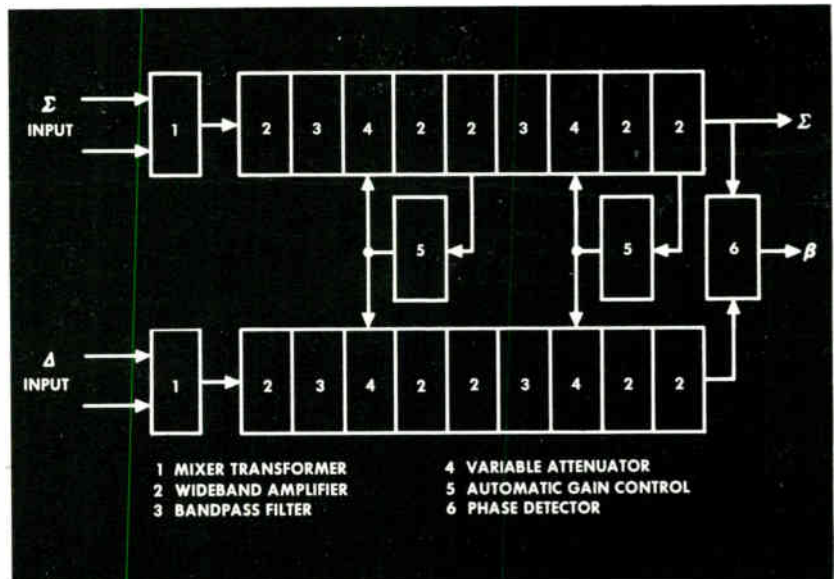


Fig. 6. Tolerance circuit analyses require circuit function over total range of composite temperature and life tolerance.

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Fig. 7. An example of how standardized thin-film microelectronics are used in 60-mc monopulse i-f receiver amplifier.



perature, and other stresses as a function of component life.

In designing equipment, distribution of applied loads (stress) and capacity to withstand each load (strength) must be considered. See Fig. 2. The relationship of these two distributions determines the probability of failure by the area of the overlap between the two distributions. Safety margins based on nominal values are inadequate. The shaded areas show how the probability of failure can vary according to stress and strength distribution even though the nominal value safety margin is quite large. It is important to remember that the strength of an object may not be constant. Strength usually decreases with time.

Fig. 3 illustrates the type of information developed at Autonetics on part characteristics. The figure represents measured distribution of the transistor parameters ( $I + h_{fe}$ ) for various points in time. By projecting the percentile line from known points in time, it is possible to predict distribution. The cross-hatched area represents parts that failed because of excessive drift.

Derating is the direct reduction of stress. The design engineer must analyze the circuits and determine the stresses to which parts will be subjected. By using derating curves, the engineering can perform a trade-off study involving gain in failure rate realized by pitting higher-rated parts against their additional weight and volume.

### May Vary Failure Rate

The engineer may vary the failure rate of each part by adjusting power loads and other environmental stresses the part must withstand. An example of reliability through derating information is shown in Fig. 4.

The initial phase is identical for all methods of circuit analyses, except preparation of part-parameter data (Fig. 3). An equivalent circuit is written as a linear representation of the physical system. The equivalent circuit should include circuit inputs and outputs, considering load impedance, input signal, and input generator impedances.

After the equivalent circuit is developed, the circuit equations are derived, reduced to matrix form and analyzed by a high speed digital computer. Fig. 5 shows information needed, methods available, and some information gained by using these analysis methods.

Included in these analyses is information on the distribution of each parameter including environmental and aging effects. The tolerance circuit analysis requires that the circuit will function over the total range of composite tolerance as indicated in Fig. 6.

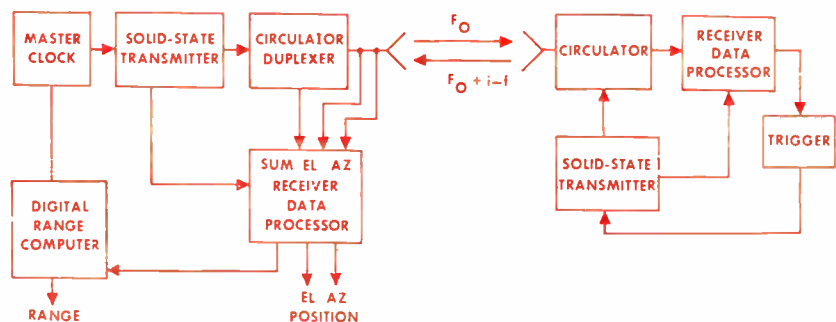


Fig. 8. Space rendezvous radar system is a good example of the use of microelectronic circuits in space applications.

### Microminiature Electronics

Microelectronic design is being used first in spacecraft, missiles, and advanced military aircraft. Prime requirements for these applications are high reliability and lower power dissipation. Small size and low weight is extremely valuable in mis-

sile and space applications; the greatest emphasis is on low weight.

The total reliability of any system is determined by the individual reliability of its parts. To have the highest possible equipment reliability, we must use components that have the greatest individual reliability.

For a number of reasons it is safe to predict that microelectronics will have increased reliability over discrete components. Microelectronic circuits require fewer materials and production processes than do present discrete component circuits. The number of mechanical interconnections (soldered and welded joints) will be reduced sharply as entire surfaces are bonded to each other.

Further, the use of microcircuitry will shrink the overall parts count as well as steps in assembly and testing. Redundancy can be fully exploited because of the small size of the equipment.

### Microminiaturization Methods

There are at least three dozen microminiaturization methods available or in development. All of them fall into three general categories:

(1) high-density packages, (2) thin film, and (3) solid-state circuits. The three categories do not represent alternative solutions.

In most applications the equipment will be hybrid combinations of two or three microminiaturization methods and conventional miniature

circuit design as well. The Armament Control Division of Autonetics has developed approximately 20 standardized circuits which include linear and digital functions for radar applications. The linear circuits are thin-film and the digital are semiconductor integrated circuits.

An example of how standardized linear thin-film microelectronics are utilized in 60 mc monopulse i-f amplifier is shown in Fig. 7. There is some evidence that thin-film microcircuits have increased radiation resistance over other forms of microcircuits.

### Rendezvous Radar Good Example

A rendezvous radar system is illustrated in Fig. 8. This system is a good example of the use of microelectronic circuits in a space application. The radar and beacon primarily use linear circuits while the range tracking computer uses digital circuits. The characteristics of the radar are listed below:

1. Peak power—0.75 watts.
2. PRF—180 pps.
3. Frequency—X-band
4. Weight—24 pounds.
5. Input power—36 watts.
6. MTBF—10,000 hours (solid state).

Table 2 is a comparison of processes and connections in solid-state and microelectronic versions. The comparison includes only those components common to the electronics of the system and do not include common elements such as antennas and integrated cooling structure.

The solid-state components are Minuteman high-reliability quality. The numbers are relative and they illustrate the large reduction of process steps and mechanical interconnection achieved through the use of microelectronics.

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# NEW TECH DATA

for Engineers.

## High-Power Loads

Data describes 2 high-power loads (air-cooled and water-cooled) which feature high temp., high heat conductivity, good thermal shock and virtually no cycling effects. These important characteristics are possible because of techniques developed in the use of high temp. refractory silicon carbide. This basic absorbent material remains stable to 2000° in air. Typical vswr is a max. of 1.08 at  $f/\lambda_0$  of 1.9. The air-cooled series is available in models having average power ratings over a range of 10 to 5,000 w. (max. peak power 0.005 to 3.0 megawatts). The water cooled series is available in models having average power ratings over a range of 5000 to 8000w. (max. peak power 0.15 to 3.0 megawatts). DeMornay-Bonardi Corp., 780 South Arroyo Pkwy., Pasadena, Calif.

Circle 238 on Inquiry Card

## Strain Sensors

Information is available on semiconductor strain gage and sensor elements. Both single and multi-element strain sensors are offered. Some of the sensor elements detect normal stress independent of shear stress, while the other sensor elements are designed to detect shear stress independent of normal stress. Prices and sales data are given on the 17 models. General Electric Co., Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

Circle 239 on Inquiry Card

## Pressure-Vacuum Pumps

A spec. sheet aids in designing and specifying pressure-vacuum pumps for airborne, environmental simulation and ground support systems. It introduces plan under which engineers can specify operating parameters of their system. From this data, pumps are application-fitted. Aero Devices Co., a div. of Guide Manufacturing Co., 8218 Lankershim Blvd., No. Hollywood, Calif.

Circle 240 on Inquiry Card

## Deep Test Facilities

Brochure describing outdoor under-water deep test facility and bulletin on indoor test facility are available from General Dynamics/Electronics, 1400 N. Goodman St., Rochester 1, N. Y. Both of these facilities are available to government and industry for test programs. Rates are on a time and material basis. Test programs have been conducted at both facilities for BuShips, BuWeps, (and their laboratories), and for several private contractors. In some instances facility personnel made the measurements, and in others they assisted other organizations' measurement personnel.

Circle 241 on Inquiry Card

## Resistance Thermometers

Application Bulletin 1, "Resistance Temperature Transducers," 13 pages, discusses the properties of resistance materials, mechanical considerations affecting resistance temp. transducers, and design features. It compares resistance thermometers with thermocouples, includes tables, graphs, drawings, and a brief historical note. Nova-Netics Corp., 232 Glasgow Ave., Inglewood 1, Calif.

Circle 242 on Inquiry Card

## Hall-Effect Multipliers

Models ML-21B, 25B, and 27B are Hall-effect magnetic circuits which feature increased stability when operating in varying amb. temps. Coil inputs range from 15ma to 14a; the max. output is 600mv. The circuits can be linearized to better than 1%. Ohio Semiconductors, 1205 Chesapeake Ave., Columbus 12, Ohio.

Circle 243 on Inquiry Card

## SCR Commutating Capacitors

"Capacitors for SCR Commutation Applications," GEC-155, describes low equivalent series-resistance designs for silicon controlled rectifier commutation and other similar sq. wave voltage uses. The 8-page brochure is intended to help circuit designers select the proper capacitor for use with "breadboard" development work for SCR commutation. Covered in the application data are topic headings on commutation period, power loss, size, weight, life, capacitance tolerance, and capacitance vs. temp. Photos, typical capacitor curves, voltage and current graphs, and outline drawings are included. Marketing Section, Capacitor Dept., General Electric Co., Hudson Falls, N. Y.

Circle 244 on Inquiry Card

## Direct-Writing Recorders

"Direct Writing Recorders," a new short form catalog, describes recorders which have an exclusive direct-carbon transfer writing technique which offers good freq. response at full pen deflection. These recorders are used for test instrumentation, research, aerospace vehicle check-out and tracking, analog computer read-out and telemetry recording, industrial process and control analysis. American Optical Co., Instrument Div., Buffalo 15, N. Y.

Circle 245 on Inquiry Card

## Zener Regulators

This bulletin describes 10w. silicon zener regulators. Nominal voltage ratings range from 6.8 to 200v; test current ranges from 12ma. to 370ma. Diodes, Inc., 7303 Canoga Ave., Canoga Park, Calif.

Circle 246 on Inquiry Card



# NEW TECH DATA

for Engineers.

## Telemetry Transmitter

Catalog No. 290PC, a 2-color brochure on airborne VHF/FM 2w. telemetry transmitters is now available from Advanced Electronics Corp., Hicksville, L. I., N. Y. The literature describes and illustrates 2 new transmitters for the 215 to 260mc range. Complete physical and electrical specs, as well as performance characteristics are detailed.

Circle 247 on Inquiry Card

## Ferrite Circulators

Data is available on 2 wideband ferrite circulators that eliminate the need for magnetic shielding. Equipped with full magnetic shielding, the units are designed for uses requiring small rugged units capable of operating over wide freq. ranges. One unit, a 3-port coax. circulator, provides 20db minimum isolation and 0.4db max. insertion loss from 2gc to 4gc. VSWR is less than 1.3 to 1.0 over this frequency range. Second unit, a 3-port circulator with coax. connectors in a tee shape, provides 20db min. isolation and max. insertion loss of 0.4db from 3gc to 4gc. Sylvania Electric Products Inc., 1100 Main St., Buffalo, N. Y.

Circle 248 on Inquiry Card

## PIN Diodes

A new series of high-voltage silicon PIN diodes for microwave switching are described in catalog MS-6000. Features incorporated include low insertion loss and high isolation characteristics, high reliability and miniaturization. A complete spec. chart for both the microwave pill and coaxial pin package is shown, along with electrical characteristics and actual size schematics. Micro State Electronics Corp., 152 Floral Ave., Murray Hill, N. J.

Circle 249 on Inquiry Card

## Groupable Potentiometers

New tech. data sheet on Daystrom 319 Series groupable potentiometers provides complete specs. Twenty-four individual cups can be grouped in a space of 6 in., then individually phased without interference to adjacent cups. Ideal for multi-channel uses where space and weight are critical, the 319 Series offers good resistance to shock, vibration, and other severe environmental influences. Weston Instruments & Electronics Div., 614 Frelinghuysen Ave., Newark 14, N. J.

Circle 250 on Inquiry Card

## Telecommunications Equipment

Catalog describes solid-state telecommunications equipment. This book includes tech. data on teleprinter relay, repeaters, polarized high-speed telegraph relays and transistorized high-speed telegraph relays. Trepac Corp. of America, 30 W. Hamilton Ave., Englewood, N. J.

Circle 251 on Inquiry Card

## Space Activities

A 3-color, 28-page booklet describes space activities and capability of the Westinghouse Air Arm Div. Well-illustrated publication outlines the division's work on the Gemini rendezvous radar, the UK-2/S-52 international scientific satellite, and related space projects. Westinghouse Air Arm Div., Box 746, Mail Stop 210, Baltimore 3, Md.

Circle 252 on Inquiry Card

## Radar System Capabilities

Canoga Electronics has published a 20-page brochure on its systems capability in radar, telemetry trackers, digital data handling, antennas and pedestals, beacons and feeds. Canoga Electronics Corp., 15330 Oxnard St., Van Nuys, Calif.

Circle 253 on Inquiry Card

## Tunable Notch Filter

A new 2-color bulletin, NF-1000-321, describes new tunable notch filter, Model NF-1000. This device can be used as a cw interference rejection filter; a means of removing cross modulation products; a versatile carrier on sideband elimination filter; or for investigating spectral distributions in vibration analysis. Correlated Data Systems Corp., 1007 Air Way, Glendale, Calif.

Circle 254 on Inquiry Card

## Two-Axis Gyro

Gyro G-12 has no gimbal rings, flexes, and pivots. G-12 design eliminates all mechanical and electrical connections from the gyro housing to the float. It has an operating life of 20,000 hrs.; weight 1.5 lbs.; measures 3 in. in dia.; requires no power during storage and shipment; features extremely rapid start up. American Bosch Arma Corp., Garden City, N. Y.

Circle 255 on Inquiry Card

## Instrumentation Printer

Bulletin ITR-7 describes new instrumentation printer, which electrostatically records up to 5 columns of numeric characters across 1 in. paper tape at a speed of 300 lines/sec. synchronously or 30 lines/sec. asynchronously. Omnitronics, Inc., 511 N. Broad St., Philadelphia 23, Pa.

Circle 256 on Inquiry Card

## Microwave Switch

The SRL Series SMA N405 microwave switch features a 0.5 in. bandwidth, an insertion loss of 1.25db, and a peak power of 1kw. The weight is less than 2.5 oz. Somerset Radiation Laboratory, Inc., 192 Central Ave., Stirling, N. J.

Circle 257 on Inquiry Card

## Publications

(Continued from page H-9)

"Commerce Business Daily." A daily list of gov't. procurement invitations, subcontracting leads, contract awards, etc. Published by Dept. of Commerce. Subscription \$20 per year. U. S. Dept. of Commerce, Room 1300, 433 West Van Buren St., Chicago 7, Ill.

"Federal Purchasing Directory," a 6-page folder and chart, showing principal agencies and materials bought. Obtainable from General Services Administration, Regional Office Bldg. Wash. 25, D. C., free.

"Procurement Handbook" (1959). By General Services Adm. A very general book but helpful to those selling to GSA. From U. S. Gov't. Printing Office, price \$1.50.

"Selling to NASA." Available free from J. M. Roey, NASA, 1520 H St., N.W., Wash. 25, D. C.

"Selling to AEC." Available free from J. H. Wells, Div. of Contracts, Atomic Energy Commission, Washn. 25, D. C.

"Navy Procurement Directives." (Apr. 1, 1959). Catalog No. D 201.6/10:959. Includes revisions issued irregularly for an indefinite period. In looseleaf form punched for 3-ring binder. Consists basically of a compilation of procurement directives which set forth procurement policies and procedures to be followed by all purchasing activities of the Department of the Navy. Subscription price \$9, \$2.25 additional for foreign mailing.

"Procurement Handbook." Catalog No. GS 2.6:3:P 94. \$1.50.

"Provisions Governing Qualification (qualified products list) (Mar. 1961). Catalog No. D 7.6:Q 2/961. 15 cents.

"Small Business Specialists and Advisors, by Organization and States." (Contains the addresses of the field offices which conduct purchasing for the Army.) Catalog No. D 101.22:715 3. 15 cents.

"Selling to AEC" (organization and purchasing program, directory of purchasing offices, lists of products purchased, information on atoms for peace). (Includes enclosure entitled Principal Construction Contractors, and Subcontractors on AEC Projects, 1958.) Catalog No. Y 3.A1 7:2 Se 4/2/961. 25 cents.

"Selling to Navy Prime Contractors." Catalog No. D 201.2Se 4/2/961. 50 cents.

"U. S. Government Purchasing, Specifications and Sales Directory. Catalog No. SBA 1.13/3:962. 60 cents.

"Index to Navy Procurement Information." Catalog No. D 201.6 11:962. 50 cents.

"Air Force Procurement Instruction." (Dec. 1960) Catalog No. D 301.6/4:960. Includes supplementary material for an indefinite period. In looseleaf form, punched for 3-ring binder. Implements the Armed Services Procurement Regulation and establishes for the Department of the Air Force uniform policies, procedures, and instructions relating to the procurement of supplies and services. This instruction applies to all purchases and contracts for the procurement of supplies and services which obligate appropriated funds (including available contract authorizations). Subscription price \$28, \$8 additional for foreign mailing.

"Armed Service Procurement Regulation." (Being revised.) Catalog No. D 1.13:963. Includes supplementary material for an indefinite period. Revised pages not sold separately. In looseleaf form, punched for 3-ring binder. This regulation establishes for the Department of Defense uniform policies and procedures relating to the procurement of supplies and services under the authority of chapter 137, title 10, United States Code, or under other statutory authorization. The regulation applies to all purchases and contracts made by the Department of Defense, within or without the continental United States, for the procurement of supplies or services which obligate appropriated funds. Subscription price \$15, \$4 additional for foreign mailing.

"Department of Defense Small Business Specialists Designed to Assist the Businessman." (Small Business specialists of the Department of Defense procurement offices are available to assist businessmen in obtaining information and guidance on defense procurement procedures how to be placed on the bidder's mailing list and identification of both prime and subcontract opportunities. Catalog No. D 1.2:Sm 1/2 25 cents.

# SECTION J

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## MICROWAVE

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|                                      |    |
|--------------------------------------|----|
| Microwave Tubes: After Three Decades | J2 |
| New Developments in Antennas         | J8 |

# MICROWAVE TUBES: AFTER THREE DECADES

Conceived more than thirty years ago, microwave tubes are still undergoing a rapid evolution. Reductions in size and weight and increases in power and efficiency have produced the new generation of tubes discussed in this report.

MINIATURIZATION IS THE CRY OF MODERN ELECTRONICS and microwave tubes are no exception. The needs of industry for smaller, efficient components have produced microwave tubes that would amaze earlier designers. Here are a few of them.

## Low-Noise TWTs

The traveling-wave tube, unique for its extreme wideband capabilities, has been available as a low-noise amplifier for about ten years. During this time the attainable noise figure has steadily decreased and, at present, noise figures of 3 to 5 db are available in L- and S-bands.

Recent developments have resulted in a tremendous improvement in reliability, convenience, and adaptability to a wide variety of systems applications. Chief among these advances are permanent-magnet focusing, the integration of the power supply into the amplifier package, extension of low-noise techniques to higher frequency bands, and the maintenance of tight tolerances on performance characteristics. Heretofore, solenoid focusing was required to obtain the best noise performance from a traveling-wave tube. The total weight for an amplifier system could be 100 pounds or more. Permanent-magnet focusing has rendered the solenoid and its power supply unnecessary, thus reducing the weight of an amplifier package to between ten and fifteen pounds. Fig. 1 shows the permanent-magnet package used to focus an S-band low-noise tube. Both the outer housing and the cylinder surrounding the magnet are steel, thus confining the external flux. Consequently, identical units can be operated side by side without mutual magnetic interference.

As a further step toward operational simplicity, the power supply needed for tube operation has been built into the amplifier package. Amplifiers of this type operate over the 1 to 2 gc band with less than

5 db noise figure, and from 2 to 4 gc with under 5.5 db. Small-signal gain in each case is 25 db minimum. Fig. 2 shows an L-band low-noise amplifier with integral power supply.

Work is being carried on to extend these results to higher frequency bands. Experimental tubes have yielded noise figures between 5 and 6 db in X-band, and between 8 and 9 db K<sub>u</sub>-band. Permanent-magnet focusing will also be applicable in these bands. K<sub>u</sub>-band and millimeter-wave tubes are also under development, with an expected noise figure of 10 db or under.

Certain applications, such as phased-array radars, require that tubes be matched one to another to a high degree of accuracy. This is accomplished by maintaining close control over mechanical tolerances and by practically eliminating reflections due to mismatches at input and output terminals and at the mid-section attenuator. For example, permanent-magnet focused tubes operating over a 15% bandwidth in L-band with noise figure between 3.5 and 4 db have been matched in gain to  $\pm 0.3$  db and in phase to  $\pm 2$  degrees.

## TWTs for Space

The use of traveling-wave tubes in satellites or other space vehicles has produced a new generation of these devices. Although only modest power (typically 1 to 20 watts) is required, other factors such as efficiency, reliability and life, minimum size and weight, and the rigors of the space environment place special restrictions on the tube design.

Tubes have been developed for space programs

By Dr. DEAN A. WATKINS

President,  
Westinghouse Co.,  
San Jose, Calif.



such as Telstar, Syncom, Relay, Advent, and others. These tubes were developed by Bell Telephone Laboratories, Hughes Microwave Tube Division, RCA Tube Division, and Watkins-Johnson Company respectively. Typical performance characteristics are:

- Power output—2 to 35 w
- Center frequency—1.7 to 8.5 gc
- Bandwidth—20 to 100%
- Gain—30 to 35 db
- Efficiency—25 to 35% (depending on mode of operation)
- Weight—1 to 3 lbs.
- Volume—Less than 40 cubic in.
- Vibration—10 to 50 g, 20 to 3000 cps
- Shock—50 to 100 g, 11 millisecc duration
- Temperature—50°C to +85°C
- Cooling—Conduction
- Life—Greater than 20,000 hrs.
- Focusing—PPM or single reversal PM

This specification is not intended to be all inclusive but merely to give a general impression of this new breed of traveling-wave tube.

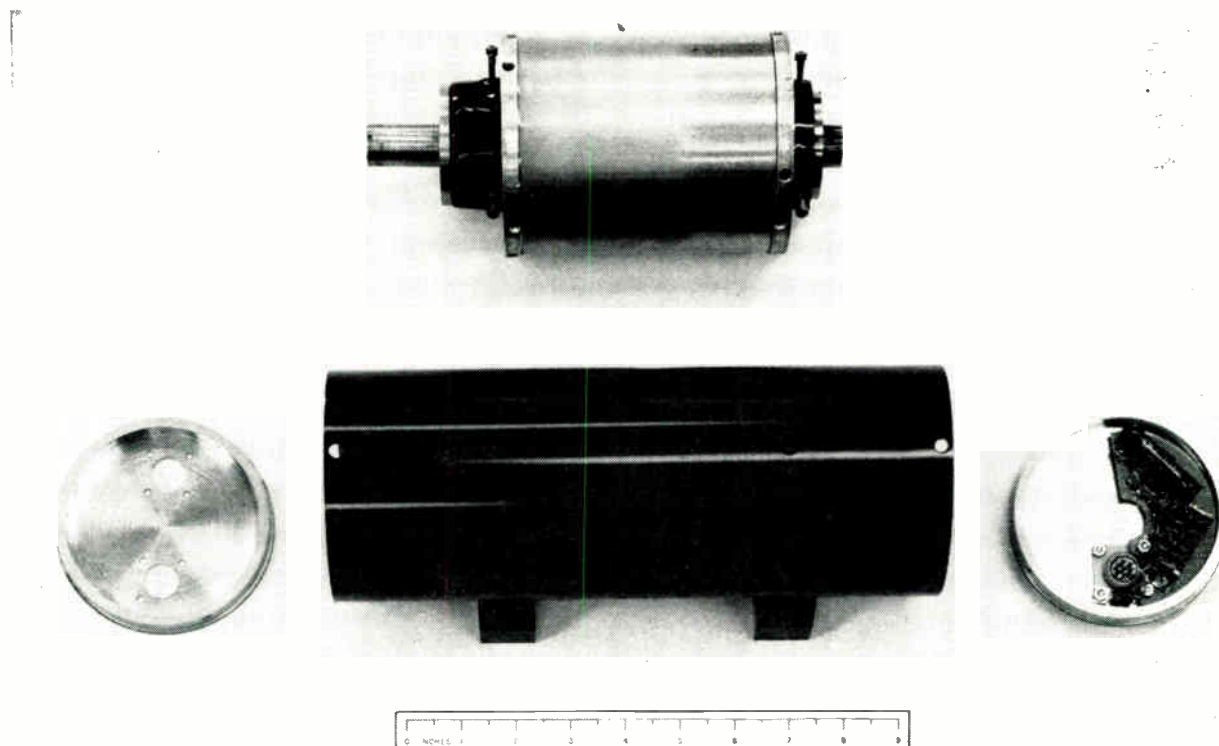
Fig. 3 shows the WJ-227 which is a 10 to 20 watt, 2 to 3 gc tube developed for space applications. It is 13.5 inches long and weighs 35 ounces. The efficiency including heater power is 27%; without heater power the efficiency exceeds 30%. Special versions of this tube have exhibited efficiencies without heater power of 39%.

### Future Tubes

Currently the major development effort is being devoted to efficiency improvement and weight reductions. Over-all tube efficiency can be improved by increasing the electronic (or interaction) efficiency, by improving the depressed collector design (reduction of power input), and by reducing the heater power. The basic interaction efficiency is a function of the tube design parameters such as circuit diameter and impedance, beam diameter and impedance, and space charge. Once these are optimized, the power lost in heat is reduced by operating the collector at a lower potential than the slow-wave interaction circuit.

The tubes mentioned previously have uniform helix circuits and single-stage depressed collectors. Improvements in laboratory tubes have been obtained by reducing the circuit phase velocity near the output of the tube, thus keeping the electrons more nearly in synchronism with the beam as its kinetic energy is extracted. Multi-stage depressed collectors have also reduced input power. The present 40% and higher efficiencies now measured on laboratory models should be available in flight models perhaps within one year, and with continued research even higher values may be possible. Life tests on the BTL 1789 tube have already demonstrated over 50,000 hours/tube on a 12 tube sample, and major difficulties have

Fig. 1: The permanent-magnet package eliminates the need for the solenoid focusing system and its power supply.



## MICROWAVE TUBES (Continued)

been overcome in meeting the present launch and flight environments.

Additional weight and size reductions can be expected as higher perveance electron beams are used.

Higher perveance (perveance =  $\frac{I_0}{V_0} \cdot 3/2$ ) means higher gain per unit length and therefore shorter tubes. Higher perveance electron beams are more difficult to focus, however, so that improvements in beam focusing must precede the use of these beams.

Another area of current interest is the distortion and additional frequency components produced by multi-signal operation. These effects, known as cross-modulation and intermodulation, can have significant bearing on the design of communication equipment. Small signal theory and results are presently available, but more information and study is needed under large signal conditions where tube efficiency is high.

### PHASED-ARRAY TUBES

The increasing requirements on radar scanning, acquisition, and tracking have intensified interest in phased-array systems. Although this system can be achieved by splitting the power of a few tubes into many transmission lines and using a phase shifter to adjust each of the individual lines, there are good reasons for using a separate tube in each output line. Using many tubes places severe restrictions on the phase characteristics of the tubes and requires them to be as identical as possible in performance. In addition, efficiency, size and weight, reliability and life,

Fig. 2: Operating simplicity is increased by building the tube's power supply into the amplifier package.



and cost are all very important when a system requiring 1000 or more tubes is contemplated.

Both traveling-wave tubes and crossed-field amplifiers have been considered for these systems. Crossed-field tubes have higher efficiencies, and due to lower-voltage, higher-current operation they may be less phase sensitive to voltage changes. Traveling-wave tubes have higher gain, are easier to modulate, and have better form factor for phase-array stacks. In order to compare these two types of devices, some specific examples of each tube type will be given. More tubes have been developed for phased-array systems, but these are believed to be typical.

**Crossed-Field Tubes** consisting of a two-tube chain of tubes at L-band is being developed at S-F-D Laboratories for phased-array application. The following data shows the present status of development.

| Characteristic                           | Driver Tube (SFD-209)  | Power Tube (SFD-208)   |
|--|------------------------|------------------------|
| Center frequency                         | 1.250 gc               | 1.250 gc               |
| Gain                                     | 15.2 db                | 8.4 db                 |
| Peak output power                        | >100 kw                | 700 kw                 |
| Bandwidth                                | 8%                     | 5%                     |
| Operating voltage                        | 8 kv                   | 35 kv                  |
| Efficiency                               | 35-50%                 | 65%                    |
| Tube diameter (without magnet)           | 3 $\frac{5}{8}$ inches | 3 $\frac{5}{8}$ inches |
| Magnet cross-section                     | 6 x 6 inches           | Not determined         |
| Control electrode $\mu^*$                | 3                      | None                   |
| Phase change for 1% variation in voltage | >3°                    | Not measured           |

\*Turn-on time is 30 to 50  $\mu$ sec; turn-off time is 0.15  $\mu$ sec.

**Three Traveling-Wave Tubes** have been developed at Watkins-Johnson Company which are suitable for phased-array systems. Some of their characteristics are:

| Characteristic                        | Transmitting             |              | Receiving            |
|---------------------------------------|--------------------------|--------------|----------------------|
|                                       | (WJ-228)                 | (WJ-234)     | (WJ-252)             |
| Gain                                  | 43 db                    | 13 db        | 22 db (small signal) |
| Peak power output                     | 13-18 kw                 | 100 kw       | -3 dbm (cw)          |
| Center frequency                      | 5.66 gc                  | 1.29 gc      | 1.3 gc               |
| Bandwidth                             | 8.8%                     | 15.5%        | 15.4%                |
| Operating voltage                     | 23 kv                    | 21 kv        | 90 v                 |
| Efficiency                            | 22-30%                   | 30%          | Not applicable       |
| Tube and magnet cross-section         | 2 $\frac{5}{8}$ in. dia. | 4 in. dia.   | 4.5 in. dia.         |
| Control grid $\mu$                    | 46                       | 60           | None                 |
| Phase change for 1% voltage variation | 25°                      | 3°           | 30°                  |
| Maximum phase variation tube to tube  | $\pm 7.5^\circ$          | Not measured | 3°                   |
| Noise figure (typical)                | 50 db                    | Not measured | 3.6 db               |

The WJ-228 is shown in Fig. 4. Although the phase sensitivity in the WJ-228 is larger than the refer-

enced crossed-field tubes, the gain and consequently the number of wavelengths is correspondingly much greater. If the beam perveance ( $I_0/V_0^{3/2}$ ) is increased and the gain reduced as in the WJ-234, a more comparable figure results.

The choice between these two competing devices will depend upon the particular system characteristics as both types have unique capabilities. The technical problems, although not completely solved in all cases, appear to be well on the way to solution. However, the most significant problem still remaining is cost. For these systems to be practical, significant reductions in tube cost must result. Many pessimistic predictions about the future of these systems have been made on the basis of tube cost. Due to the small quantity demand and ever changing product designs, microwave tube production is presently a job-shop type of activity where little automation has been introduced. Once the capability and clear demand for these tubes in really large quantities is actually present, there is little doubt that microwave tube production techniques can be re-oriented to mass-production methods.

### CROSSED-FIELD AMPLIFIERS

Crossed-field amplifiers are classified into two general types: reentrant-beam tubes, in which the current circulates continuously around a cylindrical cathode, and nonreentrant-beam tubes. The reentrant-beam tubes can use either a backward-wave or a forward-wave circuit structure. The backward-wave tubes built by Raytheon are called Amplitrons. In the Amplitron tubes, the drift space between the input and output is short so that the electronic feedback is very strong. Forward-wave tubes have been built with short drift spaces and with drift spaces long enough to result in demodulation of the electron stream.

Nonreentrant beam tubes are of two types: tubes in which the beam is injected into the circuit region from a gun, much as in a klystron or traveling-wave tube, and tubes in which the sole plate opposite the circuit is a continuous cathode.

#### Characteristics

The reentrant-beam tubes have efficiencies from 55 to 60%, and in some cases reported for low-gain Amplitrons it exceeds 80%. The bandwidth of reentrant-beam tubes with short drift spaces is generally less than about 8% with gains in the order of 10 db, although gains in excess of 20 db have been reported. These tubes behave as locked oscillators. The gain and bandwidth restrictions are imposed be-

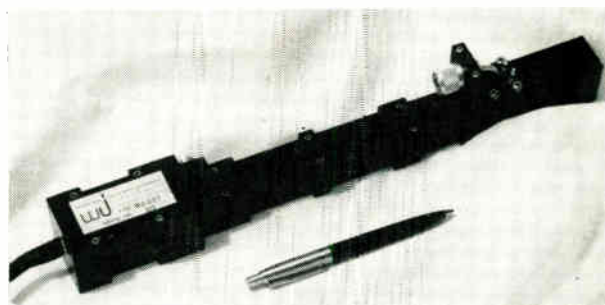


Fig. 3: Developed for space applications, the WJ-227 produces 20 watts and weighs 35 ounces.

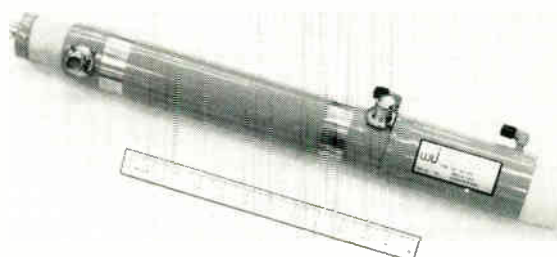


Fig. 4: The WJ-228 is used in phased-array applications. It weighs less than 14 lb., produces 18 KW, and is 34% efficient.

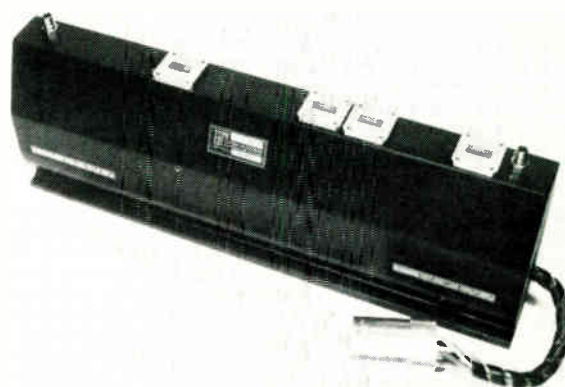
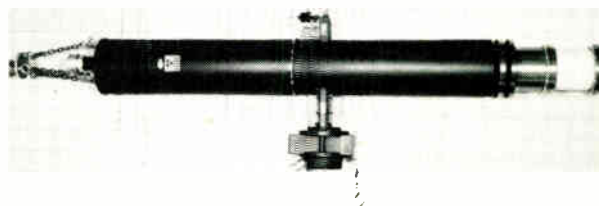


Fig. 5: The L-3652 is an injected-beam crossed-field amplifier which produces 1 KW cw in the freq. range 8.5 to 11 GC.

Fig. 6: This L-band klystron produces 30 megwatts peak power, has 33 db gain, and a 100 MC bandwidth.





## MICROWAVE TUBES (Continued)

cause the tube length must allow positive electronic feedback. Reentrant beam tubes with long drift spaces do not have the same restrictions, but thus far gains have not been greater than 20 db at 10% bandwidth. Tubes with long drift spaces have efficiencies in the order of 40%.

Nonreentrant-beam tubes have made real progress in achieving wide bandwidth and high gain in a crossed-field device. Fig. 5 shows an injected-beam amplifier, L-3652, developed by Litton that produces 1 kw cw from 8.5 to 11 gc, has a 26 db saturation gain, and has an efficiency of 30 to 35%. This tube has a single circuit sever and behaves as a linear amplifier. Litton is also working on a nonreentrant tube with a distributed emission cathode for higher peak-power levels where the emission densities that would be required from an injection gun become excessive.



Fig. 7: The SE203 covers a freq. range of 5.3 to 6.0 GC and has a minimum power output of 100 milliwatts.

Most of the really high peak and average powers have been achieved with Amplitrons. Raytheon has reported 30 megwatts peak at S-band and 3 megwatts peak and over 40 kw average also at S-band. The major emphasis in the development of other crossed-field tubes has been on gain, bandwidth, and novel pulsing techniques, although peak powers of a megawatt or more have been achieved.

Considerable effort for reentrant-beam amplifiers has gone into "self-pulsing" techniques. Ideally, a self-pulsed tube has a cold secondary-emission cathode that allows a dc voltage to be applied to the tube without drawing current. The introduction of an r-f drive signal causes sufficient electrons to bombard the cathode, thus producing secondary emission and amplification. Removing the r-f drive signal causes amplification to cease. In practice, turn on is accomplished in a time which corresponds to several electron transits around the circuit. However, oscillation continues in a space-charge mode or circuit cutoff

mode after the drive pulse has been removed. Turn off is accomplished by placing a positively pulsed electrode in the drift space between input and output to draw the electrons out of the interaction space. The mu of this electrode is about 3.

All reentrant-beam type devices can operate without heaters. Continuous emission nonreentrant-beam tubes can operate with only the first part of the cathode heated. Litton is using an injection gun to trigger secondary emission from a continuous cathode. Conduction is, therefore, controlled by the grid.

### High-Power Klystrons

At present 25 to 30 megwatts peak power is the state-of-the-art at S-band and lower frequencies. At C-band, the peak power level is about 5 megwatts, and at X-band, where little work has been done on high peak-power tubes, the power level is about 1 megawatt. There are virtually no high peak-power klystrons above X-band. The projected peak power level at the lower frequencies is 50 to 75 megwatts. The major problem at this time is the r-f window. A single-surface multipactor effect in which electrons leave the window surface and return with additional energy results in heating and eventual cracking of the window due to thermal stresses.

The Litton L-3702 (Fig. 6), which produces 30 megwatts peak power and 150 kw average power, best represents the state-of-the-art at L-band. Other tubes are available with 300 kw average power. At S-band state-of-the-art is represented by the tube used in the Stanford Linear Accelerator, which produces 24 megwatts peak power and 24 kw average power. Tubes, however, have been operated at the S-band to about 100 kw average power, and no limitation was found.

The outstanding achievement in CWTs is the Varian single-beam klystron, which has produced 100 kw cw at X-band. General Electric's multiple-beam klystrons have produced 50 kw cw also at X-band. As yet there has not been a corresponding effort to try for maximum cw powers at lower frequencies.

Efficiency of 45% is good in narrow-band tubes that have been tuned for high efficiency. An efficiency of 40% is easily obtained. In wideband tubes efficiencies are typically lower—35% efficiency in a 5% bandwidth tube is good. Where solid-beam gun perveances are as high as  $3 \times 10^{-6}$ , a bandwidth of 5% and a gain of 50 db can be achieved with 7 cavities at the lower frequencies.

### Hollow Beam Tubes

Hollow beam tubes offer the possibility of obtain-

Fig. 8: Power and tuning curves for Steward OD 1-2.6.

ing greater bandwidths without sacrificing efficiency. At L-band, 5% bandwidth at 40% efficiency has been achieved, and a 15% bandwidth does not appear to be difficult. The problem presently being encountered with hollow beam klystrons is the noise associated with the magnetron injection electron gun. This noise is suppressed by a strong r-f drive signal; thus the signal-to-noise ratio during the r-f drive is generally greater than 30 db. However, the noise level during the rise and fall of the voltage pulse before the r-f drive is applied is significantly greater than the level during the drive pulse. This problem is not well understood.

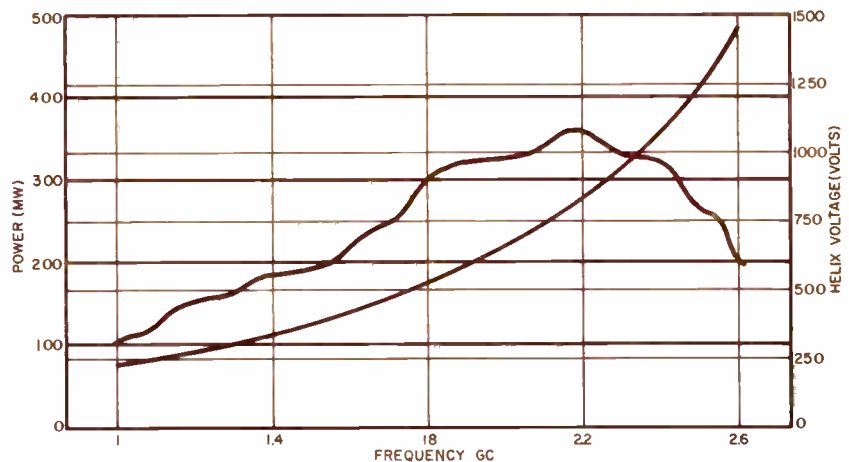
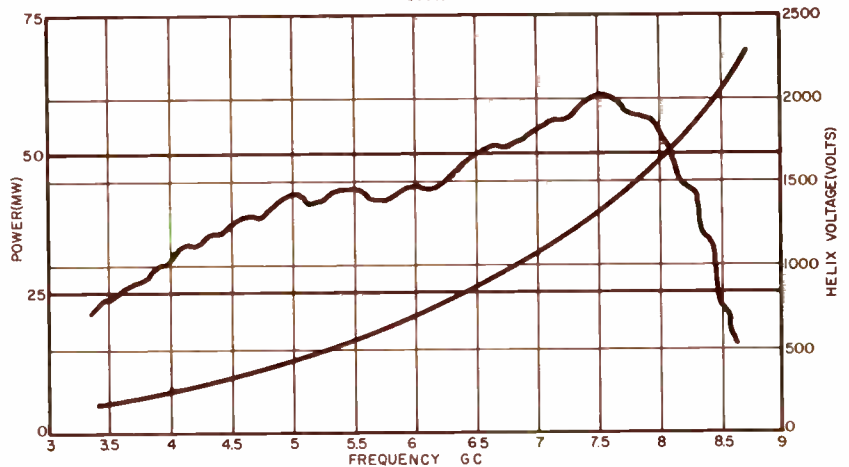


Fig. 9: Power and tuning curves for Steward OD 3.4-8.7.



### Backward-Wave Oscillators

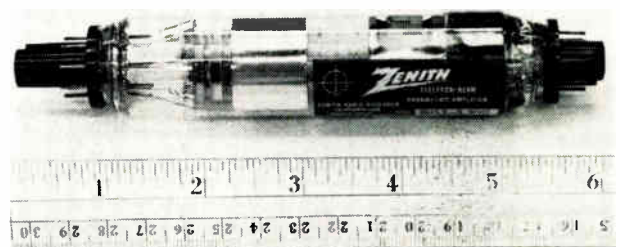
The "O"-type backward-wave oscillator is the highest frequency microwave tube yet produced. Power output of several milliwatts has been obtained by CSF at 500 gc, using a vane-line slow-wave structure and a highly convergent solenoid-focused electron beam. CSF has also built similar tubes operating at 425 gc, 300 gc and 150 gc, and work is being performed on a 750 gc model. Typical tube bandwidths are 10%. Beam-current densities up to 2000 amps/cm<sup>2</sup> have been achieved with cathode density of 1 amp/cm<sup>2</sup>. Usual beam voltages are 4 to 6 kv; beam currents are 10 ma; and focusing fields of 5 to 7000 gauss are required.

In the 40 to 120 gc range, CSF is joined by Bendix and Sperry. The slow-wave structures used are of the Karp type or the vane-line. Power outputs of 10 to 50 milliwatts are available and focusing is either solenoid or permanent magnet. The slow-wave structures used by Sperry are fabricated by photoetching techniques, thus allowing higher production precision and more uniformity of tube performance. Typical beam voltages are 2 to 4 kv; beam currents are 15 to 20 ma; and focusing fields of 2 to 3000 gauss are required.

Below 40 gc there are many companies which produce both solenoid and permanent-magnet focused tubes. These tubes cover all waveguide bands and some octave bandwidths at the lower microwave frequencies. The slow-wave structures are either helix in monofilar or bifilar form or they are interdigital. These tubes are used in commercial applications where wideband tuning is desired. Stewart Engineering's SE 203 (Fig. 7) covers a frequency range of 5.3 to 6.0 gc with a minimum power output of 100 milliwatts. Bifilar helix structures and balun con-

*(Continued on page J18)*

Fig. 10: The 1300 MC degenerate electron-beam parametric amplifier tube. The electron gun is at the left, followed by the input coupler, quadrupole pump, and output coupler.



# NEW DEVELOPMENTS IN ANTENNAS

Antennas are probably the single most costly component of a transmitting/receiving system.

They are also a limiting factor in the art of microwave.

The work being done toward improving antennas is largely in four general areas:

phased arrays, Luneberg lens antennas, traveling wave antennas and radio frequency interference.

FOUR AREAS IN ANTENNA RESEARCH are very active at present and are discussed here. These areas are: radio frequency interference (RFI), phased arrays, Luneberg lens antennas, and traveling wave antennas.

The importance of antenna sidelobes and backlobes has increased because of radio frequency interference (RFI) problems. The geometrical theory of diffraction allows calculation of the complete radiation pattern, including backlobes, of reflector and horn antennas.

In phased array studies the advantages of an adaptively phased array of independently steered elements are being investigated. Phase lock circuitry is used so that the signals from each element can be summed coherently, regardless of phase disturbances.

In research on lens antennas, new types of Luneberg lens antennas have been derived and are being studied. These lenses can scan  $360^\circ$  as well as provide multiple beam formation and appear to be useful for many tasks. Finally, a brief summary of traveling-wave antennas is given. Traveling-wave antennas exist in many forms, mainly in the form of radiating transmission lines.

## Antenna Considerations in RFI

Increasing demands of communications and radar systems mean that many radiating systems will be operated close together. These demands, coupled with higher powers, greater receiver sensitivities and lower noise capabilities lead to increased RFI problems. This means that portions of the antenna radiation pattern previously ignored are now important. Consider, for example, the parabolic antenna which has 3 distinct types of radiation. These are<sup>1</sup>:

1. aperture radiation, or energy radiated by the feed and reflected by the parabolic surface to form the main beam and its side lobes;

2. direct feed radiation, or energy radiated by the feed which is not reflected by the parabolic surface;

3. edge-diffracted radiation, or energy radiated by the feed which is incident on the edge of the parabola and is then diffracted to the rear of the parabola.

The portion of the pattern due to the aperture radiation should be controlled to yield low side lobe levels. Methods for obtaining such low side lobes have been known since World War II<sup>2</sup> and consist of keeping an appropriate aperture distribution. Jacobs<sup>3</sup> notes that for large antennas and short wavelengths, a low side lobe level can be obtained only by meeting certain mechanical tolerances on the parabolic surface.

The unwanted direct radiation may be controlled through the design of the feed antenna. This usually means a larger feed antenna. This yields increased aperture blocking and hence, higher side lobes for the aperture radiation pattern for intermediate-sized antennas. Thus the need to reduce direct feed radiation and reduce aperture radiation side lobes conflict, and in many cases requires a compromise. This type of radiation is not significant for extremely high gain antennas, as the magnitude of the direct feed radiation is independent of reflector size.

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Greater interference problems of modern systems increase the need to examine the edge-diffracted radiation. In many cases, spurious transmitter emissions or spurious receiver responses interfere with fundamental frequency operation of a closely located system. Also, personnel, explosives, etc., at the rear of an antenna may be affected if this radiation is not controlled. This radiation may be reduced by either reducing radiation incident on the edge or by modifying the edge so that the energy incident on it is not diffracted behind the antenna.

The geometrical theory of diffraction<sup>4</sup> has recently been used to compute the diffracted radiation level for a parabola<sup>5</sup> and a horn antenna.<sup>1</sup> By this method calculation of the rear 180° of the radiation patterns

The antenna temperature is a property of large directional antennas that is closely related to side lobe structure. Energy received by an antenna from noise sources is transmitted by the antenna to the receiver where it appears as noise.<sup>6</sup> More precisely, the antenna temperature is defined as the temperature of a matched load which generates the same receiver noise when the matched load replaces the antenna. The antenna temperature is a function of the noise sources and the radiation pattern of the antenna. Among the most important noise sources are the sun, galaxy, radio stars, thermal radiation from the ground and man-made noise. To reduce the antenna temperature at a given site the radiation pattern should be reduced as far as possible everywhere ex-

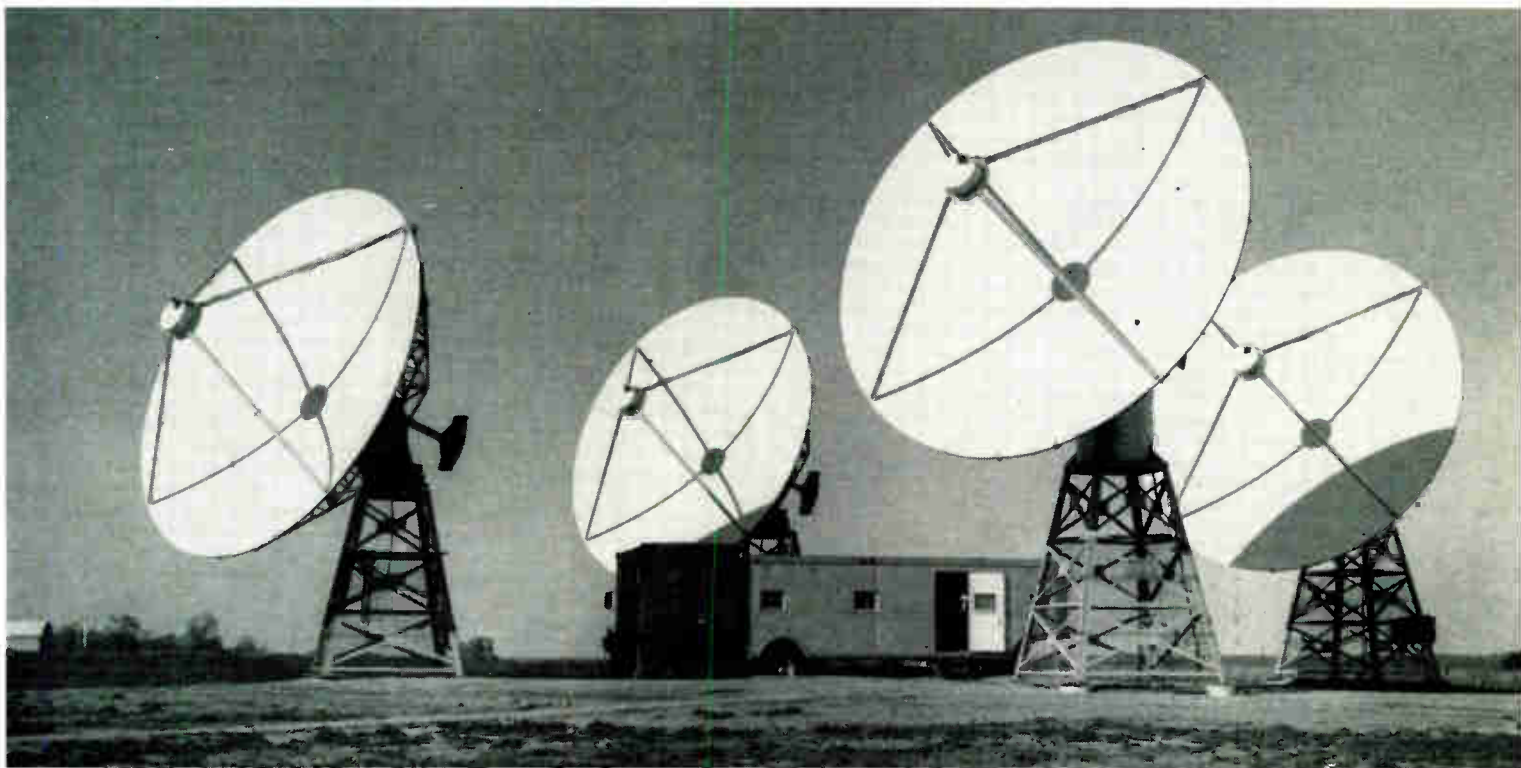


Fig. 1: This array of 30 ft. diameter reflector antennas has been installed at Ohio State Univ. to prove some theories about steered arrays.

of reflector and horn antennas is now practical. Further use of this method should reveal ways for reducing far sidelobes and backlobes.

Greater spurious emissions and responses, which accompany higher transmitter powers and better receiver sensitivities, create RFI at frequencies other than the frequency of a given radar. Consequently, antenna properties at these other frequencies are now important. The spurious frequency radiation patterns may differ from the fundamental frequency pattern, depending on the feed antenna and discontinuities in the transmission line that may excite higher-order modes.

cept near the main beam. The lowest temperature antenna now available is the horn reflector antenna developed by Bell Labs. It was used in the Telstar satellite experiment. It has the disadvantage that it is a huge, unwieldy structure.

Parabolic antennas<sup>7</sup> have been designed with realistic temperatures which may be used in lieu of the reflector horn antenna in many cases without adding much noise. The major exception occurs when the receiver makes use of low noise masers.

#### Adaptively Phased Array

An array of four 30 ft. diameter paraboloidal re-

## ANTENNAS (Continued)

reflector antennas has been installed at Ohio State University.<sup>8</sup> The main purpose of this array is to show the feasibility of self-phasing techniques in an array of independently steered elements. This approach presents several obvious advantages over a single large aperture in achieving high antenna gain at high frequencies.<sup>8,9</sup> This is a new approach and there are several unanswered questions that need to be studied. It is for this purpose that the antenna array was built. In addition to the design as a research tool, careful thought was given to the system so that it would function as an operational site in a communication system using passive reflectors. Right now the array is instrumented for the Echo II sphere. In these experiments, the array will act as a receiver with transmitters being located at Rome, N. Y., and Trinidad, Federated West Indies. A 60 ft.

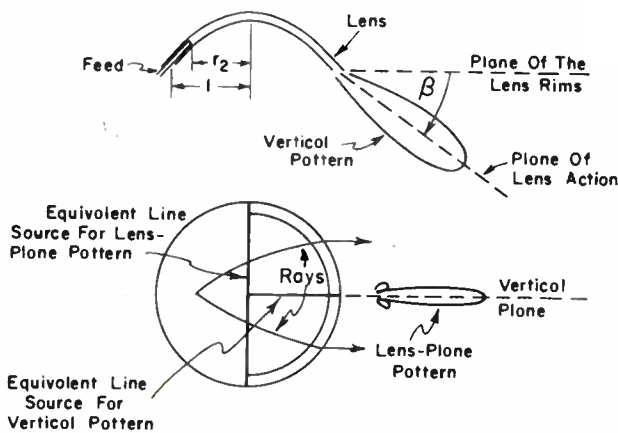
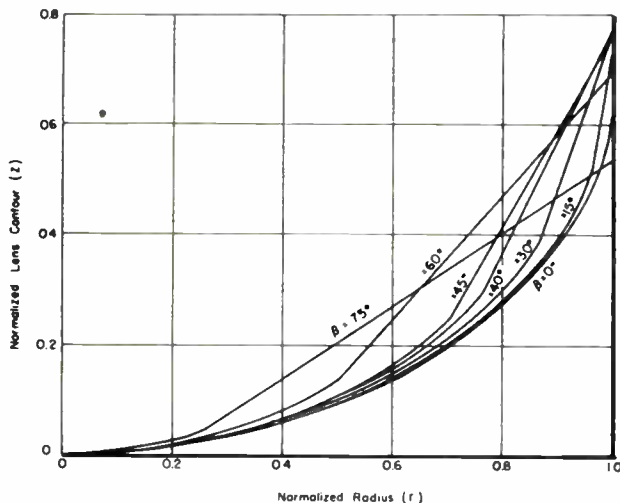


Fig. 2: Antenna lens patterns are shown. Lens action is achieved by proper combination of index of refraction and contour.

Fig. 3: Unit-index contours which have an outer annulus of constant slope and for which the focal radius is  $r_1 = \cos \beta$ .



parabola at Rome, N. Y., which is the aperture equivalent to the antenna array, will function as a receiver also and hence, will afford a good check on the performance of the array.

The array consists of four 30 ft. parabolic reflectors arranged on the corners of a square 60 ft. on a side, with the diagonals located in a north-south and east-west direction. It is shown in Fig. 1. The reflectors can operate up to frequencies greater than 15 mc and are steered by elevation over azimuth mounts. While the mounts have individual servo systems, they can operate in a closed loop where one of them functions as a master and the others are slaves. Input information to the master can be in the form of a remote system source, auto track information or manual position, while input information to the slaves is remote synchro source or manual position.

The antennas are each focal point fed with the capability of a Cassegrain geometry. Each waveguide feed has a parametric amplifier with a 180°K to 300°K noise temperature, mixer-i-f preamp, test couplers and polarization switches. The master also has equipment for the auto track function. The signals from the mixers at 30 mc are distributed by coax cables to a common summing point in a van at the center of the array. Local oscillator signals, as well as the various power and control signals, are fed through cables to each antenna.

There are two tracking functions needed in an array of this type. One is that of mechanically tracking the antennas so that the element patterns will be centered on the signal source for maximum signal. The second function needed is that of electrically tracking the interferometer lobes within the element patterns. This insures that one of the lobes is centered on the signal source for full gain of the antenna system. To accomplish the electrical tracking function, the 30 mc signals are each fed to a phase locked receiver in which the reference signals for the phase detectors are obtained from a common source. In this way each signal is locked in phase to a common source and hence are in phase with each other. Thus, they may be added to obtain an increase in signal to noise ratio.

The auto track function is done by an amplitude monopulse system located in one of the antennas. Tracking is done on the data signal with the master antenna, and the slave antennas are kept collimated with the master by a common servo system.

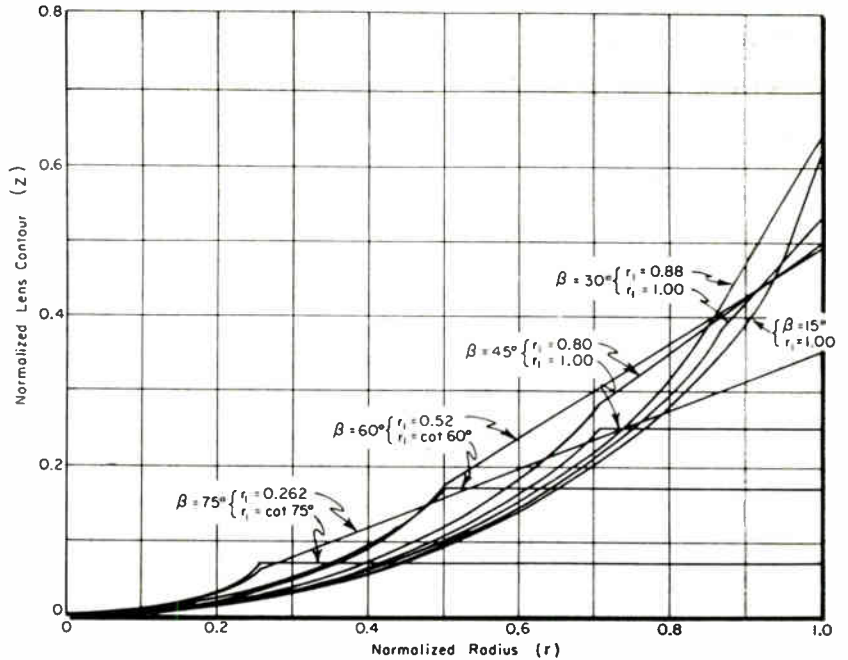
Acquisition in the array is done by decollimating the antennas into a fan beam which is controlled in azimuth, elevation and beam tilt angle. In the acquisition mode, the fan beam is positioned so that its wide

Fig. 4: Unit-index lens contours are shown when the focal radius is  $r_1 > \cos\beta$ .

dimension is perpendicular to the expected trajectory of the signal source. When one of the antennas picks up a signal in its threshold detection circuit, the remaining 3 antennas collimate with it and the tracking is started by means of logic circuitry.

### Lens Antennas

Two classes of multiple beam antennas appear quite promising for use in aerospace vehicles, ground-based installations and satellites. These are the most recent in the general area of circularly symmetric or Luneberg lens antennas. The main feature of these lenses is circular symmetry which provides multiple beam capability as well as scan by feed movement alone. In many cases, this is a major advantage over mechanically-steered antennas, e.g., reflector antennas. The recent lens types have better radiation pat-

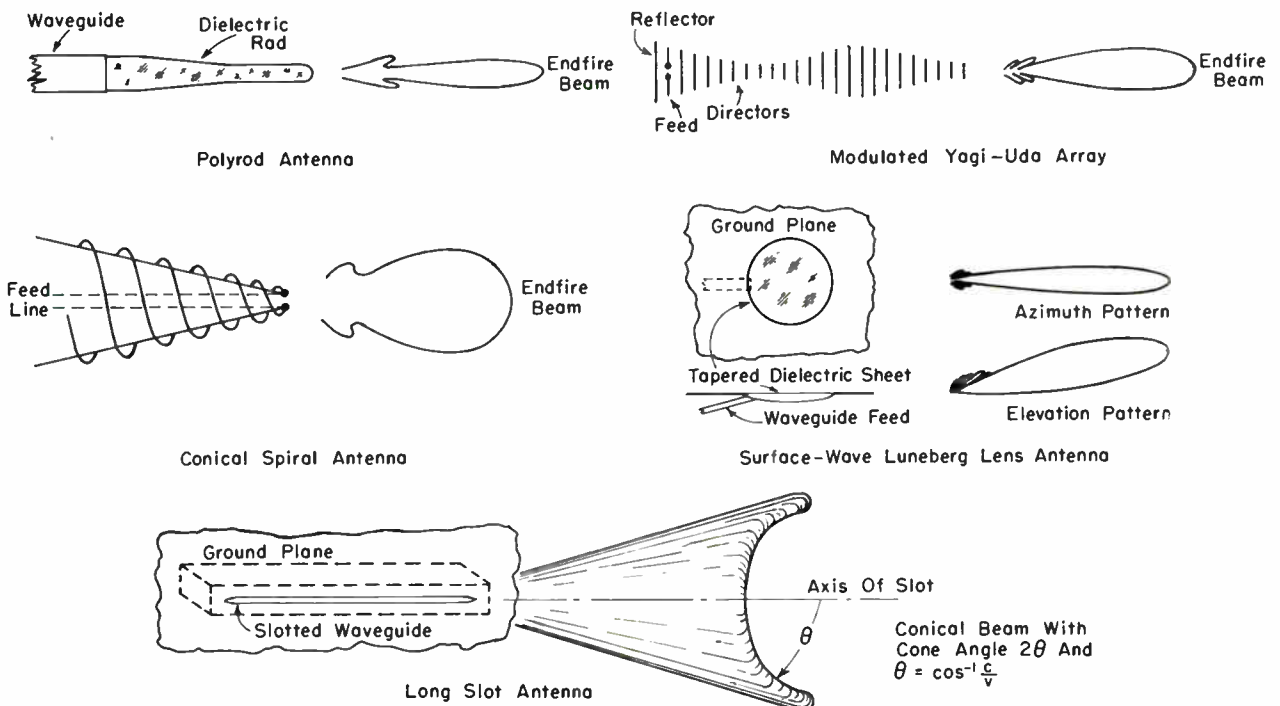


terns than previous lenses. They can be flush-mounted to a wide variety of surfaces such as flat surfaces on aerospace vehicles, or conical surfaces in the nose sections of planes and missiles.

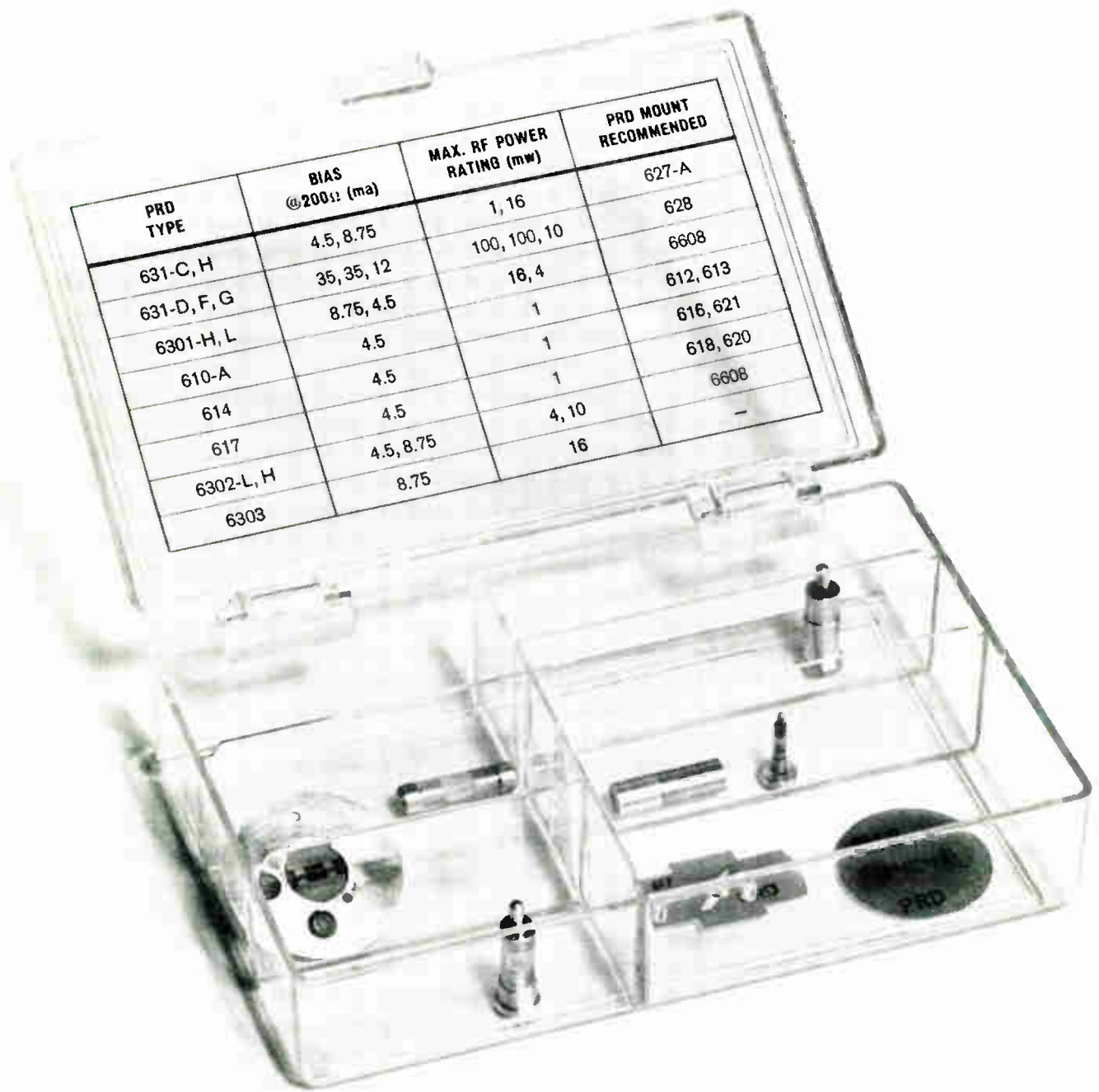
Basically, the recent lenses are two-dimensional waveguide structures in which energy is refracted to give the focussing or lens action. The lens structure is a surface of revolution so that circular symmetry is preserved. The energy propagates between the feed

(Continued on page J16)

Fig. 5: Various traveling-wave antennas and their general radiation patterns are sketched here for comparison.







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| 57  | 58  | 59  | 60  | 61  | 62  | 63  | 64  | 65  | 66  | 67  | 68  | 69  | 70  | 71  | 72  | 73  | 74  | 75  | 76  | 77  | 78  | 79  | 80  | 81  | 82  | 83  | 84  |
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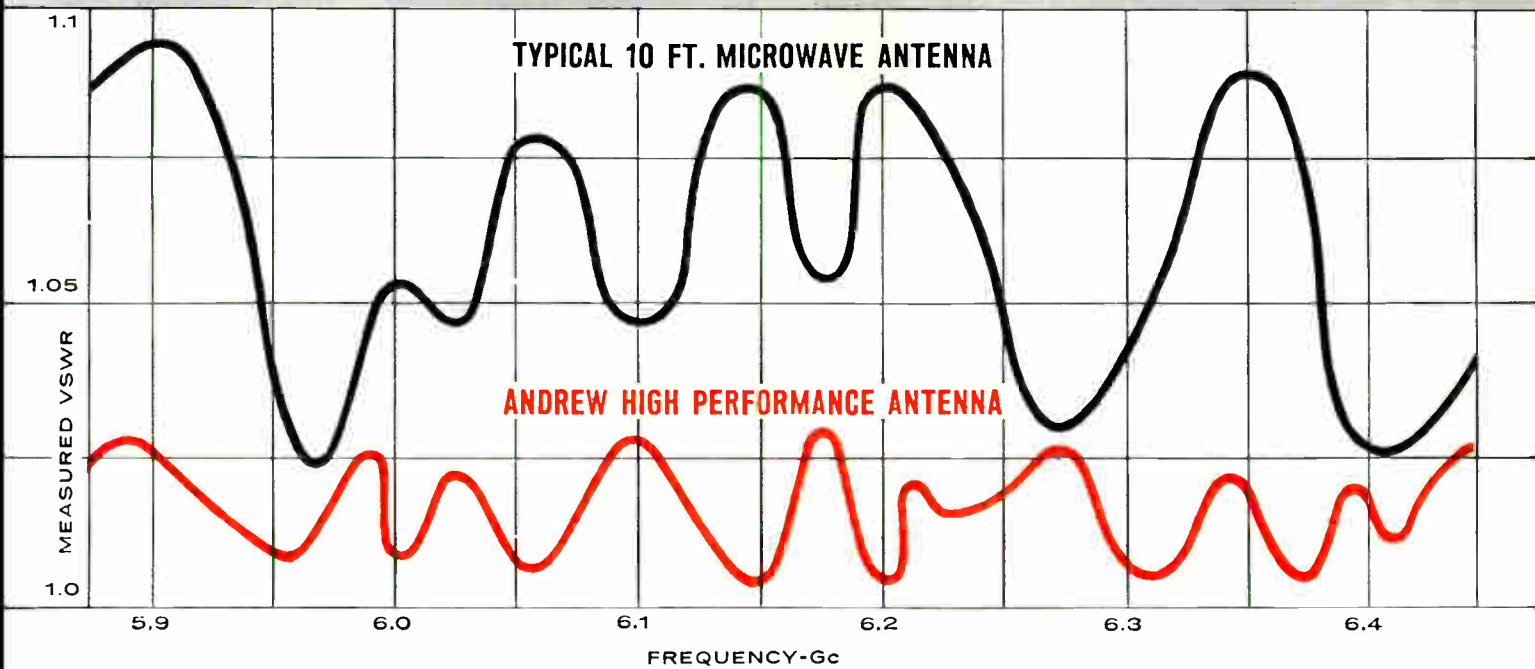
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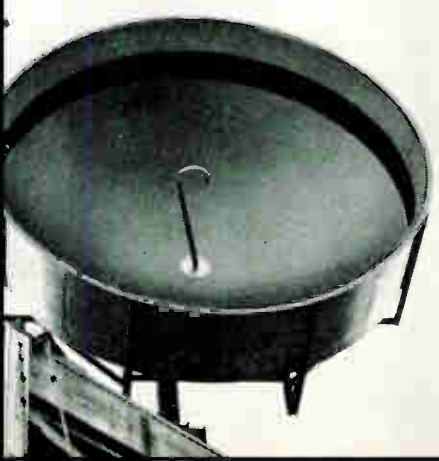
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on the focal radius and the aperture at the lens rim as shown in Fig. 2. The lens action is achieved by the proper combination of index of refraction and contour, both of which are functions only of radius. This lens can be designed for a radiated beam maximum at any specific angle  $\beta$  with respect to the plane of the lens rim. The beam maximum is also diametrically opposite the feed. Thus, beams can be obtained anywhere around the symmetry axis of the lens at the design beam angle from the plane of the lens rim.

For a horizontal lens, a plane containing the symmetry axis is a vertical plane and, for convenience, will be so designated. Since the radiating aperture is semi-circular as shown in Fig. 2, the beam is fan-shaped with its broad cross-section in the vertical plane. Thus, some coverage is obtained transverse to the dimension in which the beam position can be controlled. Some of these lenses have shown the capability of beam positioning in the vertical plane. The vertical beam position is controlled by the radial feed position.<sup>10</sup>

In a lens structure the index variation is achieved with proper control of the phase velocity. For example, in the  $TE_{01}$  waveguide mode, the index can be controlled by variation in plate spacing. In this mode the electric field is parallel to the lens plates, giving horizontal polarization for a horizontal lens. In the TEM mode the index must be obtained by variation of the dielectric constant of the medium between the lens plates. Since the electric field is perpendicular to the lens plates, this mode gives vertical polarization. The index is frequency-independent for the TEM mode, whereas it varies with frequency for the  $TE_{01}$  mode. Thus, wide frequency bandwidth is possible with the TEM mode. The lens structure may also be a surface-wave structure<sup>11</sup> (see Fig. 5) in which the fundamental modes are the  $TM_0$  and the  $TE_1$  modes which radiate vertical and horizontal polarizations, respectively.

The whole class of lens antennas, in which the lenses have variable index of refraction possessing circular symmetry, is often denoted Luneberg lenses.<sup>12</sup> The best known Luneberg lens has the geometrical optics property that rays from a point on the lens rim are refracted into a collimated beam. In this case, lens action is by an index variation as expressed by

$$n(r) = \sqrt{2 - r^2}, \quad 0 \leq r \leq 1. \quad (1)$$

A common use of this design is a three-dimensional spherical lens constructed from concentric dielectric shells of polystyrene foam or similar material, giving the appearance of a foam ball.

In one of the new classes of lenses, the nonplanar lens is of arbitrary contour along the radius. The index of refraction needed to give proper lens action can be represented by a complex equation which is a function of radius inside the lens and depends on the lens contour, the design focal radius, and the design vertical beam angle.<sup>13</sup> A simple example of index variation is that for a planar lens with design focus at the rim. The index of refraction for a lens of this type, which has a vertical beam angle  $\beta$  is given by

$$n(r) = (\cos \beta) \sqrt{2 - r^2}, \quad 0 \leq r \leq 1. \quad (2)$$

This index is a constant multiple of that for the lens of Eq. 1, which has a design angle of  $\beta = 0$ . In fact, any lens design for  $\beta = 0$  can be converted to a design for angle  $\beta$  by multiplication of the index by  $\cos \beta$ , as in the above equation.

Another, and perhaps more important class, is the geodesic lenses.<sup>14</sup> In these lenses the index of refraction is arbitrarily chosen and the contour needed to give the desired lens action is obtained. The name "geodesic" comes from the fact that the ray paths in a constant-index lens follow the geodesics on the mean surface between the lens plates. The original geodesic Luneberg lens, which was derived by Rinehart,<sup>15</sup> is the unit-index equivalent of the lens of Eq. 1. The unit-index contours which have an outer annulus of constant slope and for which the focal radius  $r_1 = \cos \beta$  are shown in Fig. 3. The Rinehart lens contour is labelled  $\beta = 0$  in Fig. 3. Some of the lens contours having the same properties, except that  $r_1 > \cos \beta$ , are shown in Fig. 4.

Low power handling capability is a limitation in some lenses using dielectric materials. Unit-index geodesic lenses, which need no dielectric material, potentially have very high power handling capabilities. For some receiving antenna or low-power transmitting antenna uses, a nonplanar lens with dielectric material might be desirable because the lens contour is more versatile.

### Traveling Wave Antennas

Traveling wave antennas are antennas for which the fields and currents that produce the pattern can be pictured as waves traveling over the antenna structure. In general, the amplitude and phase of a wave will vary with position on the antenna. The velocity with which a point of constant phase moves is known as the phase velocity  $v$ . The phase velocity, too, may vary with position.

When the phase velocity  $v$  is less than or equal to the velocity of light  $c$  in free space, the antenna is said to be a slow wave antenna. This usually means that the energy is bound to the surface of the antenna and such antennas are called surface wave antennas.

On the other hand, a structure which has a phase velocity greater than light in free space permits energy to leak away from the structure. These are usually known as leaky wave antennas. A useful relation for finding the angle  $\theta$  that the antenna beam makes with axis of the source along which the wave is propagating is  $\cos \theta = c/v$ . The angle  $\theta$  can be varied (i. e., the beam can be scanned) by simply varying the phase velocity.

If the structure supporting a traveling wave is properly terminated, the reflected wave will be quite small and essentially a traveling wave distribution will exist. Examples of early traveling wave antennas are the long wire and rhombic antennas.<sup>16</sup> A standing wave antenna, however, can be considered as a traveling wave antenna with waves going in opposite directions. The pattern of a half-wave dipole can be obtained in this manner.<sup>17</sup> Even the aperture distribution of a horn or dish antenna can be treated as a traveling wave. In this case the wave travels over the aperture with infinite phase velocity.

To many engineers, a traveling wave antenna is synonymous with radiation from a continuous source. Actually, many arrays of discrete elements can be satisfactorily approximated by a traveling wave current or field distribution.

Antenna needs from WWII to now have led to extensive studies of traveling wave antennas. These include polyrod antennas,<sup>18</sup> long, continuous slots in waveguides,<sup>19, 20, 21</sup> Yagi-Uda antennas,<sup>22, 23</sup> helical antennas,<sup>24, 25</sup> spiral antennas,<sup>26</sup> closely spaced slots and holes in waveguides,<sup>21, 27, 28</sup> reactive grid an-

tennas,<sup>29</sup> and various surface-wave antennas.<sup>11, 30, 31</sup> Some of these antennas are shown in Fig. 5. A good summary of surface- and leaky-wave antennas with further references is given by Zucker in Chapter 16 of Ref. 16.

The interest in traveling wave antennas is due to several basic properties of this type of radiator. These are:

1. Good bandwidth characteristics. The traveling wave antenna is generally a non-resonant structure and has good pattern and impedance bandwidths. Frequency independent antennas, such as the spiral antenna<sup>26</sup> are traveling wave antennas.

2. Low frontal area. Endfire traveling wave antennas, such as the polyrod and the Yagi-Uda array give good gain from length alone. Using the usual definition of antenna gain as the ratio of the power density in the direction of maximum radiation to the average power radiated, the gain of an endfire antenna of length  $L/\lambda$  (where  $\lambda$  is wavelength) ranges from about  $4L/\lambda$  ( $7L/\lambda$  for modulated structures)<sup>31</sup> for lengths greater than  $10\lambda$  to about  $10 L/\lambda$  for lengths approaching a wavelength. For comparison the gain of an aperture antenna such as a horn or dish is about  $2 \pi A/\lambda^2$  where  $A$  is the area of the aperture.

3. Flush mounting capability. Traveling wave antennas in the form of slotted waveguides and surface wave structures can be mounted on a surface so that one side is perfectly flush and the other side nearly so (see Fig. 5). This is important in antennas for missiles and high performance aircraft.

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The first electron-beam parametric amplifiers were of the degenerate type, with the pump frequency nearly twice the signal frequency. This resulted in an idler very near the signal frequency. The presence of an idler at or near the signal frequency is frequently a disadvantage in the degenerate amplifier. Recent work has resulted in the successful operation of nondegenerate amplifiers near 400 mc with a 2100 mc pump. Single-channel noise figure of less than 2 db was obtained. Development of similar nondegenerate tubes for L-band, pumped at C-band, is now in process. How nondegenerate amplifiers will perform at higher frequencies is not known. If a broadband noise source is used with a degenerate amplifier, the double-channel noise figure is yield. Degenerate amplifiers are available as packaged units which contain the amplifier tube, solenoid, power supply, and pump generator. Two different models cover the center frequencies of 350 to 850 mc and 850

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to 1800 mc. Fig. 10 is a photograph of a 1300 mc degenerate tube. Instantaneous bandwidths of up to 100 mc, broadband noise figure as low as 0.9 db, and gain adjustable from 20 to 45 db have been measured.

Degenerate amplifiers are available that operate in both S- and C-bands. A 5 gc fixed-tuned unit with 50 mc bandwidth and 1.5 to 2 db noise figure has been reported. The X-band seems to be a practical upper limit because 3500 gauss is required at X-band, and the magnetic field increases with frequency.

### Beam-Plasma Amplifiers

A great deal of work is being done to provide a harder vacuum within the tube since gas is generally associated with short life, ion-modulation noise, cathode poisoning, and arcing. The beam-plasma amplifier attempts to use an ionized gas, such as mercury or hydrogen, to provide the gain otherwise provided by the slow-wave structure of the TWT. The microwave signal is fed onto an electron beam by a slow-wave structure such as a helix. The beam passes through an ionized gas (with no helix) where the signal is rapidly amplified through interaction with the free electrons of the plasma. The beam then passes through another slow-wave structure which picks up the amplified beam modulation and transfers it to the output of the tube.

Ion noise, high electron temperature, and efficiency limit the use of beam-plasma amplifiers. There is, however, a possibility that a use may be found for them in the future.

### Acknowledgements

The author gratefully acknowledges the contributions of Drs. Boyd P. Israelsen, O. Thomas Purl, and James W. Sedin of Watkins-Johnson; Dr. C. B. Crumly of Zenith Radio; A. T. Isaacs of Stewart Engineering, and D. W. Reid of Litton Industries.

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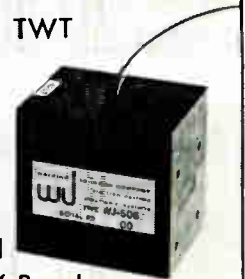
A C-Band Low-Power Ferrite Limiter

**WJ-519**



**WJ-506**

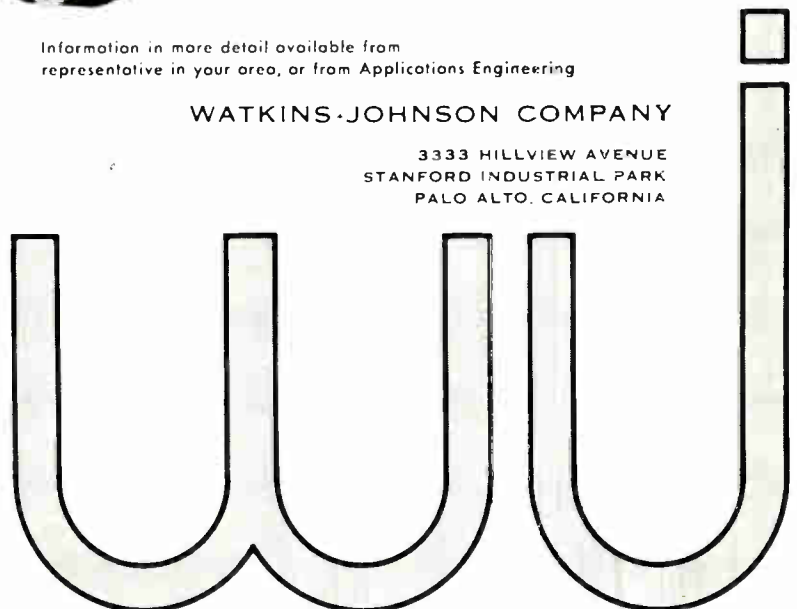
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# NEW TECH DATA

for Engineers.

## Microwave Tubes, Components

This fully illustrated 84-page catalog covers complete range of microwave tubes and components. Included are reflex klystrons, medium-power klystron oscillators and amplifiers, high-power klystron CW amplifiers and pulse amplifiers, BWO's, TWT's, magnetrons, freq. standard tubes, and solid-state products, including varactor diodes and ferrite components. Other components covered include gas switching tubes, surge protectors, ignitor power supplies, microwave plumbing, noise sources and pressurizing windows. A product index and general sales data are included. Tube Div., Varian Associates, Palo Alto, Calif.

Circle 571 on Inquiry Card

## Microwave Diodes

A 29-page brochure on microwave semiconductor products features device characteristics and uses. It includes diode speed index and complete data on mixers, detectors, tunnel diodes, varactors and microwave switches. Package outlines, photos, mechanical and environmental test methods are included. Sylvania Electric Products, Inc., 1100 Main St., Buffalo 9, N. Y.

Circle 572 on Inquiry Card

## Microwave Analyzer

This 20-page brochure includes comprehensive data on 3 panoramic spectrum analyzers for r-f and microwave bands (10 to 44cc), including specs. and design descriptions. Special considerations in the use of the instruments for CW and pulsed-signal analysis are covered. Singer Metrics Div., The Singer Mfg. Co., 915 Pembroke St., Bridgeport, Conn.

Circle 573 on inquiry Card

## Coaxial Iso-Filter

A microwave device called an Iso-Filter which converts low-priced signal sources into precision systems is described on this data sheet. It functions as an isolator within its freq. range and also filters out harmonics of pass-band freqs. Useful in laboratory test set-ups, microwave systems and missile system test equipment. E & M Laboratories, 15145 Califa St., Van Nuys, Calif.

Circle 574 on Inquiry Card

## Microwave Device Folder

Informative file folder and other enclosed technical bulletins on solid-state r-f and i-f amplifiers, oscillators, mixers, and receivers are available. Bulletin G-101. International Microwave Corp., 105 River Rd., Cos Cob, Conn.

Circle 575 on Inquiry Card

## Microwave Catalog

Catalog 634, 68 pages, 2 colors, covers the complete line of electronic instruments and microwave components available from Empire Devices, Inc., Amsterdam, N. Y. In addition to noise and field intensity meters, crystal mixers, attenuators and power supplies, it presents several new instruments for r-f interference measurements and a new group of versatile microwave signal generators. Each item is illustrated, described, and data includes complete specs., operating characteristics, and accessories.

Circle 576 on Inquiry Card

## Microwave Switches

Three new solid-state microwave switches for use with low-power r-f are available from Westinghouse Electronic Tube Div., Elmira, N. Y. The WX-5329 features a switching speed of 1 nsec, operates in the C-band, and has an isolation rating of 40db. The WX-5385 operates between 1.7cc and 5.5cc, has a switching speed of 10 nsec. and a min. isolation of 23db. The WX-5080 has an isolation of 80 db (min.), a freq. range of 5.4cc to 5.9cc, and switches at 40 nsec. No dc bias is required for any tube.

Circle 577 on Inquiry Card

## Microwave Components

This 24-page catalog, 12-H, includes descriptions, specs. and illustrations of standardized microwave components in the following product categories: waveguide preselectors, waveguides, waveguide filters, freq. selective diplexers, variable power dividers, diode switches, cavity oscillators, crystal mixers, and high pass filters. Microlab, 570 W. Mt. Pleasant Ave., Livingston, N. J.

Circle 578 on Inquiry Card

## Time Code Generator

Model TIM-01 features solid-state components and is used as a timing reference for data telemetered via an air-to-ground link and a source of on-board timing for navigation, communications or flight planning. A precise timing reference for use in conjunction with electronic countermeasures, electronic intelligence, or reconnaissance systems. Correlated Data Systems Corp., 1007 Air Way, Glendale 1, Calif.

Circle 579 on Inquiry Card

## Full Ku-Band Attenuator

Data on a full Ku-band variable attenuator contains specs. and typical curves of attenuation vs. coil current. Two models are described. E & M Laboratories, 15145 Califa St., Van Nuys, Calif.

Circle 580 on Inquiry Card



# SECTION K

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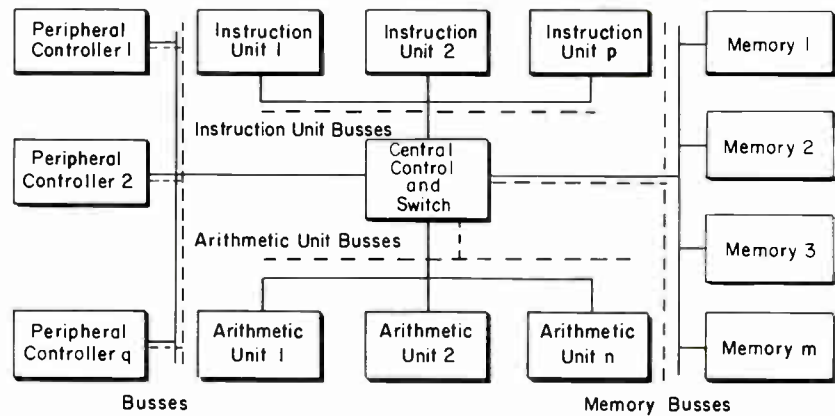
## DATA PROCESSING & AUTOMATION

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|   |     |
|---|-----|
| Data Processing System Advances                       | K2  |
| Operational Systems . . . A Current Computer<br>Trend | K7  |
| Trends in Process Control Computers                   | K10 |

## DATA PROCESSING (Continued)

With multi-processing systems such as this, an automatic supervisor is needed to keep track of everything and to schedule work.



another in the case of either machine or program errors?

**Multi-processing:** An extension of multi-programming is the addition of several computers to the system complex. This makes available several arithmetic and control units to interlace among themselves and among the several tapes, printers, disc memories, and punch card peripherals. With some systems an automatic supervisor is needed to keep track of everything and schedule work to the various equipments. Design of these routines is itself a new technology, and extension of this idea to automatic test and diagnostic programs is becoming a reality. Computers are tending to be used to run themselves and diagnose their own malfunctions as well as to do useful work.

**Data Communications:** Data communications is one of the pressures moving system organization toward multi-programming and multi-processing. With the large, on line, data input/output capacity that can be achieved using communications methods, it is possible to overwhelm even the 20 mc computers being designed today. System complexes are being contemplated to use data communications in a sophisticated multi-processing mode.

**Satellite & Remote Processing:** Ramifications of these system concepts are the ideas of satellite and remote processing. These approaches may or may not use long distance communications, but the idea is to use a remote large computer, with something smaller at the customer site. Satellite processing is the term applied to the use of a customer's small computer tied into a remote large computer.

The small computer would do editing and minor local problems. It would automatically draw on the large capacity and memory of the remote large computer for file inquiry or overflow problem handling.

With remote processing only the problem input/output means would be located at the customer's site; the remote computer would solve the computational

problems and provide all memory and file storage functions.

Another industry controversy concerns centralized vs. decentralized computers. The problem is the competition between the small self-standing computer and the large central computer with many small remotes tied into the central machine with data communications.

Which approach gives the best performance, and the best cost/performance to the small user? The high cost of data communications and questionable reliability are obstacles to effective decentralized small user complexes built around a large central. Which way it turns out in the future will be determined by the resourcefulness of the proponents of each systems approach. However, if small machines can be built at low enough cost, they have the real advantage, in that, everyone prefers his own machine.

There has been a feeling in the industry for a long time that the larger and faster a computer, the lower the cost per computation. This is not necessarily the case if one makes this comparison using all of the technologies available at any given time. And it certainly will not be the case in the future if low cost, high speed methods evolve which are suited for making small but not large computers. An example of such a method might be the 500 mc. circuits.

While there are not large memories that could be used at such speeds, there are small ones; and because of the limited logical gain of this kind of circuit, and signal propagation limitations, it is conceivable that a small computer could be built that had a lower cost/computation than a large computer. The reasons this has not been done are also simple—of the kinds of problems needing computer solution, they are either larger problems than most small machines can handle, or the problems are data processing uses where the cost of the computer is only a small portion of the cost of the peripherals necessary to print, handle cards and paper tape, and store data

on discs or random access memories. Centralized vs. decentralized machine will continue to be a controversy between computer system developers.

**Compatible Computer Families:** The real trend to a family of small, medium, and large size computers, that are program-compatible upward, has arrived. All major computer companies have recognized both the need and their capability to provide these families. The problem originally associated with this concept was the price one had to pay to provide this upward compatibility in the larger machine. This price was both in the higher shop cost of the larger machine and/or in the reduced performance of the larger machine in its own right. This problem has now been solved, with computer organization structures and instruction formats which allow for this growth as the smaller machine is designed. This is really the answer to both the manufacturer's and the user's problem of conversion when the user's load builds up and he is otherwise faced with the task of converting to a new and different larger-scale computer.

Two of the major system concepts which have enabled this growth compatibility are the ideas of memory buses and common peripheral interfaces. With a memory bus, the builder can introduce bigger and faster memories in his basic structure. With a standard interface going out to his peripherals, he can have a variety of computers, each working with the same peripheral instructions and the same peripherals.

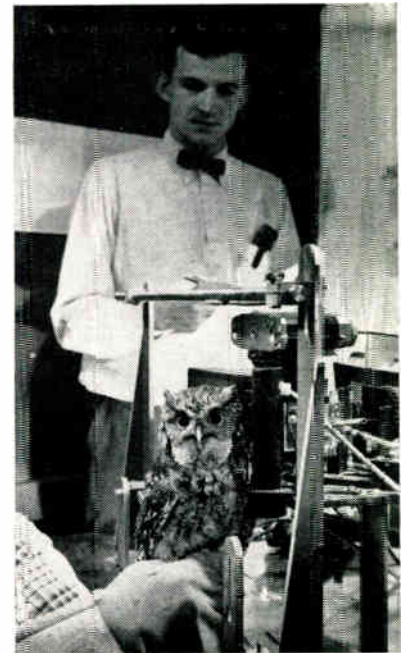
Thus far, we have discussed problems and trends the engineers are involved with in the design of the computers themselves.

### Input/Output Trends

An equally important problem is the development of input/output machines which will ease the difficulties and cost of getting the business's information into and out of the computer. Operators of large computer centers often state they would not mind having a new, larger, faster computer—but what can they do to eliminate the keypunchers? The crude methods used to collect information, and the equally crude methods used to distribute results to its users severely limit computer uses.

**Character Reading:** Lately, machines for reading printed characters have been introduced as a partial solution to the input limitation. Depending upon the kind of use, and in particular on the kinds of mutilation and over-printing, these machines read characters printed with magnetic ink for magnetic scanning or with regular ink for optical scanning. Main advantage of magnetic ink is the ability to read it despite severe over-printing.

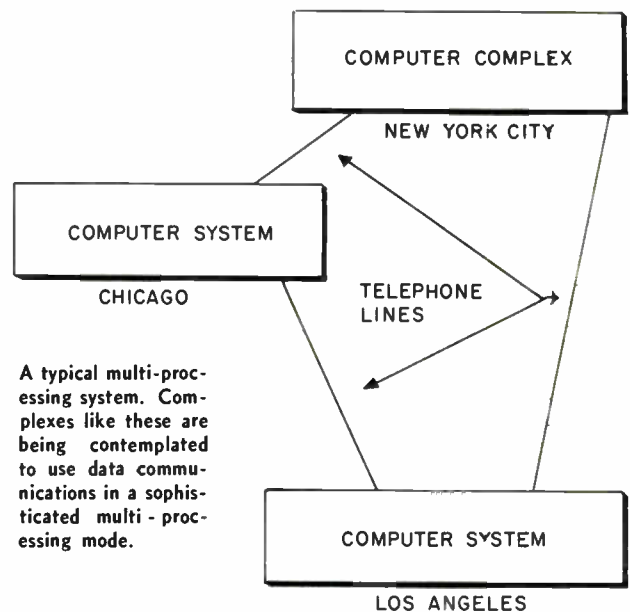
The steady gaze of this Otus asio owl is an important factor in studies being conducted on the nervous system by the Massachusetts Institute of Technology. The owl's pupillary system is under careful scrutiny by a computer in an effort to develop a clearer understanding of human nerve and brain disorders.



The advantage of optical scanning is the potential ability to read printing from any source. The limitation on all present character readers is that they should only read printing put out from certain specified sources. This constraint is usually placed on the type font; a given reader reads fonts made by certain printers or typewriters much more reliably than other fonts.

The trend for source document input is certainly for character reading. And, except for uses needing the highest reading reliability on documents subject to mutilation, optical scanning has developed to the point of greatest potential for general computer input.

The current challenging problem in optical character recognition is the design of a standard font.





## DATA PROCESSING (Continued)

This font should have the maximum reading reliability. It should be readable by the lowest cost reader consistent with the fact that generally many printing or encoding devices are involved, but only a few character readers. The font must be easily printed by cheap imprints and read with few rejects or errors. A measure of the adequacy of any given font design is the separation between various characters in that font. The greater the distance between the characters, the greater their potential to be reliably recognized. A difficulty with this concept is that the concept of distance must be coupled with the concept of resolution. Optical noise or distortion in the font image picked up by the transducer, or electrical noise picked up before decoding this font image, can significantly modify the apparent distance between characters within a given font. Effect of non-linear noise and distortion cannot be calculated in general, particularly with respect to its effect on the non-linear decision-making recognition electronics. The only significant answer to this problem is simulation and field test of the font and its reader under realistic conditions.

**Document Handlers:** Computer installations are getting to be paper handling factories in many instances. With the crush of source documents and

A 12-pocket MICR document handler. It can read and sort bank checks and other documents at the rate of 1,200 per minute.



mass-punched cards, paper and document handlers are becoming a major product. The trend for input card readers or bank check readers has been to go from one stacking pocket to two. In the future, it will probably continue to five or ten pockets, even for the input devices.

The reason for this is that engineers are recognizing that it saves time and effort to physically separate the input documents by varying criteria, such as, whether or not they were read successfully. Shutting a large computer down just because the input device mis-read a card or a character is an expensive waste of computer time.

Another future trend in document handlers is toward completely self-contained units which will, for example, sort a given batch of bank checks into complete sequence without having an operator pick up the stacks under each pocket during each pass. Cartridges or magazines which are appearing on some document handlers to speed the manual handling of the large volumes of input and source documents evidence this trend.

**Re-entry Printers:** Final partner in the immediate input/output family of character reader/document handler is the computer connected printer capable of printing fonts on documents that can be distributed to customers. These include bills, invoices, and tickets for automatic re-entry into the computer when the customer sends in his payment or uses his ticket.

**Management Display Devices:** Military systems are leading with the use of direct computer-connected display methods for command management purposes. Little work has been devoted to the extension of displays for managements using business data processors, but a need is there and management displays will evolve.

A question related to displays is the ability of data processing systems to work directly with managers. An ideal approach is to have a small management display and inquiry console located in the manager's office. With this console, the manager can issue a rapid series of questions and look at the answers derived from all the files available to the computer. He can then ask questions as he sees partial answers and obtain a paper copy of the data he wants to keep.

Advantages of such a hypothetical system are obviously many. Time is saved; the manager can see as much as he desires of the data and the analytical process; programming and keypunch operations are eliminated; and waste of reams of relatively useless print-outs is bypassed.

*(Continued on page K13)*

The operational system gathers data from many facets of a business on a current basis, processes them according to a stored program and makes the results available immediately to management.

The goal is to react faster and more efficiently to a given situation.

WHEN COMPUTERS FIRST APPEARED, many of them were used for record keeping and manipulation of historical data. This was to be expected. Their ability to store vast amounts of data in one place, and then retrieve any or all of it rapidly, marked an end to many problems. This was particularly true in such industries as insurance, utilities and banking.

### Simulation

As industry became more familiar with the tool, there was a change in emphasis—and important new concepts emerged. Among these was a better method of planning. This covered the scientific computing and operations research areas. Here both physical phenomena and economic situations are reduced to mathematical terms. They are then stored in computers as simulated models. Management presents a series of hypothetical “what happens if . . .” questions to this model. It gets back a survey of possible results, or the best possible choice among many alternatives.

A numerically controlled jig borer automatically machines a part. Jig borer is directed by a punched paper tape produced by a computer. AUTOSPOT language was used to write the program.



# OPERATIONAL SYSTEMS...

## A CURRENT COMPUTER TREND

Simulation is particularly successful in the aerospace and electronic industries. At the George C. Marshall Space Flight Center in Redstone, Ala., computer simulated models of Saturn rockets are “built, flown and torn down” many times before an actual prototype is constructed. Without the expense of building actual vehicles, engineers get a good idea of how various configurations will perform under different sets of conditions. Result: savings in both time and dollars.

Another important area for simulation methods is in design. Computers can be used to design new random access memories, process control systems, and system components.

The method of building a mathematical model and then simulating the philosophy of engineering has proved to be an important adjunct to the build-and-try approach. In development of a part such as a cam, for instance, time can be cut from 120 hr. by manual methods to just 50 min. on a computer. Also, accuracy of the computer-produced cam is 0.0002 in. as compared with 0.0003 in. for a hand produced one.

### Aerospace Uses

Aerospace engineering is a fruitful area for advanced data processing methods. It has been estimated that from 70 to 90% of engineers' time in this industry is spent on non-creative chores. Other problems are increasing product complexity, rigid reliability needs, and an advancing technology. Changes and modifications must be made at every stage of a product's life. These changes create mountains of paperwork and data.

By **ROBERT E. CLEMENT**

Manager, Industry Marketing  
Data Processing Div., IBM Corp.  
White Plains, N.Y.







Customer engineer hooks up power cables inside the main frame while installing a computer system.

## OPERATIONAL SYSTEMS (Continued)

Future data processing needs for this industry are in six major areas: information dissemination and control, structural design, electronic design, reliability assurance, engineering data control, and configuration management.

A mechanized approach to the first of these problems — information retrieval — is inevitable. Over 8,000 journals publish almost a quarter of a million papers a year. Most of this information is valuable for only a short period of time. Also, specific nature of the data requires a more selective method of indexing than has been used in the past.

To overcome these difficulties, information centers using both broadcast and selective dissemination methods need to be developed. Both approaches make use of the computer, which can maintain bibliographical files of current literature, indexed according to key title words. A periodic computer printout lists the latest articles according to key words. This allows an engineer to select rapidly those of value to him.

The selective dissemination method compares the bibliography index with an interest profile established for key engineering personnel and selects and prints out titles of interest to them. The interest profile may also be used to help locate the persons most knowledgeable on a certain subject. These

methods can be applied to many industries and professional disciplines.

### Operational Systems

Simulation and information retrieval are examples of computer methods developed to solve specific problems. But perhaps more important is the trend toward operational systems. These systems, in effect, gather data from many facets of a business on a current basis, mathematically “massage” it according to stored programs, and make results available immediately. In some cases this means a real-time closed-loop system whereby an event is sensed, translated into digital terms, fed into a computer, projected and corrected within seconds and without manual intervention. This is a “total” system. In other cases it involves updating of many files from a single input so that the total company picture is accurate at all times. In all cases it means putting current information and alternative solutions at the elbow of management so they can react faster and more efficiently to a given situation.

Such operational systems are of value in almost all areas of computer use. In manufacturing industries, for example, there are many systems planned or underway where the objective is control of production.

At Inland Steel in Chicago a computer has been tied directly to a blast furnace for the first time in the history of the steel industry. An IBM 1710 is



linked to analog measuring instruments at the furnace. These devices are scanned at the rate of 20 measurements a second, translated into digital terms and compared with predetermined parameters stored within the computer. Any abnormal situation is displayed to engineers as an exception item. Reaction is fast, positive and effective.

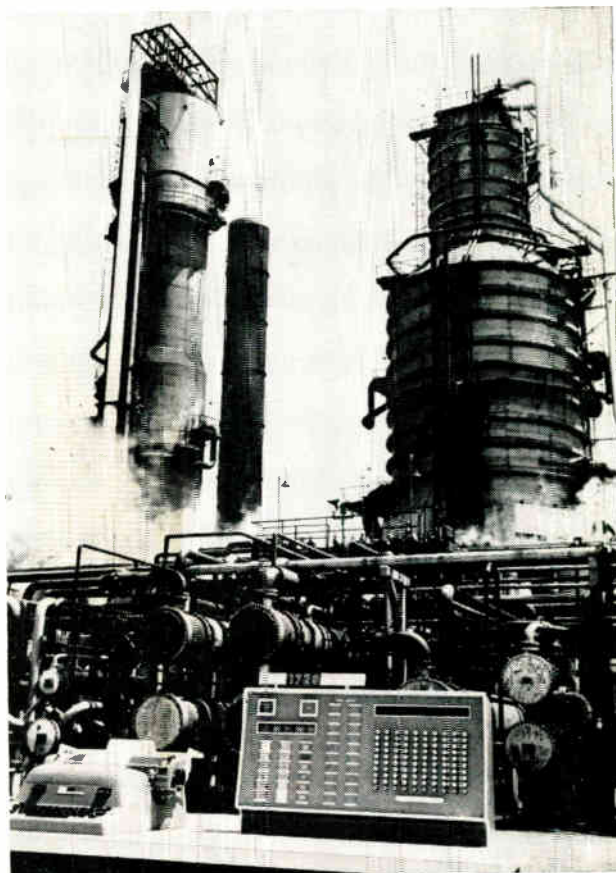
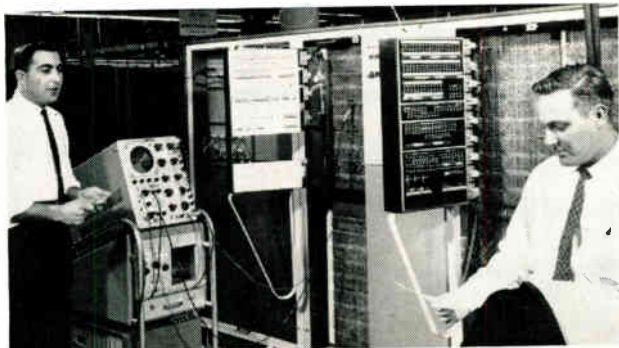
In the petroleum industry there are examples of catalytic cracking units being adjusted on-line as the result of computer calculations. Measurements are fed directly from the unit into a computer. Once within the system they are projected and compared with previously stored parameters. If the computer—through its stored program—determines that flow, temperature, percentage or any other factors are out of line, then an analog signal is generated to adjust the cracking unit. Thus, direct control of a production device is effected on a totally “hands off” basis.

Paper making is another process benefiting from operational systems. Instrument readings from hundreds of points along a paper production line are translated from analog into digital terms by a data converter. Once in digital form, the information is fed into the computer, which compares these samples against standards already stored in the machine. Needed adjustments are printed out for monitoring of the paper run, or are fed directly on-line to the various production units for real-time corrections. In either case, the results are greater product uniformity, reduction of off-grade runs and higher efficiency.

Operational systems are not restricted to the real-time control or rapid adjustment of production machines. They are just as valuable in distribution and service industries.

One California distributor uses a Management Operating System (MOS) to: (1) provide a daily shipping schedule for supplying thousands of stores with over 100 fast moving items; (2) update inventory levels at 50 warehouses; and (3) produce daily

**Engineers test the 7750 programmed transmission control. Unit enables users to design IBM Tele-processing system in which communications nets are linked to a single computing center.**



**This American Oil Co. 140,000-barrel-a-day crude-oil still will be under continuous computer control. Operator's console for fully automatic, or closed-loop system is in the foreground.**

production schedules for 21 plants distributing over \$100 million worth of products annually.

MOS, in essence, is an total systems concept designed to provide continuous coordination among the sales, inventory, shipping and production facilities of a company.

Another computer approach to inventory management is a program known as Inventory Management Program and Control Techniques (IMPACT).

Through a series of mathematical and statistical methods—all written into the program—it answers those two critical management questions “when to buy and how much” with more precision than was ever possible before.

IMPACT is made up of three basic functions stored within the computer: ordering, forecasting and reviewing. The ordering function determines how much to order. Forecasting has to do with the order point, or when to order.

Finally, the reviewing function parallels the action of a buyer in analyzing stock status figures. The order point set by the forecasting function is compared with available stock to find out if inventory is low enough to order. If it is, the reviewing function

*(Continued on page K23)*

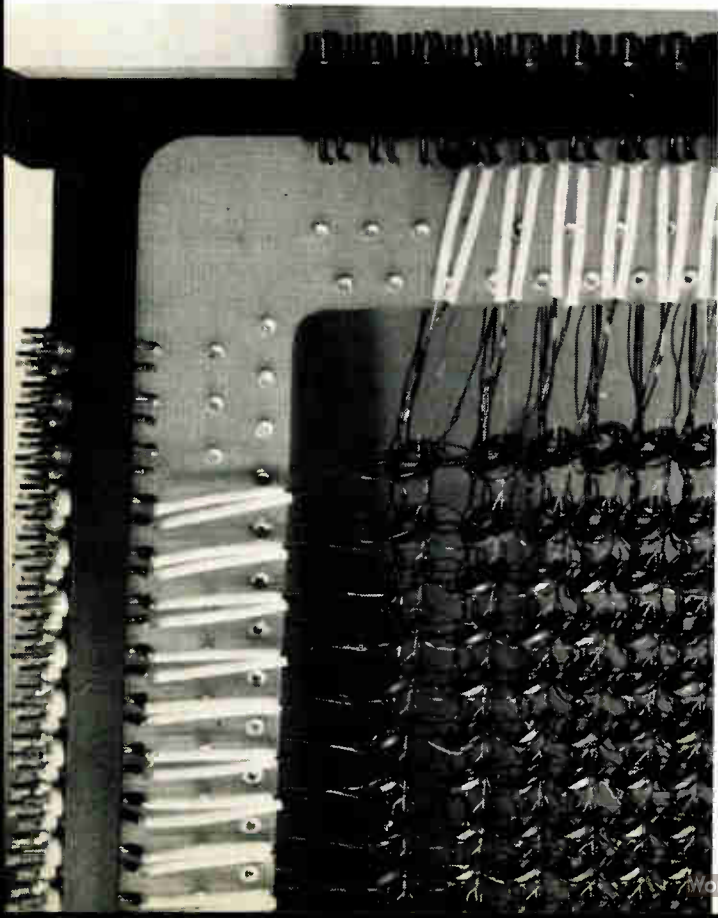
## PROCESS CONTROL (Continued)

### Software

Development of process control software is as much a part of the state-of-art as the hardware changes. While its progress has not been as rapid as that of hardware, its importance cannot be overlooked. Availability of process control compilers enhances the prospects for long-term control computer success as much as any other single item.

Programming has always been both time-consuming and costly. To ease these difficulties, computer manufacturers have developed a number of compilers (FORTRAN, ALGOL, and COBOL) which are problem-oriented, mainly toward scientific or business data processing problems. With industrial process control, a further software development was needed. This development has been made more difficult, however, by the variety of computational tasks inherent to a typical industrial process. In addition to the areas similar to scientific and engineering calculations of the general purpose computer, process control programming is confronted with unique routines: Logging, scanning and limit determinations. The compiler must also be comprehensive enough to

Typical core memory matrix is shown. Hand-wiring of the matrix accounts for a large percentage of the core memory cost.



effect complete on-line control of physical, real-time processes.

Previously, no available software system has been adequate for all these needs of process programming. For this reason, PROCOMP, an integrated process control software system was developed by TRW. This system allows for programming in user-oriented language. It was designed with a number of basic building blocks so that computer addressing is available on several levels. It contains computational statements for linearization and scaling, and FORTRAN statements for algebraic equation interpretation.

### Future Trends

Several users and manufacturers are investigating the use of direct digital computer control systems as a substitute for normal single-loop controllers. By eliminating a cost of \$500 to \$1000 per set-point controller, a digital computer controlling several hundred loops simultaneously could offer savings in plant investment. In many cases, it would also provide better control than the normal analog controller, plus a gain in accuracy, flexibility, and display convenience. This is the direction in which the process industries are heading; a few of the approaches to this as yet unresolved area are offered.

Machine-time availability of supervisory and optimizing control computers is quoted at 99.5%—or all but about 40 hr/yr. However, for direct digital control, a big improvement is needed. Four approaches are listed, from the most expensive way of achieving higher availability to the cheapest method. The first three solutions are too costly; the fourth already has been used successfully in some installations.

1. Use two small computers back-to-back to perform the controller function; when one system is down, the other automatically takes over.

2. Use one small computer with a redundancy of circuits that would be active. (It is debatable how much less expensive this would be than #1.)

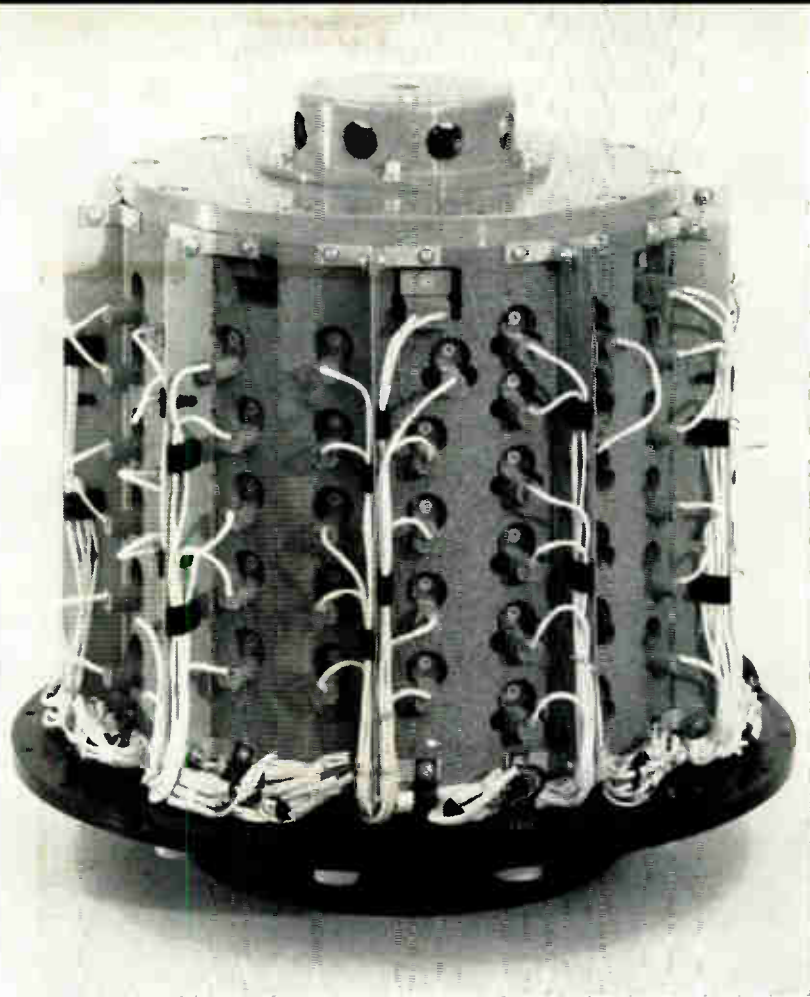
3. Use a supervisory computer as back-up for a small satellite computer; if the satellite computer is down, the supervisory computer can interrupt its optimizing operation and temporarily take over.

4. Use a supervisory computer for direct control and omit the critical set-point controllers from the computer program (provide normal control with the most critical areas where any computer failure is not tolerable).

At this point it is impossible to predict which, if any, of these solutions will be the accepted means of achieving direct digital control. Perhaps this control will only be economically feasible using the fourth



Exterior of a magnetic, bulk-memory drum. As the drum revolves within this frame, the read-write heads extract or deposit information bits according to programmed instruction. Drum speed is 3600 RPM.



approach, with continually improved optimizing computers gradually taking control over more and more loops.

It should be restated that computer manufacturers are actively striving for faster and cheaper memory systems; but there are doubts that they will have them in the near future. Fast, homogenous memory is, of course, wanted in any system; but by the time the core memory price is reduced, a breakthrough in still faster memory systems is likely to occur. If this happens, non-homogenous memories probably will be used indefinitely.

## DATA PROCESSING (Concluded)

The trouble is that we do not yet know how to do all of these things as cheaply as we can by using filing cabinets, secretaries, financial analysts, and conventional computers, printers and output plotters.

**Automatic Filing Systems:** A needed part of future computer systems is the electronic filing system. Such files will contain both analog information (statistics, costs, etc.) and identity codes. This file is desirably accessible via program control, displayable and changeable via remote console control, and centrally locatable.

Thermoplastic tapes or disc memories are suited to such use because of their erasability characteristic and because of their high storage capacity for analog, digital, and color information. Systems of this nature have been made using microfilm or Kalvar as the

basic storage medium. These systems have generally limited themselves to semi-permanent storage where the partial contents of each file are not changed. File updating is done by replacing large chunks of the file with, for example, a new micro-film strip.

Likely uses for these systems are for large personnel files, finger print and criminal records, title and other public record files, and for patent, legal, or even medical records, pictures and charts.

### Conclusions

New methods in computer system structures, computer designs and devices and in their input/output media are coming. They will have a dramatic effect on people's lives, businesses, and activities.

Computers are accepted and used by growing segments of our society. They are no longer oddities. They are a basic tool, reasonably available and commonly used in most businesses, academic, civic, governmental, and military activities.

The engineering problems at this stage of development are to make computers easier to use; more accessible in cost; more reliable and effective; and more generally applicable to a broader spectrum of applications and customers.

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The Editor  
ELECTRONIC INDUSTRIES  
Chestnut & 56th Sts., Phila. 39, Pa.

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# NEW TECH DATA

for Engineers.

## Integrated Circuits

A 16-page booklet discusses design problems in integrated circuitry, details the PEC® concept, and describes the manufacturing process. Illustrated, colorful booklet describes integrated circuits, gives case histories, involving such uses as in computers, undersea detection equipment, stereo equipment, electronic organs and cameras. Centralab, The Electronics Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.

Circle 360 on Inquiry Card

## Digital Systems

A colorful 36-page brochure details activity in the design and development of specialized digital systems. Systems are described in each of 6 broad application areas: space, defense, industry, business, education, and science research. Computer Control Co., Inc., Old Connecticut Path, Framingham, Mass.

Circle 361 on Inquiry Card

## Computer Tape Preparation

Systems applications showing computer-tape preparation from analog and digital data by use of EECO 751 Computer Format Control Buffer are part of a 16-page brochure available from Electronic Engineering Co. of California, Box 58, Santa Ana, Calif.

Circle 362 on Inquiry Card

## Magnetic Tape Systems

Data Sheet No. 1-204, describes the MT-36 magnetic tape transport, and magnetic tape systems. Designed for moderate data transfer rates, the equipment is well suited for use with small and medium-scale computers in mass storage and sequential access operations. Potter Instrument Co., Inc., 151 Sunnyside Blvd., Plainview, L. I., N. Y.

Circle 363 on Inquiry Card

## Logic Modules

Information on transistorized digital modules for control, drive and translation in crossbar switching applications is available from James Cunningham, Son & Co., Honeoye Falls, N. Y. Modules have 0, -6v inputs. Zener diodes suppress inductive circuits to protect transistors.

Circle 364 on Inquiry Card

## Magnetic Tapes

Spec. sheets describe a new line of professional tapes which includes a log-print master tape, a high-output master tape and a new duplicating tape. Data sheets list the tapes' electromagnetism and physical properties. Reeves Soundcraft Corp., Great Pasture Rd., Danbury, Conn.

Circle 365 on Inquiry Card

## Computer Circuit Analysis

A 6-page brochure entitled SPARC explains simulation of electronic circuits and sub-systems on RECOMP computer to achieve greater reliability, improved efficiency and reduced costs. SPARC system provides ac, dc and transient analysis on a computer operated independently by engineer. Autonetics Industrial Products, 3400 E. 70th St., Long Beach 5, Calif.

Circle 366 on Inquiry Card

## Plug-in Logic

Data sheet describes transistorized plug-in digital logic elements that make it possible to readily convert from logic diagram to operative system. Input and output connections are made on a color coded front panel imprinted with appropriate logic symbols. Logic symbol concept also makes the line ideal for breadboarding systems and teaching digital logic. Tech Serv, Inc., 5451 Holland Dr., Beltsville, Md.

Circle 367 on Inquiry Card

## Synchro/Servo Catalog

A 44-page catalog gives electrical and mechanical characteristics on synchros, servo motors, precision computing resolvers, linear transformers, motor rate tachometers and other rotating components. Synchro information is included for sizes 8, 10, 11, 15 and a wide variety of gyro pick-off (pancake) synchros. Also included is detailed information on the company's servo motors, including 24 detailed performance graphs. Catalog contains considerable general information on rotating components and the servo field. Clifton Precision Products Co., Inc., 5050 State Rd., Drexel Hill, Pa.

Circle 368 on Inquiry Card

## Perforated Tape System

Data Sheet No. 2-110, describes the PTR/PTS perforated tape system. The standard 2-speed PTR-500 reads tape dependably at 25 or 50ips. The bi-directional reader uses photoelectric sensing with silicon solar cells to read 5, 7, or 8-level perforated tape. PTS-500 perforated tape spooler provides tape supply and takeup. It operates compatibly with PTR-500 at speeds up to 50ips. Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, L. I., N. Y.

Circle 369 on Inquiry Card

## NOR Logic Modules

Data sheets describe in detail silicon-transistor U-series universal NOR logic-welded modules available from Engineered Electronics Co., 1441 E. Chestnut Ave., Santa Ana, Calif. Products covered include dual NOR circuits, dual dc drivers, ac power drivers, converters, multivibrators, one-shots, flip-flops and circuit-board assemblies. Price list is also included.

Circle 370 on Inquiry Card

## Printed-Circuit Connector

Catalog PC-1, 20 pages, includes photos, dimension specs. and performance data. Among the connectors covered are Micro-Edge® printed-wiring receptacles and Micro-Min® connectors with 0.050 in. centers plus special printed-circuit connectors. Literature entitled, "How to Select the Best Connector for Your Printed Circuit Requirements" is available from Amphenol Connector Div., Amphenol-Borg Electronics Corp., 1830 S. 54th Ave., Chicago 50, Ill.

Circle 371 on Inquiry Card

## Low-Power Thin Films

Univac® has developed low-power thin films that are compatible with molecular integrated circuits. The films operate reliably at drive currents of 20 to 30ma; have a flux of 0.2ma; and an output of a few tenths of a mv. The reduction in drive-current was accomplished by 2 radical approaches to thin-film fabrication. Univac, Div. of Sperry Rand Corp., 315 Park Ave. So., New York 10, N. Y.

Circle 372 on Inquiry Card

## Memory Brochure

This brochure features uses of delay-line serial memories to 3C digital systems. Applications include signal processing, detection and analysis equipment, digital computers and other related special-purpose instruments. Detailed are systems descriptions and specs. Computer Control Co., Inc., Old Connecticut Path, Framingham, Mass.

Circle 373 on Inquiry Card

## Pin-Board Programming

A 20-page booklet describing many uses and applications for Sealectoboard pin-board programming devices is available. Entitled, "Sealectoboard Design Ideas for Engineers," the booklet offers detailed information on the operation and function of the cordless program boards. It also provides complete case histories of the boards in actual applications such as data loggers, process analyzers, automatic inspection equipment, machine tools and control selectors. Sealectro Corp., 139 Hoyt St., Searoneck, N. Y.

Circle 374 on Inquiry Card

## High-Speed Printer

Brochure describes Series 1000 Digital Electronic Alpha-Numeric (DEAN) Printer. It prints over 8,100 lines/min.; over 6,000 characters/sec. Firm also has brochures on an FM telemetry calibrator (Model 850), digital Decalock oscillators (Series 820), and a direct writing oscillograph (Model 444P). Century Electronics & Instruments, P. O. Box C—Admiral Sta., Tulsa 15, Okla.

Circle 375 on Inquiry Card

FIRST AS A MATTER OF RECORD... SCOTCH® BRAND INSTRUMENTATION TAPES



## *The tape with the built-in duster!*

1000 times greater conductivity than ordinary tapes! That's how "SCOTCH" BRAND Heavy Duty Tapes drain off static charges before they can attract dust. That's the built-in duster that flicks away the growing danger of dust-caused dropout errors . . . a danger greater than ever as higher and higher recorder speeds and tape tensions generate more and more static.

Electrical resistance of the oxide coating of "SCOTCH" Heavy Duty tapes is 50 megohms per square or less. The resulting conductivity, unusual in magnetic tape, not only avoids dust contamination, it minimizes such other static problems as tape drag and skew, noise induced by arcing.

Heavy duty formulation of binder and high potency oxides withstands temperatures from -40 to as high as +250°F to conquer high head



heat, assures tapes that outlast standard tapes by at least 15 times. Exclusive Silicone lubrication reduces recorder head and tape wear. And "SCOTCH" Heavy Duty Tapes are offered for all high-speed applications, even for extreme high frequency and short wavelength requirements. 16 different constructions include a variety of backing and coating thicknesses.

*TECHNICAL TALK Bulletin No. 4* provides detailed discussion of the effects of static electricity on instrumentation recording, offers helpful information in solving static-caused problems. It's free. Write 3M Magnetic Products Division, Dept. MBR-63, St. Paul 19, Minn.

"SCOTCH" AND THE PLAID DESIGN ARE REGISTERED TRADEMARKS OF MINNESOTA MINING & MANUFACTURING CO., ST. PAUL 19, MINNESOTA. EXPORT: 99 PARK AVENUE, NEW YORK CANADA LONDON, ONTARIO ©1963, 3M CO.

**Magnetic Products Division** 



## NEW TECH DATA

### UHF Signal Generator

Information on a new UHF standard signal generator, Type SDAF, with a freq. range of 170 to 940MC in 9 sub-ranges, is available. The unit has been designed for use in conjunction with AM, FM and video equipment. Its output, continuously variable from  $1.0\mu\text{v}$  to  $0.5\text{v}$ ., may be either AM or FM, or both simultaneously. Rohde & Schwarz, 111 Lexington Ave., Passaic, N. J.

Circle 624 on Inquiry Card

### Tapes

Information on Memorex Types 22, 33, 42, and 62 is available. Type 22 is for use on standard digital computer trans-ports; type 33 is a magnetic instrumentation tape; type 42 in a high-resolution tape; and type 62 is a broadband tape. Memorex Corp., 1180 Shulman Ave., Santa Clara, Calif.

Circle 625 on Inquiry Card

### Crystal Oscillator

Tech. data is available on the Model 140000 crystal oscillator, a unit for printed-circuit board mounting and other tight locations. It is available in the 3kc to 150MC range, with fixed freq. output if desired. Greenray Industries, Inc., 5281 E. Simpson Rd., Mechanicsburg, Pa.

Circle 626 on Inquiry Card

### Power Transistors

Information on 4 pnp germanium-alloy junction-power transistors is available from General Precision Aerospace, 1150 McBride Ave., Little Falls, N. J. These hermetically sealed, dynamically-tested units have an internal heat sink which allows a dissipation of 0.4w in free air or, with heat-sink well, 8w. Characteristic curves are included.

Circle 627 on Inquiry Card

### Instrument Catalog

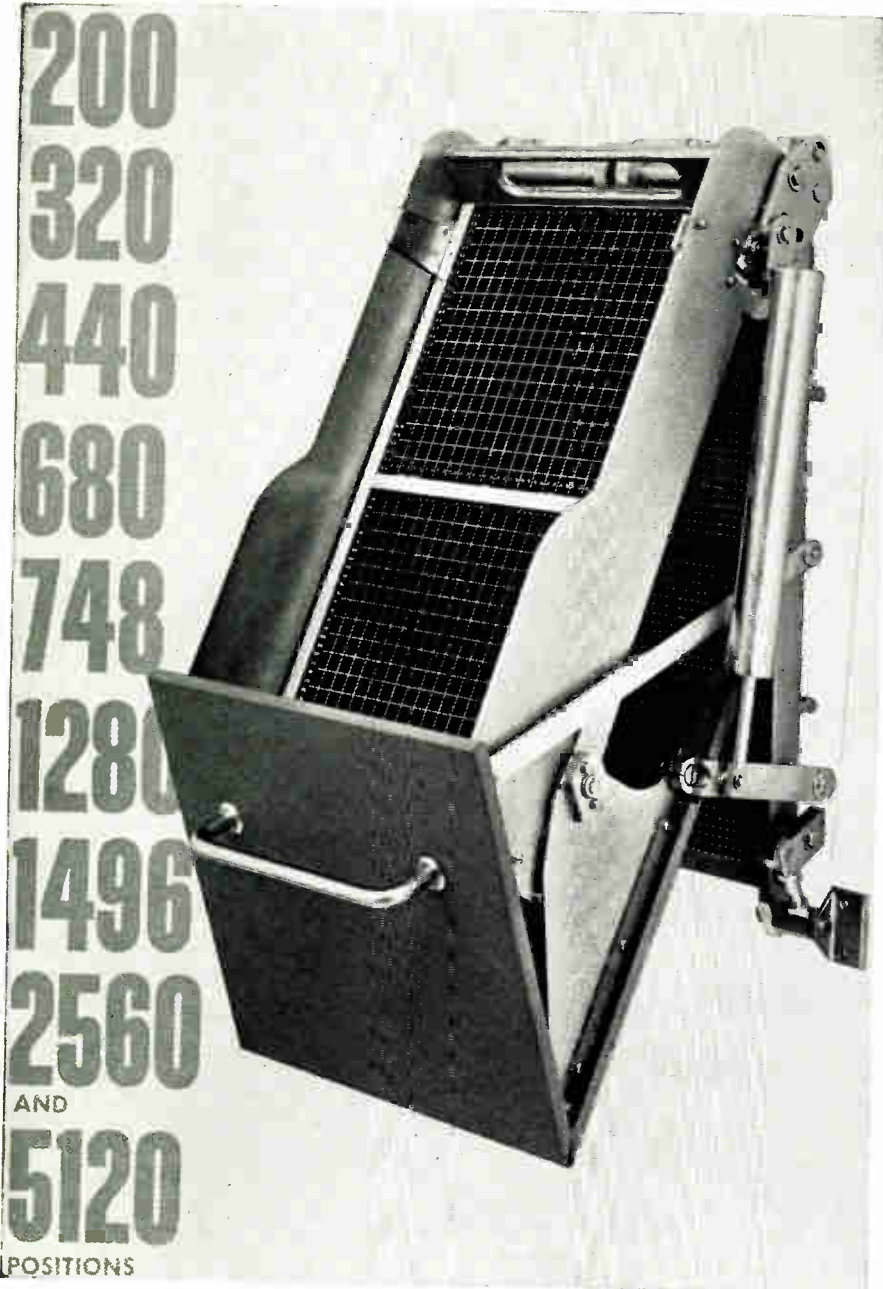
A 44-page catalog describing a full line of sensitive electronic instruments is available from Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio. It contains sections covering measurements, dc high-voltage supplies, nuclear instrumentation, and space science instrumentation. Many sections are preceded by introductory pages discussing problems, applications, and instrument selection applicable to the measurements involved. Selection charts are also provided.

Circle 628 on Inquiry Card

### Multi-Purpose Readout

Data is available on the Digivisor, a one-plane, in-line digital readout device that will accept analog, decimal, or binary input directly from low signal voltage. Industrial Electronic Engineers, Inc., 5528 Vineland Ave., N. Hollywood, Calif.

Circle 629 on Inquiry Card



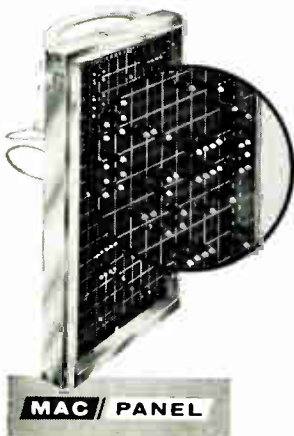
# NINE... SIZES OF PROGRAMMING SYSTEMS

Now, Plugboard Programming Systems are available in sizes ranging from 200 to 5120 positions to meet requirements for reliable, low-cost program control of electronic equipment. Systems include receivers, lightweight plugboards and a complete line of manual and fixed plugwires. Manual plugwires feature Ball-D-Tent, the self-locking tip that prevents accidental dislodging. Write for catalog, price list and full information.

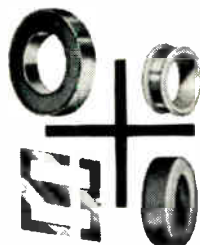
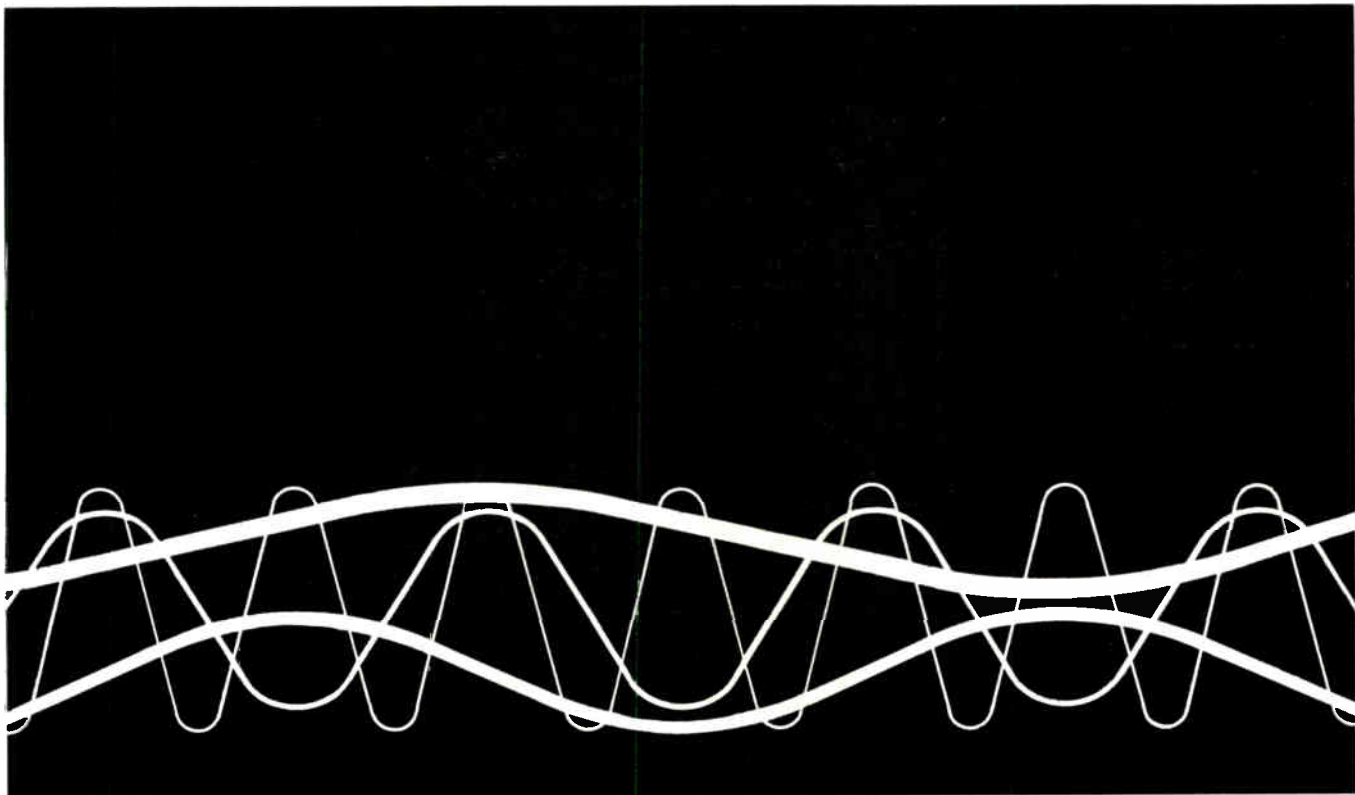
O. E. M. DIVISION

# MAC PANEL CO.

HIGH POINT, NORTH CAROLINA







## ***Optimizing circuit components to frequency? Get more from magnetics***

**THE CORE:** What's the best core for operating at low frequencies? What powder core or flake core is best for a higher frequency? That depends on what you're looking for. Frequency alone does not determine where one type of core should be used in favor of another. There's an overlap of usefulness and many core possibilities within a frequency range. Core choice for optimum performance at a given frequency must be related to core cost, and operating temperature, to name a few. Optimizing comes from a careful analysis of the many variables. The *man from Magnetics Inc.* will re-acquaint you with them and will assist you with your selection.

**THE MORE:** The 550 mu Permalloy cores permit greater circuit miniaturization, bridging the design selection gap between laminations and powder cores. Or, choosing a laminated core where you may have thought to use a powder core might be just the thing to effect lower costs, size reduction, operating stability, and high efficiency. Because we produce and stock a wide range of sizes and types of high permeability components, we can assist you a little more than most. Just how much more? Ask the *man from Magnetics Inc.* next time he calls . . . or write us on your letterhead giving the details of your problem. Magnetics Inc., Dept. EI-6 Butler, Pa.

TOTAL ASSISTANCE, SERVICE, SELECTION/GET THE MORE FROM MAGNETICS

**MAGNETICS inc.**

# Did you know Sprague makes...?

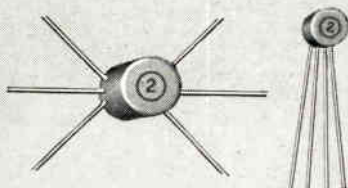
## MAGNETIC LOGIC DEVICES



Core-diode and core transistor magnetic shift registers and magnetic counters for switching and storage applications in computer and logic circuitry.

CIRCLE 131 ON READER SERVICE CARD

## MOLDED PULSE TRANSFORMERS



Miniature Pulse Transformers with tough molded cases for increased protection against physical damage and severe atmospheric conditions.

CIRCLE 132 ON READER SERVICE CARD

## NANOSECOND PULSE TRANSFORMERS IN TO-5 TRANSISTOR CASES

Special design offers distinct advantages: (1) Mini-fied size. (2) Welded hermetic seal. (3) Increased reliability. (4) Compatibility with transistor mounting techniques.



CIRCLE 133 ON READER SERVICE CARD

## SOMETHING NEW IN COUNTING TECHNIQUES

Simple yet versatile, low-cost yet reliable counters available for predetermined (2 to 11) or selectable (5 through 10) counting cycles.



CIRCLE 134 ON READER SERVICE CARD

## DYNACOR® BOBBIN CORES



Series "300" Cores with logical flux values in popular physical sizes are stocked in production quantities for fast delivery. They're value engineered for quality with economy!

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## HERMETICALLY-SEALED TO-5 ENCASED SWITCH CORES

Designed especially for high-speed, low-power switching up to 100 kc, adaptability with conventional transistor packaging techniques, and performance under MIL-S-21038 environmental conditions.



CIRCLE 135 ON READER SERVICE CARD

## ELECTRONIC MODULES TO CUSTOMER REQUIREMENTS



Custom packaging is no novelty at Sprague's Special Products Division, where "specials" are continually being developed and produced with countless variations in electrical characteristics and mechanical configurations.

CIRCLE 137 ON READER SERVICE CARD

For application engineering assistance (without obligation, of course) on any of the above products, write or call the Special Products Division, Sprague Electric Company, 233 Union Street, North Adams, Massachusetts.

SSP-111-63 RS



"Sprague" and "Ⓢ" are registered trademarks of the Sprague Electric Co.

## NEW TECH DATA

### Logic Card Connector

The MOD-U-CON female receptacle contains three-fingered 30 contacts. Each basket-weave contact has double readout taper pin receptacle, providing 60 different readout positions. The mating male plugs are right angled, 15-pin strip connectors for solder dipping to a printed circuit board. Modular Electronics, Inc., 21-4th St., S.W., Osseo, Minn.

Circle 630 on Inquiry Card

### Electrometer

Bulletin 781 describes the Model CS-57 electrometer, which eliminates inaccurate readings caused by damage or component changes within the instrument. Each range may be checked in seconds. It is capable of current increments from  $10^{-2}$  to  $10^{-13}$  amps. Information includes specs. and a block diagram. Gyra Electronics Corp., P.O. Box 184, La Grange, Ill.

Circle 631 on Inquiry Card

### Integrated Circuit Headers

Information is available on multiple-lead, integrated circuit packages. These packages are available in the basic TO-5, TO-18 and TO-46 configurations. Lead combinations vary from 1 to 12 per package. Grounded and ungrounded leads are optional. Dept BN, Glass-Tite Mfg. Div., Glass-Tite Industries, Inc., 725 Branch Ave., Providence, R. I.

Circle 632 on Inquiry Card

### Oscillating Tables

Illustrated, 2-color catalog product data sheet on oscillating rate tables and flight simulation test equipment is available from Micro Gee Products, Inc., a sub. of Menasco Mfg. Co., 805 So. San Fernando Blvd., Burbank, Calif. The data sheet contains descriptive information on the new Model 64A Oscillating Rate Table. Major sections include operating description, specs., including dimensional information, data on uses, price and delivery. Of interest to test and environmental check-out engineers, designers and users of gyroscopes, accelerometers and flight package. Request Model 64A oscillating rate table data sheet.

Circle 633 on Inquiry Card



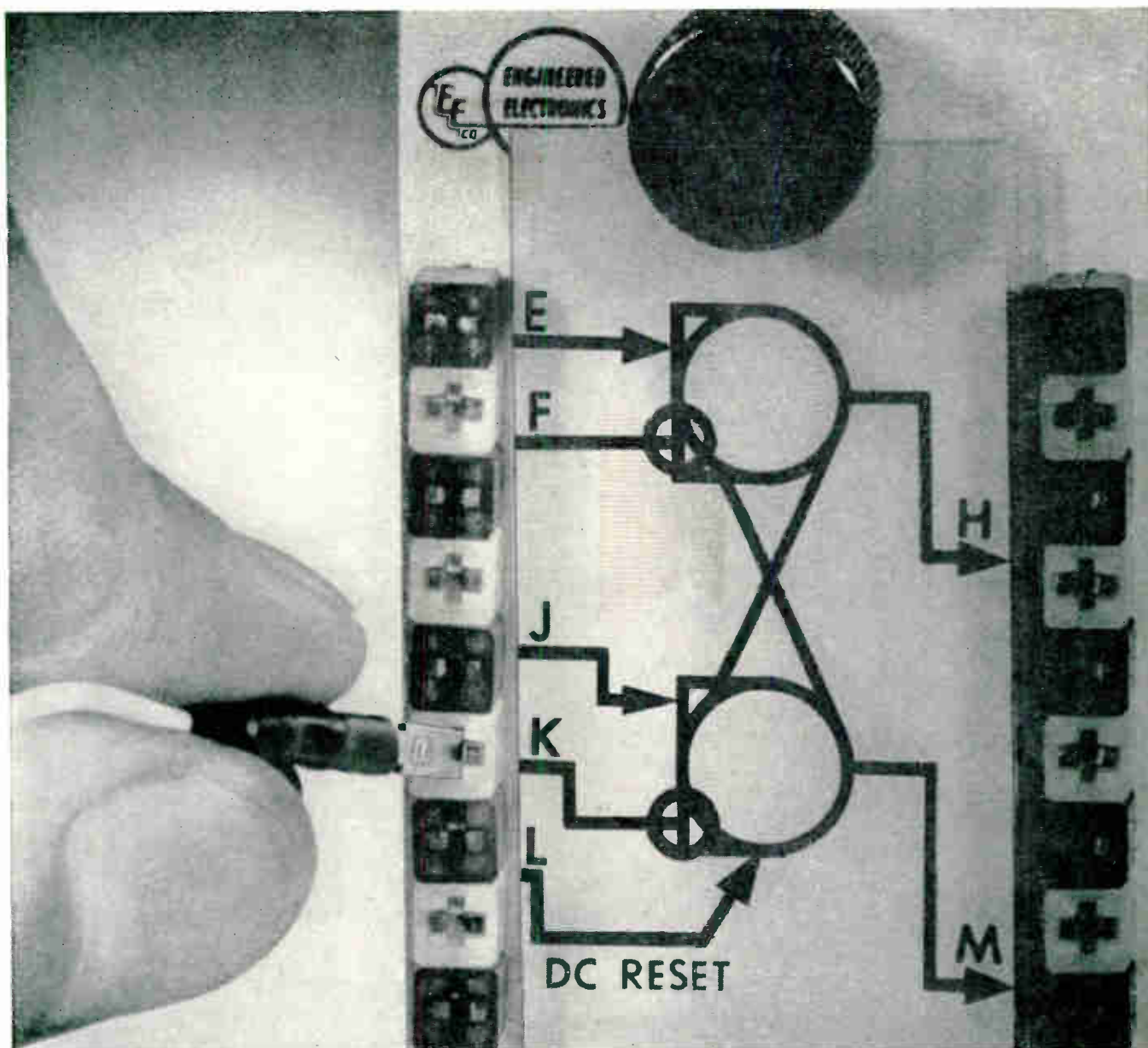
## ELECTRICAL INSTRUMENT SERVICE, INC.

- Staff has 61 years accumulative experience in the repair, recalibration and modification of precision electrical indicating instruments
- 2 year warranty
- Calibrations traceable to NBS

Phone LOUIS MILLER 914 OW 9-9717

48 Potter Ave., New Rochelle, N. Y.





## HOW TO BREADBOARD A 10 MC DIGITAL SYSTEM—FAST

Your fastest, surest means is EECo's new high-speed system breadboard. This transistor unit lets you: (1) patch up trial circuit combinations with the same catalog modules that go into the final system, (2) perform tests at operating frequencies by pushbutton and (3) get a "stop-action" look at the over-all logic flow.

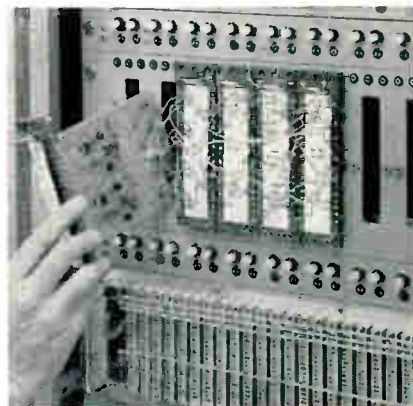
Using patchcords, you can hook up, take down or change circuitry at will to study the effects of wiring, propagation delay, clock duty cycle and alternative design approaches. And, because you use field-proven modules in the breadboard, you know that the final system will work.

EECo equipment has no equal for practicality or versatility. It is com-

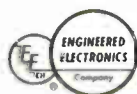
pletely self-contained, but has provision for external test equipment. The built-in clock source lets you apply pulses singly or in pairs. You may operate the system slowly to watch individual operations or at high speeds to simulate end-system performance. To help you patch your circuits together, EECo provides handy symbol cards — cards that indicate module circuitry, part numbers and input-output pin connections to give you a road map of the system as you assemble it.

The more you value your time and ability, the more you can benefit by using EECo breadboard equipment. Write today for the full story.

**ENGINEERED ELECTRONICS Company**  
1441 East Chestnut Avenue, Santa Ana, California  
Telephone 547-5651 • Cable Address: Engelex



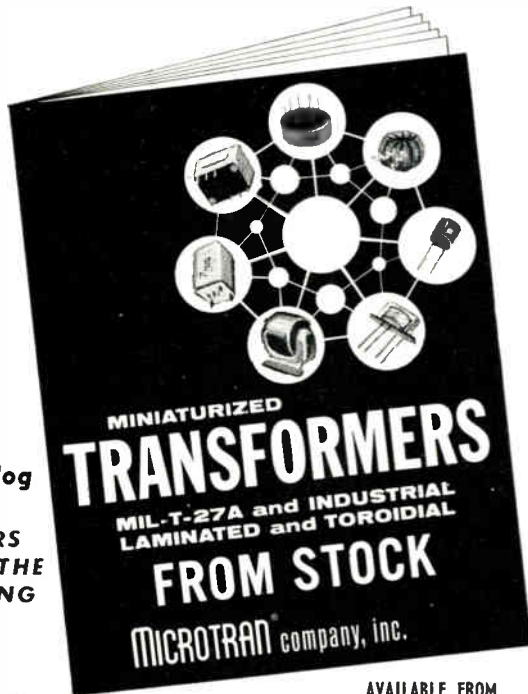
Breadboard (first stage shown) uses standard EECo catalog modules, permits pushbutton tests at operating frequencies.





## OFF-THE-SHELF DELIVERY

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AVAILABLE FROM  
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**MICROTRAN** company inc.  
145 East Mineola Avenue, Valley Stream, New York

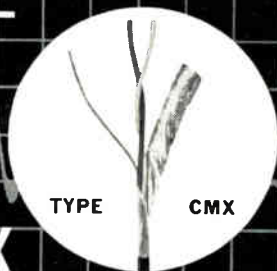


Circle 211 on Inquiry Card

for cleaner signals—

# DEKORON

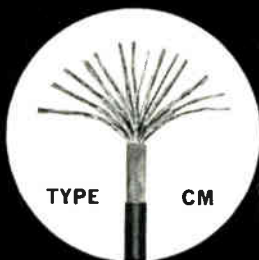
## Computer TWIST-EX Thermocouple Extension Wire



Clear, clean control signals are now readily available when you specify Dekoron Computer Twist-Ex thermocouple extension wire.

Twisted pair construction enables the EDP designer to increase wire density and cut installed costs substantially. Twisted pairs with total coverage shield of Mylar® tape with aluminum backing in contact with bare copper drain wire provides maximum electrostatic and electromagnetic noise rejection.

Dekoron Computer Twist-Ex is also available in cables (lower left) of from 4 to 36 pairs per cable in up to 1000 ft. lengths. Wire insulation and cable jackets are color coded to ISA standards. Engineered to highest standards, Dekoron computer wire products assure cleaner signals and lower installed costs. Samuel Moore & Co., Mantua, Ohio.



# SAMUEL MOORE

A-9273A

Circle 212 on Inquiry Card

## PHOTOCONDUCTIVE DEVICES

(Continued from page D17)

All types of CdS and CdSe photo-cells are limited to a maximum operating temperature of 70° to 80°C. Thus, when handling power they must be provided with adequate heat sinks. Further, the sensitivity of CdSe decreases sharply with increasing temperature so that CdSe is not used for high power. Since moisture greatly affects every type, plastic encapsulations are not widely used.

### Applications

Photoconductive devices of interest are really resistors whose value of resistance depends upon the incident light intensity. Thus, we shall refer to these devices (CdS and CdSe) as light dependent resistors (LDR).

Vacuum and gas-filled photoelectric devices can usually be replaced by LDRs where sensitivity is important but not speed. Here photoconductive devices do not need amplifiers. The lower power units need an intervening relay, but even this can be left out by using the high power device now on the market.

Of course, the applications of interest are those in which the LDR cannot be replaced by photoelectric devices. These are many so only a few will be discussed; viz., those in which the cell must dissipate some power (at least a few hundred mw).

One example of a group of uses is in safety monitoring in an oil or gas furnace where the LDR actuates a relay to cut off the fuel supply. The device can also be used in the safety line for smoke detection.

An obvious application is the dimming of automotive headlamps, or switching them on or off under set conditions. Also, LDRs can be used

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for street light control, resulting in a more simple circuit.

In consumer products, LDRs can be used for automatic changing of contrast and brightness of a TV image with the level of lighting in a room, and possibly by remote control.

TV may have a need of LDRs in a more refined use of a noise-free potentiometer. With a small lamp whose intensity can be varied and a fixed resistor whose value is about 20% of the dark resistance of the LDR, it is possible for the voltage tapped by the potentiometer to vary almost linearly by a factor of nearly 10,000. So, there are many uses for this device; one is remote volume control of hi-fi sound systems.

#### Power Capability

So far we have cited uses for cells of relatively low power. There is now, a cell (Delco type LDR-25) which is able to dissipate 25 w. and switch or control up to 100 w. This

cell can be used for prior unfulfilled needs. Also, it can eliminate intervening relays now in use. In general, here is a device which may be plugged into the power line to handle enough power for operating small motors or large relays. Thus, plants can use them in servo systems for counting, detecting, or operation cycling. As shown in Fig. 5, the LDR is used to detect whether or not the feeding mechanism of the furnace is properly loaded; it also runs a motor to feed the next boat into position.

Perhaps the most promising use of the LDR is to control the speed of small motors. Fig. 6 shows 3 methods of motor speed control. Compare a typical SCR circuit in A to a more simple LDR circuit (B or C). The LDR alone costs less than an SCR. Where only one SCR is used for cost reasons, this circuit, due to the rectifier nature of the SCR, will permit the motor to come up to only half-speed unless it is

abruptly switched to direct line voltage. This is not the case of either of the LDR circuits. However, the simplest LDR circuit does not allow the motor to supply as much torque at low speeds as the SCR circuit, because the latter provides feedback. With a series resistance across which a voltage is developed to control a second lamp shining on the LDR, (as in C of Fig. 6) one can provide feedback to improve the torque appreciably. Since the LDR is in effect a resistor, power is consumed by it. However, in most small motor uses this is not a serious setback. Delco Radio has, with success, operated household mixers and sewing machines in addition to small motors in servo systems. In general, the speed control is quite accurate and reproducible.

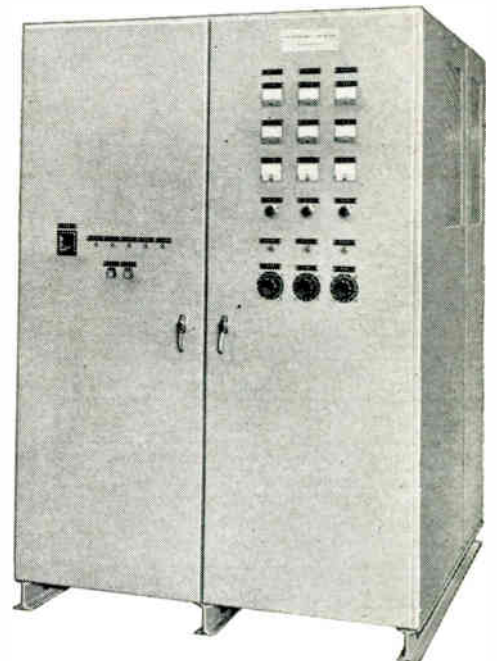
Thus, it would appear that in power photoconductors, we have reliable, low cost solid state devices for switching inductive loads and for controlling speeds of small motors.

## ★ ★ SPECTROMAGNETIC INDUSTRIES' CUSTOM DESIGN

The current regulated mag-amp power supply illustrated here is the answer to a problem. A Nuclear Physics Research Laboratory, operating a special type of 3 element magnetic quadrupole lens system to focus beams of charged particles coming from accelerators, required a special power source. Spectromagnetic Industries created, designed and furnished it.

The cabinet contains two 40 volt, 400 amp and one 80 volt, 400 amp power supplies, each controlled independently in order to optimize focal properties of quadrupole lens system. Output range is variable from 10% to 100%.

*Do you have a problem? Write details to:*



**SPECTROMAGNETIC INDUSTRIES**

*P. O. Box 3306*

*Hayward, California*

*Telephone 782-1300*

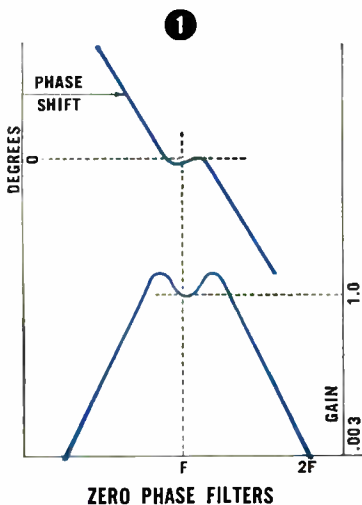
# Now available!

# THREE NEW FILTER FAMILIES

## designed to improve future systems!

If you are concerned with new systems development, and would like to take advantage of advanced technology and the kind of sophistication that will improve transient response and eliminate obsolete circuitry . . . then here are three new filter families, that have advanced the state of the art, which you can immediately incorporate in your network designs — exclusive from Burnell. Call or write today for literature and technical assistance.

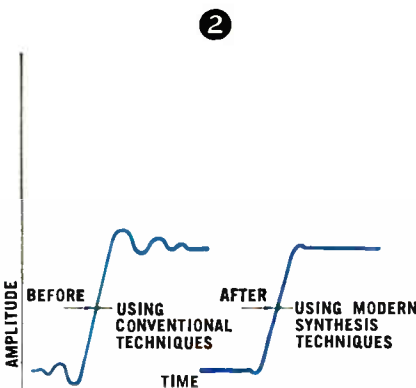
Burnell offers the most complete line of communications network components available to the electronics industry, with a versatility of experience unmatched in the production of filters, delay lines and toroids for interpretation of *complex signals*. Burnell will custom design filter networks to your specifications which may include special delay, attenuation, and transient response, involving precisely specified rise time, overshoot and ringing.



ZERO PHASE FILTERS

| Impedance  | 1000 ohms/Grid          | 400 cps Center                                  |
|--|-------------------------|---|
| ATTENUATION & PHASE CHARACTERISTICS  |                         |   |
| OP SERIES  | OP400 L                 | OP400 M OP400 H                                 |
| Pass Band (3 DB)   | $\pm 20$ cps            | $\pm 20$ cps $\pm 20$ cps                       |
| Harmonic attenuation 2nd harmonic and all higher frequencies   | 50 DB                   |   |
| Harmonic attenuation (2nd)   | $> 15$ DB               | $> 25$ DB                                       |
| Harmonic attenuation (3rd)   | $> 40$ DB               | $> 60$ DB                                       |
| Max. phase $\pm 20$ cps  | $\pm 1^\circ$           | $\pm 1^\circ$ $\pm 1^\circ$                     |
| Max. phase $\pm 30$ cps  |                         | $\pm 5^\circ$                                   |
| Phase shift at Center Frequency  | $0^\circ \pm 1/2^\circ$ | $0^\circ \pm 1/2^\circ$ $0^\circ \pm 1/2^\circ$ |
| Gain =   | UNITY                   | UNITY UNITY                                     |
| 60 cps equivalent filters are also available having a pass band of $\pm 5\%$ with phase of $\pm 1^\circ$ . |                         |   |

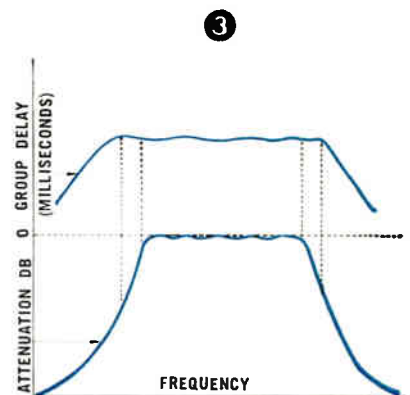
For the Servo Engineer . . .  
By specifying Burnell's new line of Zero Phase Shift networks, it is possible to recover, without phase shift, the fundamental frequency from any periodic wave form without using complex squaring circuitry. This advancement in the state of the art is accomplished by combining zero phase shift in the vicinity of the center frequency — with high attenuation in the stop bands.



### LOW PASS FILTERS WITHOUT DISTORTION

This family of filters is designed with modern synthesis techniques to have specified transient characteristics such as fast rise time, low overshoot and ringing.

| 60/3 DB Shape Factor | Ringing (over/undershoot) |
|----------------------|---------------------------|
| 2:1                  | $< 5\%$                   |
| 3:1                  | $< 2\%$                   |
| 4:1                  | $< 1\%$                   |



### CONSTANT DELAY BAND PASS FILTERS

This is part of a family of constant delay band pass filters of unusual characteristics, for example:

- 1—Group delay is constant well into the stop band!
- 2—Matched delay—as an example of delay matched band pass filters, we have produced a set of four filters having the same band widths of 500 cycles at  $1\frac{1}{2}$  DB with center frequencies ranging from 680 cycles to 2720 cycles; having a 20 DB band width of 710 cycles with group delay constancy of  $\pm 3\frac{1}{2}\%$  over the pass band and between channels.
- 3—Constant delay band pass filter.

| Frequency  | Attenuation |
|--|-------------|
| 5210 cps to 8336 cps   | $< .5$ DB   |
| 1,000 cycles & below   | $> 20$ DB   |
| 10,000 cycles & higher   | $> 20$ DB   |
| Delay: Group delay constant $\pm 1\%$ from 3,500 cps to 9,900 cps. |             |

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## Burnell & Co., Inc.

PIONEERS IN microminiaturization OF TOROIDS, FILTERS AND RELATED NETWORKS

SUBSIDIARIES: G-K Electronics, Inc., Pelham, N.Y. • GLP Electronics, Inc., Bristol, Conn.

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PELHAM, NEW YORK  
PELHAM 8-5000  
TELETYPE PELHAM 3633



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WELLINGTON 2-6774  
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PACIFIC DIV.



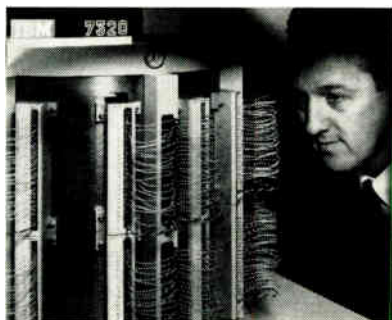
## OPERATIONAL SYSTEMS (Concluded)

looks up the order quantity computed by the ordering function. This figure is then sent to the buyer for his approval.

In industries with much paperwork, operating systems are used to centralize records so that vital facts are available to management on short notice. As an example, Connecticut Blue Cross is installing a computer system which will be linked to member hospitals through data communication channels. With policyholder data maintained on the computer random access disks, member hospitals can get answers to vital questions almost immediately. When a patient is admitted, the admissions clerk simply "asks the computer" for a status report and, within seconds, the information is being typed out on a receiving machine.

In other branches of the insurance industry there are many instances of firms tying their field offices to the home office computer via common carrier lines for the transmission of typed, punched tape or punched card data. These systems eliminate a lag of days or weeks while remote branches wait for needed information.

Engineer checks wiring of a random access magnetic drum. The IBM unit was designed to speed storage and retrieval of computer programs.

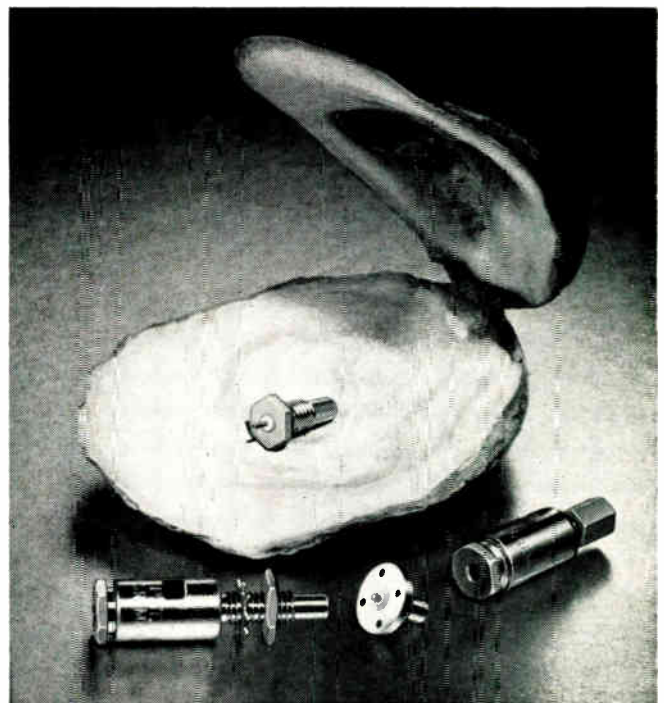


### Major Need

These examples show that most of the hardware needed for effective operating systems is now in existence. The need now is for better ways to get information into and out of the centralized system. Solutions to this problem will be found through such devices as optical scanners and magnetic ink character readers, voice recognition systems, Tele-processing units capable of accepting machine codes, and production reporting devices located on the manufacturing line.

### Meaning

What does this all mean? It means that the present trend toward operational systems will provide management in all facets of business with a lot more information about how things happen and what they can do to correct or maintain quality and quantity levels. With current information available faster and in more detail than ever before, EDP is becoming a tool almost any business can use to do a better job.



## A BIG NEW FIND IN SUBMINIATURE CONNECTORS

Now . . . Greomar Connectronics® makes available a superior subminiature RF connector for coaxitube and flexible cables!

If you've been looking for subminiature connectors that handle problems associated with .140 Dia. coaxitube and RG/U cables — you now have a simple solution: contact Greomar and ask about our screw-on MIL-C-22557A connector series.

These connectors offer all these advantages: subminiature size, light weight, low VSWR, matched impedance, quick, easy secure assembly and ease of field serviceability. They conform to all applicable requirements of MIL-C-22557A.

### LOOK AT THESE FEATURES:

- \* Closed entry contacts
- \* Teflon dielectric
- \* 500 volt peak operating voltage
- \* Operating frequencies up to 6 gc
- \* Irradiated polyethylene dielectric versions are available for radiation environments.
- \* Metal parts heavily gold plated
- \* Also available in crimp types, using commercial crimping tools . . . and in Greomar's patented Redline cable assembly technique that eliminates braid combing, saves up to 80% assembly time, insures low VSWR and pull out strength up to 25 lbs.

Greomar MIL-C-22557A connectors come in all standard configurations for .140 Diameter, 50 ohms coaxitube, for RG-122, 178, 180A, 188, 195, 196 and 316/U as well as Raychem 32-196 and 52-508 cables. Strip transmission line adaptors are also available.

Look to Greomar for the latest in new developments in all RF Standard or special connectors.

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# GREOMAR

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# SECTION L

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## MANUFACTURERS & PRODUCTS

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| Electronic Manufacturers, A-Z | L3  |
| Product Finding Index         | L42 |
| Products & Manufacturers      | L48 |



# INDUSTRIAL ELECTRON TUBES

|         |      |         |       |        |       |      |       |          |        |        |        |      |       |
|---------|------|---------|-------|--------|-------|------|-------|----------|--------|--------|--------|------|-------|
| 0A2     | 1.50 | 3C22    | 17.50 | 5R1WGA | 3.50  | 417A | 6.50  | 927      | 1.75   | 5763   | 2.50   | 6107 | 25.00 |
| 0A2W.A. | 8.00 | 3C23    | 5.00  | 5R1WGB | 10.00 | 418A | 10.00 | 929      | 30.00  | 5768   | 1.50   | 6173 | 8.00  |
| 0A3     | 1.85 | 3C24    | 5.00  | 5R1WGY | 1.50  | 420A | 4.00  | 931A     | 150.00 | 5777   | 1.50   | 6177 | 60.00 |
| 0A4G    | 1.00 | 3C45    | 16.50 | 3RPA   | 35.00 | 421A | 7.50  | 1000T    | 150.00 | 5778   | 2.50   | 6186 | 1.75  |
| 0A5     | 5.00 | 3C100A5 | 10.00 | 3RPA   | 75.00 | 422A | 4.00  | CR-1000  | 2.75   | 5783WB | 2.00   | 6197 | 1.50  |
| 0B2     | 1.50 | 3D22    | 10.00 | 5R17A  | 3.50  | 427A | 4.00  | CR-1000  | 2.00   | 5784WB | 2.00   | 6199 | 35.00 |
| 0B2W.A. | 1.75 | 3D23    | 10.00 | 5R17A  | 3.50  | 428A | 4.00  | R11300B  | 2.00   | 5784WA | 3.50   | 6201 | 1.50  |
| 0B3     | 1.50 | 3D24    | 10.00 | 5R17A  | 3.50  | 429A | 4.00  | 1229     | 2.00   | 5784WA | 2.50   | 6202 | 1.50  |
| 0C3     | 3.50 | 3E22    | 10.00 | 5R17A  | 15.00 | 429B | 6.50  | 1237     | 6.00   | 5796   | 2.50   | 6203 | 2.75  |
| 0C3     | 5.00 | 3E23    | 10.00 | 5R17A  | 15.00 | 431A | 5.00  | V.C.1287 | 10.00  | 5796   | 2.50   | 6204 | 2.75  |
| 0C3     | 5.00 | 3E24    | 10.00 | 5R17A  | 15.00 | 432A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6205 | 2.75  |
| 0C3     | 5.00 | 3E25    | 10.00 | 5R17A  | 15.00 | 433A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6206 | 2.75  |
| 0C3     | 5.00 | 3E26    | 10.00 | 5R17A  | 15.00 | 434A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6207 | 2.75  |
| 0C3     | 5.00 | 3E27    | 10.00 | 5R17A  | 15.00 | 435A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6208 | 2.75  |
| 0C3     | 5.00 | 3E28    | 10.00 | 5R17A  | 15.00 | 436A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6209 | 2.75  |
| 0C3     | 5.00 | 3E29    | 10.00 | 5R17A  | 15.00 | 437A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6210 | 2.75  |
| 0C3     | 5.00 | 3E30    | 10.00 | 5R17A  | 15.00 | 438A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6211 | 2.75  |
| 0C3     | 5.00 | 3E31    | 10.00 | 5R17A  | 15.00 | 439A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6212 | 2.75  |
| 0C3     | 5.00 | 3E32    | 10.00 | 5R17A  | 15.00 | 440A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6213 | 2.75  |
| 0C3     | 5.00 | 3E33    | 10.00 | 5R17A  | 15.00 | 441A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6214 | 2.75  |
| 0C3     | 5.00 | 3E34    | 10.00 | 5R17A  | 15.00 | 442A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6215 | 2.75  |
| 0C3     | 5.00 | 3E35    | 10.00 | 5R17A  | 15.00 | 443A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6216 | 2.75  |
| 0C3     | 5.00 | 3E36    | 10.00 | 5R17A  | 15.00 | 444A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6217 | 2.75  |
| 0C3     | 5.00 | 3E37    | 10.00 | 5R17A  | 15.00 | 445A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6218 | 2.75  |
| 0C3     | 5.00 | 3E38    | 10.00 | 5R17A  | 15.00 | 446A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6219 | 2.75  |
| 0C3     | 5.00 | 3E39    | 10.00 | 5R17A  | 15.00 | 447A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6220 | 2.75  |
| 0C3     | 5.00 | 3E40    | 10.00 | 5R17A  | 15.00 | 448A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6221 | 2.75  |
| 0C3     | 5.00 | 3E41    | 10.00 | 5R17A  | 15.00 | 449A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6222 | 2.75  |
| 0C3     | 5.00 | 3E42    | 10.00 | 5R17A  | 15.00 | 450A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6223 | 2.75  |
| 0C3     | 5.00 | 3E43    | 10.00 | 5R17A  | 15.00 | 451A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6224 | 2.75  |
| 0C3     | 5.00 | 3E44    | 10.00 | 5R17A  | 15.00 | 452A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6225 | 2.75  |
| 0C3     | 5.00 | 3E45    | 10.00 | 5R17A  | 15.00 | 453A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6226 | 2.75  |
| 0C3     | 5.00 | 3E46    | 10.00 | 5R17A  | 15.00 | 454A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6227 | 2.75  |
| 0C3     | 5.00 | 3E47    | 10.00 | 5R17A  | 15.00 | 455A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6228 | 2.75  |
| 0C3     | 5.00 | 3E48    | 10.00 | 5R17A  | 15.00 | 456A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6229 | 2.75  |
| 0C3     | 5.00 | 3E49    | 10.00 | 5R17A  | 15.00 | 457A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6230 | 2.75  |
| 0C3     | 5.00 | 3E50    | 10.00 | 5R17A  | 15.00 | 458A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6231 | 2.75  |
| 0C3     | 5.00 | 3E51    | 10.00 | 5R17A  | 15.00 | 459A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6232 | 2.75  |
| 0C3     | 5.00 | 3E52    | 10.00 | 5R17A  | 15.00 | 460A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6233 | 2.75  |
| 0C3     | 5.00 | 3E53    | 10.00 | 5R17A  | 15.00 | 461A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6234 | 2.75  |
| 0C3     | 5.00 | 3E54    | 10.00 | 5R17A  | 15.00 | 462A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6235 | 2.75  |
| 0C3     | 5.00 | 3E55    | 10.00 | 5R17A  | 15.00 | 463A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6236 | 2.75  |
| 0C3     | 5.00 | 3E56    | 10.00 | 5R17A  | 15.00 | 464A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6237 | 2.75  |
| 0C3     | 5.00 | 3E57    | 10.00 | 5R17A  | 15.00 | 465A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6238 | 2.75  |
| 0C3     | 5.00 | 3E58    | 10.00 | 5R17A  | 15.00 | 466A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6239 | 2.75  |
| 0C3     | 5.00 | 3E59    | 10.00 | 5R17A  | 15.00 | 467A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6240 | 2.75  |
| 0C3     | 5.00 | 3E60    | 10.00 | 5R17A  | 15.00 | 468A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6241 | 2.75  |
| 0C3     | 5.00 | 3E61    | 10.00 | 5R17A  | 15.00 | 469A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6242 | 2.75  |
| 0C3     | 5.00 | 3E62    | 10.00 | 5R17A  | 15.00 | 470A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6243 | 2.75  |
| 0C3     | 5.00 | 3E63    | 10.00 | 5R17A  | 15.00 | 471A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6244 | 2.75  |
| 0C3     | 5.00 | 3E64    | 10.00 | 5R17A  | 15.00 | 472A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6245 | 2.75  |
| 0C3     | 5.00 | 3E65    | 10.00 | 5R17A  | 15.00 | 473A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6246 | 2.75  |
| 0C3     | 5.00 | 3E66    | 10.00 | 5R17A  | 15.00 | 474A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6247 | 2.75  |
| 0C3     | 5.00 | 3E67    | 10.00 | 5R17A  | 15.00 | 475A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6248 | 2.75  |
| 0C3     | 5.00 | 3E68    | 10.00 | 5R17A  | 15.00 | 476A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6249 | 2.75  |
| 0C3     | 5.00 | 3E69    | 10.00 | 5R17A  | 15.00 | 477A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6250 | 2.75  |
| 0C3     | 5.00 | 3E70    | 10.00 | 5R17A  | 15.00 | 478A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6251 | 2.75  |
| 0C3     | 5.00 | 3E71    | 10.00 | 5R17A  | 15.00 | 479A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6252 | 2.75  |
| 0C3     | 5.00 | 3E72    | 10.00 | 5R17A  | 15.00 | 480A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6253 | 2.75  |
| 0C3     | 5.00 | 3E73    | 10.00 | 5R17A  | 15.00 | 481A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6254 | 2.75  |
| 0C3     | 5.00 | 3E74    | 10.00 | 5R17A  | 15.00 | 482A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6255 | 2.75  |
| 0C3     | 5.00 | 3E75    | 10.00 | 5R17A  | 15.00 | 483A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6256 | 2.75  |
| 0C3     | 5.00 | 3E76    | 10.00 | 5R17A  | 15.00 | 484A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6257 | 2.75  |
| 0C3     | 5.00 | 3E77    | 10.00 | 5R17A  | 15.00 | 485A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6258 | 2.75  |
| 0C3     | 5.00 | 3E78    | 10.00 | 5R17A  | 15.00 | 486A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6259 | 2.75  |
| 0C3     | 5.00 | 3E79    | 10.00 | 5R17A  | 15.00 | 487A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6260 | 2.75  |
| 0C3     | 5.00 | 3E80    | 10.00 | 5R17A  | 15.00 | 488A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6261 | 2.75  |
| 0C3     | 5.00 | 3E81    | 10.00 | 5R17A  | 15.00 | 489A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6262 | 2.75  |
| 0C3     | 5.00 | 3E82    | 10.00 | 5R17A  | 15.00 | 490A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6263 | 2.75  |
| 0C3     | 5.00 | 3E83    | 10.00 | 5R17A  | 15.00 | 491A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6264 | 2.75  |
| 0C3     | 5.00 | 3E84    | 10.00 | 5R17A  | 15.00 | 492A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6265 | 2.75  |
| 0C3     | 5.00 | 3E85    | 10.00 | 5R17A  | 15.00 | 493A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6266 | 2.75  |
| 0C3     | 5.00 | 3E86    | 10.00 | 5R17A  | 15.00 | 494A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6267 | 2.75  |
| 0C3     | 5.00 | 3E87    | 10.00 | 5R17A  | 15.00 | 495A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6268 | 2.75  |
| 0C3     | 5.00 | 3E88    | 10.00 | 5R17A  | 15.00 | 496A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6269 | 2.75  |
| 0C3     | 5.00 | 3E89    | 10.00 | 5R17A  | 15.00 | 497A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6270 | 2.75  |
| 0C3     | 5.00 | 3E90    | 10.00 | 5R17A  | 15.00 | 498A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6271 | 2.75  |
| 0C3     | 5.00 | 3E91    | 10.00 | 5R17A  | 15.00 | 499A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6272 | 2.75  |
| 0C3     | 5.00 | 3E92    | 10.00 | 5R17A  | 15.00 | 500A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6273 | 2.75  |
| 0C3     | 5.00 | 3E93    | 10.00 | 5R17A  | 15.00 | 501A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6274 | 2.75  |
| 0C3     | 5.00 | 3E94    | 10.00 | 5R17A  | 15.00 | 502A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6275 | 2.75  |
| 0C3     | 5.00 | 3E95    | 10.00 | 5R17A  | 15.00 | 503A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6276 | 2.75  |
| 0C3     | 5.00 | 3E96    | 10.00 | 5R17A  | 15.00 | 504A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6277 | 2.75  |
| 0C3     | 5.00 | 3E97    | 10.00 | 5R17A  | 15.00 | 505A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6278 | 2.75  |
| 0C3     | 5.00 | 3E98    | 10.00 | 5R17A  | 15.00 | 506A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6279 | 2.75  |
| 0C3     | 5.00 | 3E99    | 10.00 | 5R17A  | 15.00 | 507A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6280 | 2.75  |
| 0C3     | 5.00 | 3E100   | 10.00 | 5R17A  | 15.00 | 508A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6281 | 2.75  |
| 0C3     | 5.00 | 3E101   | 10.00 | 5R17A  | 15.00 | 509A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6282 | 2.75  |
| 0C3     | 5.00 | 3E102   | 10.00 | 5R17A  | 15.00 | 510A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50   | 6283 | 2.75  |
| 0C3     | 5.00 | 3E103   | 10.00 | 5R17A  | 15.00 | 511A | 5.00  | V.C.1287 | 10.00  | 5800   | 2.50</ |      |       |

# ELECTRONIC INDUSTRIES

## 1963 DIRECTORY

### ALPHABETICAL LISTING OF MANUFACTURERS

A listing of the names and addresses of manufacturers in the electronic and allied industries. All the information in this listing and in the product listing section has been supplied by the manufacturers.

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| <p>A A METAL PRODUCTS<br/>154 ELLIOT ST BRATTLEBORO VT<br/>AAA WIRE WDRKS INC<br/>45 FOX ST NEW HAVEN CONN<br/>ABALON PRECISION MFG CORP<br/>540 CASANDVA ST NEW YDRK 59 N Y<br/>ABACUS INC<br/>1718 TWENTY FIRST SANTA MONICA CALIF<br/>ABAR CORP<br/>2424 WYANDOTTE RD WILLOW GROVE PA<br/>ABBEON INCORPORATED<br/>179-15 JAMAICA AVE JAMAICA 32 N Y<br/>ABBEY ELECTRONICS CORP<br/>143 OLD COUNTRY RD CARLE PL N Y<br/>ABBOTT PRODUCTS INC<br/>123 ST COLLEGE PT 56 N Y<br/>ABBOTT SCREW &amp; MFG CO<br/>6525 N CLARK ST CHICAGO 26 ILL<br/>ABBOTT TRANSISTOR LABS INC<br/>3055 BUCKINGHAM RD LOS ANGELES CALIF<br/>ABC FAIRCO INC<br/>543 MONTEREY PASS RD MONTEREY PK CALIF<br/>ABESTE CORP<br/>49 ACKERMAN ST BLOOMFIELD N J<br/>ABRAMS INSTRUMENT CORP<br/>606 E SHIAWASSEE ST LANSING 1 MICH<br/>ABTRONICS INC<br/>64 S P ST LIVERMORE CALIF<br/>ACCESSORY CONTROLS EQUIPMENT<br/>805 BLOOMFIELD AVE WINDSOR CONN<br/>ACCURACY INC<br/>223 CRESCENT ST WALTHAM MASS<br/>ACCURATE ELECTRONICS CO<br/>2005 BLUE ISLAND AVE CHICAGO 8 ILL<br/>ACCURATE ELECTRONICS INC<br/>13215 LEADWELL ST N HOLLYWOOD CAL<br/>ACCURATE ELECTRONICS CORP<br/>169 S ABBE RD SE ELYRIA OHID<br/>ACCURATE INSTRUMENT CO<br/>2418 ALARAMA AVE HOUSTON 6 TEXAS<br/>ACCURATE MFG CO<br/>44 HEPWORTH PL GARFIELD N J<br/>ACCURATE PAPER TUBE CO<br/>903 W CULLERTON CHICAGO 8 ILL<br/>ACCURATE SPECIALTIES CO INC<br/>345 LODI ST HACKENSACK N J<br/>ACCURATE SPRING MFG CO<br/>3811 W LAKE ST CHICAGO 24 ILL<br/>ACCUTRONICS INC<br/>12 SO ISLAND BATAVIA ILL<br/>ACDC ELECTRONICS INC<br/>2979 N ONTARIO ST BURBANK CALIF<br/>ACE COIL &amp; ELECTRONICS CO<br/>914 LINCOLN HWY METUCHEN N J<br/>ACE DRILL BUSHING CO INC<br/>5407 FOUNTAIN AVE LOS ANG CALIF<br/>ACE ELECTRIC MFG CO<br/>1458 SHAKESPEARE AVE NEW YORK 52 N Y<br/>ACE ELECTRONICS ASSOC<br/>99 DOVER ST SOMERVILLE MASS<br/>AC ELECTRONICS INC<br/>11725 MISSISSIPPI AVE LOS ANG CALIF<br/>ACE ENGG &amp; MACHINE CO INC<br/>TOMLSON RD HUNTINGDON VALLEY PENNA<br/>ACE PLASTIC CO<br/>91-30 VAN WYCK EXPWY JAMAICA 35 N Y<br/>ACE SPRING MFG CO<br/>146 32ND ST BROOKLYN N Y<br/>ACE SYCAMORE INC<br/>SYCAMORE ILL<br/>ACCESSORY PROD CO DIV OF TEXTRON INC<br/>616 WHITTIER BLVD WHITTIER CALIF<br/>ACETO CHEMICAL CO INC<br/>40 40 LAWRENCE ST FLUSHING N Y<br/>ACF ELECTRONICS DIV<br/>RIVERDALE MD</p> | <p>ACF ELECTRONICS DIV ACF INDUSTRIES INC<br/>11 PARK PL PARAMUS N J<br/>ACHESON COLLOIDS CO<br/>1951 WASHINGTON AVE PORT HURON MICH<br/>ACKERMAN ENGRAVERS<br/>43-22 36TH ST LONG ISLAND CITY N Y<br/>ACKERMAN-GOULD CO INC<br/>10 NEIL COURT PD BOX 188 OCEANSIDE LI N Y<br/>ACME BATTERY CORP<br/>200 HENRY ST STAMFORD CONN<br/>ACME BRASS FOUNDRY CO OF S A INC<br/>716 WYOMING ST SAN ANTONIO 3 TEXAS<br/>ACME ELECTRIC CORP<br/>WATER ST CUBA N Y<br/>ACME ELECTRIC HEATING CORP<br/>99 READING ST BOSTON MASS<br/>ACME INDUSTRIAL CO<br/>200-222 N LAFLIN ST CHICAGO 7 ILL<br/>ACME MFG &amp; GASKET CO<br/>738 N 41 ST PHILA PA<br/>ACME MODEL ENGG CO<br/>6224 15TH AVE BROOKLYN 19 NY<br/>ACME NEWPORT STEEL CO<br/>NEWPORT KY<br/>ACME WIRE CO<br/>1255 DIXWELL AVE NEW HAVEN 14 CONN<br/>ACOPIN TECHNICAL CO<br/>927 SPRUCE ST EASTON PA<br/>ACOUSTICA ASSOCIATES INC<br/>5331 W 104TH ST LOS ANGELES 45 CALIF<br/>ACOUSTICA ASSOCIATES<br/>10400 AVIATION BLVD LOS ANGELES 45 CALIF<br/>ACOUSTIC RESEARCH INC<br/>24 THORNDIKE ST CAMBRIDGE MASS<br/>AC RAY ELECTRONICS INC<br/>910 N 20 AVE HOLLYWOOD FLA<br/>ACR ELECTRONICS CORP<br/>551 W 22 ST NEW YDRK 11 N Y<br/>ACRD DIV ROBERT SHAW FULTON CONTROL CO<br/>2040 E MAIN ST COLUMBUS OHIO<br/>ACRO ELECTRONIC PRODUCTS CO<br/>119 ST MITHEL DR RIVERSIDE N J<br/>ACROMAG INC<br/>15360 TELEGRAPH RD DETROIT MICH<br/>ACROMARK CO<br/>309 MORRELL ST ELIZABETH NJ<br/>ACRO PRODUCTS CO<br/>369 SHURS LANE PHILADELPHIA 28 PA<br/>ACRO TOOL &amp; DIE WORKS<br/>4554 BROADWAY CHICAGO ILL<br/>ACRO WELDER MFG CO<br/>1719 W ST PAUL AVE MILWAUKEE WISC<br/>AC SPARK PLUG ELECT DIV GMC<br/>P O BOX 1002 FLINT 1 MICH<br/>AC SPARK PLUG ELECT DIV GMC<br/>1925 KENTLWORTH PL MILWAUKEE WISC<br/>ACTAN ELECTRONICS INC ENGRG MFG &amp; DEV CORP<br/>130 COUNTY COURTHOUSE RD NEW HYDE PARK NY<br/>ACTIONCRAFT PRODUCTS<br/>2 YENNICOCK AVE PORT WASHINGTON N Y<br/>ACTON LAB<br/>1180 RAYMOND BLVD NEWARK N J<br/>A C TRANSFORMER CORP<br/>89 MADISON ST NEWARK 5 N J<br/>ADAGE INC<br/>292 MAIN ST CAMBRIDGE MASS<br/>ADAM METAL SUPPLY INC<br/>463 48TH AVE LONG ISLAND CITY N Y<br/>ADAMS &amp; WESTLAKE CO<br/>1025 N MICHIGAN ELKHART IND<br/>ADAMS ELECTRONICS INC<br/>16 CHARLES ST BANGOR MICH<br/>ADAMS RITE MFG CO<br/>540 W CHEVY CHASE DR GLENDALE 4 CALIF<br/>ADAMS RUSSELL CO INC<br/>200 SIXTH ST CAMBRIDGE MASS</p> | <p>ADC PRODUCTS DV OF MAGNETIC CONTROLS<br/>6405 CAMBRIDGE ST MINN MINN<br/>ADCOM CORP<br/>9732 COTYCROFT AVE CHATSWORTH CALIF<br/>ADCON DIV WAYNE-GEORGE CORP<br/>322NEEDHAM STREET NEWTON 64 MASS<br/>ADGRAFTERS CO<br/>325 W HURON ST CHICAGO ILL<br/>ADDRESSOGRAPH MULTIGRAPH CORP<br/>1200 BABBITT RD CLEVELAND OHIO<br/>ADEC INC<br/>86 FRELINGHUYSEN AVE NEWARK N J<br/>ADEL PRECISION PROD DV GENERAL METALS CORP<br/>1444 WASHINGTON AVE HUNTINGTON W VA<br/>ADEPT INDUSTRIES INC<br/>1636 W HUNTING PARK AVE PHILA 4 PA<br/>ADLER ELECTRONICS INC<br/>1 LEFEVRE LANE NEW ROCHELLE N Y<br/>ADMIRAL CORP<br/>3800 W CORTLAND ST CHICAGO ILL<br/>ADTROL ELECTRONICS INC<br/>116 N 7TH ST PHILA 6 PA<br/>ADVANCE CARBON &amp; ELECTRIC MFG CO<br/>2505 MARIPOSA ST SAN FRANCISCO 10 CALIF<br/>ADVANCE GEAR &amp; MACHINE CORP<br/>5851 HOLMES AVE LOS ANG CALIF<br/>ADVANCE GLOVE MFG CO<br/>901 W LAFAYETTE BLVD DETROIT 26 MICH<br/>ADVANCE INSTRUMENT CORP<br/>1709 F ST BELMAR N J<br/>ADVANCE ROSS ELECT CORP<br/>2538 PETERSON AVE CHICAGO 45 ILL<br/>ADVANCE RDSS ELECT CORP<br/>860 WASHINGTON ST BURLINGTON IOWA<br/>ADVANCE RDSS ELECT CORP<br/>1010 W MADISON WASHINGTON IOWA<br/>ADVANCE TECHNOLOGY LABS DIV AMER STANDARD<br/>369 WHISMAN RD MT VIEW CALIF<br/>ADVANCED ELECTRONICS INC<br/>94 STLAS DEANE HWY ROCKY HILL CONN<br/>ADVANCED ELECT CORP<br/>2 COMMERCIAL ST HICKSVILLE LI N Y<br/>ADVANCED INSTRUMENTS<br/>45 KENNETH ST NEWTON HIGHLANDS 61 MASS<br/>ADVANCED KINETICS INC<br/>1231 VICTORIA ST COSTA MESA CALIF<br/>ADVANCED MEASUREMENT INST INC<br/>109 DOVER ST SOMMERSVILLE MASS<br/>ADVANCED SCIENTIFIC INSTRUMENTS<br/>5249 HANSEN CT MINNEAPOLIS 29 MINN<br/>ADVANCED STRUCTURES<br/>5159 BALTIMORE DR LAMESA CALIF<br/>ADVANCED TECHNOLOGY INC<br/>SANTA BARBARA CALIF<br/>ADVANCED VACUUM PRODUCTS INC<br/>430 FAIRFIELD AVE STAMFORD CONN<br/>AD-YU ELECTRONICS LAB INC<br/>249 TERHUNE AVE PASSAIC N J<br/>AERCOIL INC<br/>2207 SUMMIT AVE UNION CITY N J<br/>AERMOTER CO<br/>2500 W ROOSEVELT RD CHICAGO ILL<br/>AERODEX INC<br/>PO BOX 123 MIAMI 48 FLA<br/>AERO ELECTRONICS CORP<br/>1729 W 134 ST GARDENA CALIF<br/>AEROFLEX CORP DIV AERDFLEX LAB<br/>48 25 36TH ST LONG ISLAND CITY N Y<br/>AEROFLEX LABORATORIES INC<br/>SOUTH SERVICE ROAD PLAINVIEW LI N Y<br/>AERO GEO ASTRO CORP<br/>EDSALL &amp; LINCOLNIA RD ALEXANDRIA VA<br/>AEROJET GENERAL CORP ASTRONICS DIV<br/>6352 N IRVINDALE AVE AZUSA CALIF<br/>AEROJET-GENERAL NUCLEONICS<br/>P O BOX 77 SAN RAMON CALIF</p> |
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# ELECTRONIC MANUFACTURERS—A TO Z

AEROLITE ELECTRONICS CORP  
2207SUMMIT AVE UNION CITY NJ  
AEROLUX LIGHT CORP  
653 11 AVE NEW YORK 36 N Y

AERO MECHANISMS INC  
7750 BURNET AVE VAN NUYS CALIF  
AERONAUTICAL CDMW EQUIP CO  
3090 S W 37 AVE MIAMI FLA  
AERONAUTICAL ELECT CO  
5636 NORTHWEST HWY CHICAGO 46 ILL  
AERONAUTICAL ELECTRONICS INC  
P O BOX 6527 RALEIGH N C  
AERONAUTICAL & INST DV ROBERTSHAW FULTON CO  
SANTA ANA FREEWAY-EUCLID AVE ANAHEIM CALIF  
AERONCA MFG CORP  
MIDDLETOWN OHIO  
AERONCA MFG CORP AEROSPACE DIV  
BOX 536 BALTIMORE MD  
AERONUTRNIC SYSTEMS INC  
FORD ROAD NEWPORT BEACH CALIF  
AEROGUIP CORP  
300 S EAST AVE JACKSON MICH  
AERD RESEARCH INSTRUMENT CO  
315 N ABERDEEN ST CHICAGO 7 ILL  
AERO SERVICE CORP  
210 E CORTLAND ST PHILA PENNA  
AEROSONIC MARINE INC  
PO BOX 569 CLEARWATER FLA  
AEROSPACE ELECTRONICS INC  
PO BOX 48-495 MIAMI FLA  
AEROSPACE RESEARCH INC  
130 LINCOLN ST BRIGHTON 35 MASS  
AEROTEST LABORATORIES INC  
COMAC RD DEER PARK L I N Y  
AEROTRONIC ASSOCIATES INC  
BOX 367 CONTOCOOK N H  
AEROVOX CORP  
740 BELLEVILLE AVE N BEDFORD MASS  
AEROVOX CANADA LTD  
1551 BARTON ST HAMILTON ONTARIO CANADA  
AEROVOX CORP HIQ DIVISION  
MYRTLE BEACH SC  
AEROVOX PACIFIC  
1100 CHESTNUT ST BURBANK CALIF  
AETNA ELECTRONICS CORP  
READINGTON RO N BRANCH N J  
AETNA FELT CO  
204 CENTRE ST NEW YORK 13 NY  
AFFILIATED MANUFACTURERS INC  
P D BOX 248 WHITEHOUSE N J  
AFFILIATED PHOTOGRAPHIC CO  
21 W 45 ST NEW YORK 36 N Y  
AFFILIATED SCREW PROD CO  
3800 WESLEY TERR SCHILLER PK ILL  
AGA CORP OF AMERICA  
P O BOX 147 SOUTH PLAINFIELD N J  
A G A DIV ELASTIC STOP NUT CORP  
1027 NEWARK AVE ELIZABETH 3 N J  
AGARD ELECTRONICS CORP  
25 DENTON AVE NEW HYOE PARK N Y  
AGASTAT TIMING INSTRUMENTS  
1027 NEWARK AVE ELIZABETH N J

A H B ELECTRONIC PARTS INC  
129 05 LIBERTY AVENUE RICHMOND HILL 19 N Y  
AIDIN AUTOMATION INC  
1613 E NEW YORK AVE BROOKLYN 12 N Y  
AINSLIE CORP  
531 POND ST BRAINTREE MASS  
AIRBORNE ACCESSORIES CORP  
1414 CHESTNUT AVE HILLSIDE 5 N J  
AIR BORNE CONTROLS INC  
12173 BRANFORD ST SUN VALLEY CALIF  
AIRBORNE ELECT CO  
6813 TROOST AVE N HOLLYWOOD CALIF  
AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC  
COMAC ROAD DEER PARK LI N Y  
AIRCOM INC  
48 CUMMINGTON ST BOSTON 15 MASS  
AIRCONDUCTORS  
367 E ALONDRA GARDENA CALIF  
AIRCRAFT & ELECT SPEC  
22 GREEN ST BROWNSBURG IND  
AIRCRAFT ARMAMENTS INC  
INDUSTRY LANE COCKEYSVILLE MD  
AIRCRAFT FITTING CO  
701 FEDERAL HWY DANIA FLA  
AIRCRAFT INSTRUMENTS CO  
304 KING OF PRUSSIA RD RADNOR PENNA  
AIRCRAFT RADIO CORP  
BOONTON N J  
AIRDESIGN CORP  
BOX 987 NORRISTOWN PA  
AIR ELECTRONICS CO  
7250 HINDS AVE N HOLLYWOOD CALIF  
AIRESEARCH MFG CO DIV GARRETT CORP  
9851 SEPULVEDA BLVD LOS ANGELES 45 CAL  
AIREX CORP  
TIBBETTS RD BOX 1517 ROCHESTER N H  
AIR FILTER CORP  
4554 W WOODWORTH AVE MILWAUKEE WISC  
AIRFLYTE ELECTRONICS CO  
535 AVENUE A BAYONNE N J  
AIRGUIDE INSTRUMENT CO  
2210 WABANSIA AVE CHICAGO ILL  
AIR MARINE MOTORS INC  
2221 BARRY AVE LOS ANG CALIF  
AIR MARINE MOTORS  
369 BAYVIEW AVE AMITYVILLE L I N Y  
AIRMATIC VALVE INC  
7314 ASSOCIATE AVE CLEVELAND 9 OHIO  
AIRMATICS SYSTEMS CORP  
441 MARKET ST SADDLE BROOK NJ  
AIR MAZE DIV ROCKWELL STANDARD CORP  
25000 MILES RD CLEVELAND OHIO  
AIR O TRONICS ENG CO  
MORRISVILLE N Y

AIRPAX ELECT INC SEMINOLE DIV  
FORT LAUDERDALE FLA  
AIRPAX ELECTRONICS INC  
CAMBRIDGE MD

AIRPAX ELECTRONICS PACIFIC DIV  
NORTHBRIDGE CALIF  
AIRPAX ELECTRONICS INC  
2550 E FOOTHILL BLVD PASADENA CALIF  
AIRPAX PRODUCTS CO  
JACKTOWN RD CAMBRIDGE MD  
AIR REDUCTION SALES CO REDUCTION CO  
150 E 42 ST NEW YORK N Y  
AIR-SHIELDS INC  
HATBORO PENNA  
AIRTEC INC  
139 E 1ST AVE ROSELLE N J  
AIR TRANSPORT MFG CO  
1114 N SYCAMORE AVE LOS ANGELES CALIF  
AIRTRON A DIV OF LITTON INDUSTRY  
200 E HANOVER AVE MDRRIS PLAINS N J  
AIRTRONICS INC  
5221 RIVER RD BETHESDA MD  
AIRTRONICS INTL CORP  
6900WEST RD BOX 8576 FT LAUDERDALE FLA  
AIRTRONIX DEVELOPMENT CORP  
628 E 83RD ST BROOKLYN 36 N Y  
A & J MFG CO  
4214 ARTESTIA FULLERTON CALIF  
AJAX CONDENSER CO  
932 WRIGHTWOOD AVE CHICAGO ILL  
AJAX ELECTROTHERMIC CORP  
AJAX PARK TRENTON N J  
A K MFG CO INC  
410 S HAGER AVE BARRINGTON ILL  
AKRON METALLIC GASKET CO  
150 N UNION ST AKRON OHIO  
ALAC INC  
365 W ARDEN ST GLENDALE 3 CALIF  
ALADDIN ELECTRONICS DIV ALADDIN INDUSTRIES  
703 MURFREESBORO RD NASHVILLE 1 TENN  
A L A INDUSTRIES INC  
151 CRTONA AVE HARRISON N Y  
ALAN ELECTRONICS  
1167 HILDA ST ANAHEIM CALIF  
ALAN WOOD STEEL CO  
CONSHOHOCKEN PA  
ALBEROX CORP  
INOUST PARK NEW BEDFORD MASS  
ALCAR INSTRUMENTS INC  
411 ROBBINS AVE TRENTON N J  
ALCO ELECTRONIC PRODUCTS INC  
3 WOLCOTT AVE LAWRENCE MASS  
ALCON METAL PRODUCTS INC  
1750 N KIMBALL AVE CHICAGO ILL  
ALCONOX INC  
853 BROADWAY NEW YORK N Y  
ALDEN ELECTRONIC & IMPULSE  
P O BOX 125 WESTBORO MASS  
ALDEN PRODUCTS CO  
12359 N MAIN ST BROCKTON 64 MASS  
ALDEN SYSTEMS CO  
117 N MAIN ST BROCKTON MASS  
ALDSHIR MANUFACTURING CO INC  
111 LAKE AVE TUCKAHOE N Y  
ALECTRIC MFG CO  
7842 39TH AVE KENOSHA WISC  
ALERT PRODUCTS INC  
728 MARKET ST CAMDEN N J  
ALERT SUPPLY CO  
7343 PARAMOUNT BLVD PICO RIVERA CALIF  
ALEXANDRIA DIV AMF  
1025 ROYAL ST ALEXANDRIA VA  
ALFAX PAPER & ENG CO INC  
BOX 125 WESTBORO MASS  
ALFORD MFG CO  
299 ATLANTIC AVE BOSTON 10 MASS  
ALFRID ELECTRONICS  
PALO ALTO CALIF  
ALITE DIV U S STONWARE CO  
BOX 119 ORRVILLE OHIO  
ALKALINE BATTERY DIV  
212 DURHAM AVE METUCHEN N J  
ALLACO PRODUCTS  
238 MAIN ST CAMBRIDGE 42 MASS  
ALL AMERICAN ENGG CO  
BOX 1247 WILMINGTON DEL  
ALL AMERICAN TOOL & MFG CO  
8027 LAWNDALE AVE SKOKIE ILL  
ALLARD INSTRUMENT CORP  
146 E 2ST MINEOLA N Y  
ALLARD INSTRUMENT CORP  
770 MAIN ST WESTBURY N Y  
ALL CHANNEL PRODUCTS CORP  
JERSEY SHORE PENNA  
ALLEGANY INSTRUMENT CO  
1091 WILLS MOUNTAIN CUMBERLAND MD  
ALLEGHENY ELECTRONICS CHEMICALS CO  
20 LEAR ST BRADFORD PA  
ALLEGHENY ELECTRONIC CHEMICALS CO  
LEWIS RUN PENNA  
ALLEGHENY PLASTICS INC  
ROUTE 51 THORN RN RD CORAPOLIS PENNA  
ALLEGRI TECH INC  
41 43 RIVER RD NO ARLINGTON N J  
ALLEN AVIONICS INC  
255 E 2ND ST MINEOLA N Y  
ALLEN-BRADLEY CO  
136 W GREENFIELD AVE MILWAUKEE 4 WISC  
ALLEN BUSINESS MACHINE INC  
333 COMMERCE S W GRAND RAPIDS MICH  
ALLEN ELECTRIC & EQUIPMENT CO  
2101-2117 N PITCHER ST KALAMAZOO MICH  
ALLEN ELECTRONIC CORP  
937 INDUSTRIAL AVE PALO ALTO CALIF  
ALLEN ELECTRONICS CORP  
92 BRANCH ST PONTIAC MICH

ALLEN MFG CO  
BLOOMFIELD CONN  
ALLEN TOOL CORP  
308 MALTBIE ST SYRACUSE NY

ALLIED ALLEGRI MACHINE CO INC  
141 RIVER RD NUTLEY 10 N J  
ALLIED CHEMICAL CORP GENERAL CHEM DIV  
40 RECTOR ST NEW YORK 6 NY  
ALLIED CONTROL CO  
2 EAST END AVE NEW YORK 21 N Y  
ALLIED CONTROL CO INC  
PLANTSVILLF CONN  
ALLIED CONTROL CO INC  
WAUREGAN CONN  
ALLIED DECALS INC  
20700 MILES AVE CLEVELAND OHIO  
ALLIED RESEARCH & ENG CO  
6916 SANTA MONICA BLVD HOLLYWOOD CALIF  
ALLIED WITAN CO  
BOX 8725 12500 BELLAIRE RD CLEVE OHIO  
ALLIES PRODUCTS CORP  
P O BOX 188 KENDALL BRANCH MIAMI FLA  
ALLIS CHALMERS  
COLUMBUS & PREBLE AVES PITTSBURGH PA  
ALLIS CHALMERS  
1126 S 70TH ST WEST ALLIS WISC  
ALLIS CO LOUIS  
427 E STEWART ST MILWAUKEE I WISC  
ALLISON LABS INC  
11301 E OCEAN AVE LA HABRA CALIF  
ALLMETAL SCREW PRODUCTS CO  
821 STEWART AVE GARDEN CITY NY  
ALDY BELLOWS INC  
18125 ROSELAND RD CLEVELAND 12 OHIO  
ALLOY METAL WIRE WORKS  
PROSPECT PARK PENNA  
ALLOY METALSMITHS INC  
88 COMMERCE RD CEDAR GROVE NJ  
ALLOYD ELECTRONICS CORP  
35 CAMBRIDGE PKWAY CAMBRIDGE MASS  
ALLOYS UNLIMITED INC  
21 01 43RD AVE LONG ISLAND CITY N Y  
ALLOYS UNLIMITED INC  
26 32 SKILLMAN AVE L I S CITY N Y  
ALL PRODUCTS CO COMMUNICATION PROD OIV  
BOX 920 MINERAL WELLS TEX  
ALL STAINLESS INC  
40 RUGG RD ALLSTON MASS  
ALL STAR PRODUCTS INC  
SQUIRE AVE DEFIANCE OHIO  
ALLSTATE ELECTRONICS INC  
32 ORAWAUPUM ST WHITE PLAINS N Y  
ALL-STATE WELDING ALLOYS CO  
249 FERRIS AVE WHITE PLAINS N Y  
ALL TRONICS INC  
45 BOND ST WESTBURY L I N Y  
ALL WEATHER ANTENNA MFG CO INC  
350 S EGG HARBOR HAMMONTON NJ  
ALLYN INC WELCH  
SKANEATELES FALLS NY  
ALMA ENGINEERING  
8135 ENGINEER RD SAN DIEGO CALIF

ALMOR DEVELOPMENT CO INC  
2021 W 17TH ST LONG BEACH CALIF  
ALMOR INST CO DV DF ILL TESTING LABS INC  
420 N LASALLE ST CHICAGO ILL  
ALONGE PRODUCTS INC  
163 W 23RD ST NEW YORK N Y  
ALPAR MFG CORP  
220 DEMETER ST PALO ALTO CALIF  
ALPHA CORP  
820 ARAPAHO RD RICHARDSON TEXAS  
ALPHA METALS INC  
56 WATER ST JERSEY CITY 4 N J  
ALPHA MOLYKOTE CORP  
65 HARVARD AVE STAMFORD CONN  
ALPHA SCIENTIFIC LABS INC  
P O BDX 333 BERKELEY I CALIF  
ALPHA WIRE CORP  
200 VARICK ST NEW YORK N Y  
ALPHADUCT WIRE & CABLE CO  
25 VAN DYKE AVE NEW BRUNSWICK N J  
ALPINE ELECTRIC COMPONENTS INC  
WATERBURY CONN  
ALPINE ELECTRONIC COMPONENTS INC WOLCOTT  
NUTMEG ROAD WOLCOTT CONN  
ALPITEC INC  
49 GLEASON AVE STAMFORD CONN  
ALSPOR ENGRG CORP  
MILLDALE CONN  
ALTAIR RESEARCH & MFG CO  
BOX 106 BALOWIN PARK CALIF  
ALTEC LANSING CORP  
1515 S MANCHESTER AVE ANAHEIM CALIF  
ALTHOR PRODUCTS  
2301 BENSON AVE BROOKLYN N Y  
ALTO FONIC TAPE SERVICE INC  
211 LAMBERT ST PALO ALTO CALIF  
ALTO SCIENTIFIC CO  
4083 TRANSPORT ST PALO ALTO CALIF  
ALTRON ELECTRONICS CO  
1309 JEFFERSON AVE WOODLYN PA  
ALUMINUM ALLOYS CORP  
6650 W WALTON DETROIT MICH  
ALUMINUM CO OF AMERICA  
1501 ALCOA BLDG PITTSBURGH 19 PA  
ALUMINUM CO OF AMER REA MAGNET WIRE CO  
CNDCORD RD LAFAYETTE IND  
ALVA ALLEN INDUSTRIES  
35 & 13 JCT CLINTON MO  
ALWAC COMPUTER DIV EL-TRONICS INC  
13040 S CERISE HAWTHORNE CALIF  
AMATON ELECTRONIC HARDWARE CO INC  
88 DRAKE AVE NEW ROCHELLE N Y  
AMBROID CO  
BOX 30 WEYMOUTH 88 MASS



## ELECTRONIC MANUFACTURERS—A TO Z

AMCHEM PRODUCTS INC  
 AMBLER PENNA  
 AMCO ENG CO  
 7333 W AINSLIE ST CHICAGO ILL  
 AMECO DIV ANTENNAVISION INC  
 2949 W OSBORN RD PHOENIX ARIZ  
 AMELCO INC  
 12964 PANAMA ST LOS ANGELES CALIF  
 AMELCO INC ELECT DEVICES DIV  
 341 MOFFET BLVD MT VIEW CALIF  
 AMERAC INC  
 DUNHAM RD BEVERLY MASS  
 AMERICAN AEROSPACE CONTROLS INC  
 123 MILBAR BLVD FARMINGDALE N Y  
 AMERICAN AIR FILTER CO  
 215 CENTRAL AVE LOUISVILLE KY  
 AMERICAN AIRFRAME CORP  
 721 W 25TH ST HIALEAH FLA  
 AMERICAN ALUMINUM CO  
 230 SHEFFIELD ST MOUNTAINSIDE N J  
 AMERICAN ASTRO-SYSTEMS  
 2112 CHICO AVE EL MONTE CALIF  
 AMERICAN AVIONICS INC  
 2028-2032 STONER AVE LOS ANGELES 25 CALIF  
 AMERICAN BOSCH CORP  
 ROOSEVELT FIELD GARDEN CITY N Y  
 AMERICAN BOSCH ARMA CORP  
 5000 PARKSIDE PHILA PA  
 AMERICAN BRASS CO  
 414 MEADOW ST WATERBURY CONN  
 AMERICAN BRAKE SHOE CO RAYMOND ATCHLEY DIV  
 2339 COTNER AVE LOS ANG CALIF  
 AMERICAN CAPACITOR CO INC  
 32 HIGH ST AMESBURY MASS  
 AMER CHAIN & CABLE BRISTOL CO  
 127 BRISTOL ST WATERBURY CONN  
 AMERICAN CHAIN & CABLE DATA MASTERS CORP  
 85 HAZEL ST GLEN COVE NY  
 AMER CHAIN & CABLE WILSON MECH INST DIV  
 929 CONNECTICUT AVE BRIDGEPORT CONN  
 AMERICAN COMPONENTS INC  
 8TH AT HARRY CONSHOHOCKEN PA  
 AMERICAN CONCERTONE  
 9449 W JEFFERSON BLVD CULVER CITY CALIF  
 AMERICAN CYANAMID CO FORMICA DIVISION  
 CINCINNATI OHIO  
 AMERICAN CYSTOSCOPE MAKERS INC  
 8 PELHAM PKY PELHAM MANOR N Y  
 AMERICAN DATA MACHINES  
 7 COMMERCIAL ST HICKSVILLE N Y  
 AMERICAN DECALCOMANIA CO  
 310 LAKESIDE CLEVELAND OHIO  
 AMERICAN DISTRICT TELEGRAPH CO  
 20 BRIDWELL PLACE CLIFTON N J  
 AMERICAN ELECTRIC CABLE CO  
 181 APPLETON ST HOLYOKE MASS  
 AMERICAN ELECTRONICS CO  
 178 HERRICKS RD MINEOLA L I N Y  
 AMERICAN ELECT INC INSTRUMENT  
 9503 JEFFERSON BLVD CULVER CITY CALIF  
 AMERICAN ELECT INC TALLER & COOPER DIV  
 75 FRONT ST BROOKLYN N Y  
 AMERICAN ELECT LABS INC  
 RICHARDSON RD COLMAR PENNA  
 AMERICAN ELECTRONICS CO  
 2801 37TH AVE NE MINN MINN  
 AMERICAN ELECTRICAL HEATER CO  
 6110 CASS AVE DETROIT MICH  
 AMERICAN ELECT LABS MICROWAVE & PHASING  
 P O BOX 552 LANSDALE PA  
 AMERICAN ELECTRONICS INC  
 1596 E ROSS AVE FULLERTON CALIF  
 AMERICAN ELECTRIC SWITCH DIV  
 CLARK CONTROLLER CO MINERVA OHIO  
 AMERICAN EMBLEM CO  
 4 GENESEE ST NEW HARTFORD NY  
 AMERICAN FELDMUEHLE CORP  
 11 W 42ND ST NEW YORK 36 N Y  
 AMERICAN GELOSO ELECT INC  
 251 FOURTH AVE NEW YORK N Y  
 AMERICAN GYRO DIV TAMAR ELECT INC  
 9320 LINCOLN BLVD LOS ANG CALIF  
 AMER HYDROMATH CORP  
 24 20 JACKSON AVE L I CITY N Y  
 AMERICAN INSTRUMENT CO  
 8050 GEORGIA AVE SILVER SPRING MD  
 AMERICAN INSULATOR CORP  
 NEW FREEDOM PA  
 AMER LATEX FIBRE CORP  
 500 N BROADWAY LAWRENCE MASS  
 AMERICAN LAVA CORP SUBS MINN MINN MFG  
 CHEROKEE BLVD & MFRS RD CHATTANOOGA 5 TENN  
 AMERICAN LIGHT ALLOYS INC  
 1265 MCBRIDE AVE LITTLE FALLS NJ  
 AMERICAN MACH & FOUNDRY CO  
 261 MADISON AVE NEW YORK N Y  
 AMER MACH & FOUNDRY  
 BOX 187 STA F BUFFALO N Y  
 AMF INSTR DIV AMER MACH & FDRY  
 4304 WHEELER AVE ALEXANDRIA VA  
 AMER MACH & FOUNDRY POTTER & BRUMFIELD DIV  
 MARION KY  
 AMERICAN MAGNETICS CORP  
 P O BOX 98 CARTERSVILLE ILL  
 AMERICAN MEASUREMENT & CONTROL BURLINGTON  
 SUB COMPUDYNE CORP BURLINGTON MASS  
 AMERICAN MEASUREMENT & CONTROL INC  
 240 CALVARY ST WALTHAM 54 MASS  
 AMERICAN METAL CLIMAX INC  
 1270 AVE OF AMERICAS NEW YORK 2 N Y  
 AMERICAN MICA INSULATION CO  
 235 PARKER AVE MANASQUAN N J  
 AMERICAN MICRO DEVICES  
 10888 N 19TH AVE PHOENIX ARIZ  
 AMERICAN MICROPHONE CO DIV G C ELECT CO  
 400 S WYMAN AVE ROCKFORD ILL

AMERICAN MICROWAVE & TV CORP  
 1369 INDUSTRIAL RD SAN CARLOS CALIF  
 AMERICAN MISSILE PROD CO INC  
 15233 GREVILLE AVE LAWDALE CALIF  
 AMERICAN MOLDED PROOS CO  
 2727 W CHICAGO AVE CHICAGO ILL  
 AMERICAN OPTICAL CO INSTRUMENT DIV  
 BOX A BUFFALO 15 N Y  
 AMERICAN OPTICAL  
 1 MARLBORO ST KEENE NH  
 AMERICAN PERFIT CRYSTAL CORP  
 653 11 AVE NEW YORK 36 N Y  
 AMERICAN PHOTOCOPY EQUIP CO  
 2100 W DEMPSTER ST EVANSTON ILL  
 AMERICAN PRINTED CIRCUITS CO  
 104 FORREST ST METUCHEN N J  
 AMERICAN PRODUCT DEVELOPMENT CO  
 DIV AMERICAN DOOR & WINDOW CO INC  
 4585 S ALAMEDA ST LOS ANGELES 58 CAL  
 AMERICAN PRODUCTS MFG CO  
 8127 33 OLEANDER ST NEW ORLEANS LA  
 AMERICAN RADAR COMPONENTS INC  
 415 E MAIN ST DENVER ILL N J  
 AMERICAN RECTIFIERS CORP  
 MFRS RICHARDSON ALLEN POWER SUPPLIES  
 116 15 15TH AVE COLLEGE POINT 56 N Y  
 AMERICAN RESEARCH CORP  
 ROUTE & FARMINGTON CONN  
 AMERICAN RESEARCH & MFG CORP  
 920 HALPINE AVE ROCKVILLE MD  
 AMERICAN SEALANTS CO  
 705 N MOUNTAIN RD HARTFORD CONN  
 AMERICAN SEMICONDUCTOR CORP  
 3940 N KILPATRICK AVE CHICAGO 41 ILLINOIS  
 AMERICAN SILVER CO  
 3607 PRINCE ST FLUSHING 54 N Y  
 AMERICAN SOLDER & FLUX CO  
 19 & WILLARD STS PHILADELPHIA 4 PA  
 AMERICAN SOUND PROO CO  
 4753 4TH AVE S MINNEAPOLIS MINN  
 AMERICAN SPACE EXPLORATION INC  
 3910 S KALAMATH ST ENGLEWOOD COLORADO  
 AMER SPEEDLIGHT CORP  
 6301 METROPOLITAN AVE MIDDLE VILLAGE NY  
 AMERICAN STANDARD AD TECH LAB  
 369 WHISMAN RD MOUNTAIN VIEW CALIF  
 AMERICAN STANDARD CONTROL DIV  
 5900 TRUMBULL AVE DETROIT MICH  
 AMERICAN STANDARD CONTROL DV  
 100 ROCKWOOD ST ROCHESTER N Y  
 AMERICAN STANDARD CORP NORWOOD PRODS  
 5900 TRUMBULL AVE DETROIT 8 MICH  
 AMERICAN STERILIZER SCIENTIFIC & IND DEPT  
 ERIE PENNA  
 AMERICAN SUPER TEMPERATURES WIRES INC  
 DIV OF HAYEG WINDO  
 32 W CANAL ST WINDOSKI VT  
 AMERICAN TELEVISION & RADIO CO  
 ST PAUL MINN  
 AMERICAN THERMO ELECTRIC CO  
 1023 N FULLER AVE LOS ANGELES 46 CALIF  
 AMERICAN TIME PROD INC  
 61-20 WOODSIDE AVE WOODSIDE 77 LI NY  
 AMERICAN TOWER CO  
 BOX 29 SHELBY OHIO  
 AMERICAN TRANSFORMER DIV RADIO ENG LABS  
 29 01 BORDEN AVE L I CITY N Y  
 AMERICAN TUBE BENDING CO  
 5 LAWRENCE ST NEW HAVEN CONN  
 AMERLINE CORP  
 2727 W CHICAGO AVE CHICAGO ILL  
 AMERSIL QUARTZ DIV ENGELHARD INDUST INC  
 685 RAMSEY AVE HILLSIDE NJ  
 B C AMES CO  
 131 LEXINGTON ST WALTHAM MASS  
 AMETEK INC LAMB ELECTRIC DIV  
 KENT OHIO  
 AMETEK INC HUNTER SPRING DIV  
 1 SPRING AVE HATFIELD PENNA  
 AMEY CORP  
 246 E 2ND ST PLAINFIELD N J  
 AMFLEX PRODUCTS INC  
 689 HOPE ST SPRINGDALE CONN  
 AMGLO CORP  
 4333 RAVENSWOOD AVE CHICAGO 13 ILL  
 AMI INC  
 1500 UNION AVE GRAND RAPIDS 2 MICH  
 AMMON INSTRUMENTS INC  
 345 KELLEY ST MANCHESTER N H  
 AMP INC CAPITRON DIV  
 155 PARK AVE ELIZABETHTOWN PA  
 AMP INCORPORATED  
 EISENHOWER BLVD HARRISBURG PENNA  
 AMPREX ELECTRONICS CORP  
 SLATERVILLE R I  
 AMPREX ELECTRONIC CORP  
 230 DUFFY AVE HICKSVILLE N Y  
 AMPERITE CO  
 561 BROADWAY NEW YORK 12 N Y  
 AMPEX AUDIO/SUB AMPEX CORP  
 1020 KIFER RD SUNNYVALE CALIF  
 AMPEX CORP  
 934 CHARTER ST REDWOOD CITY CALIF  
 AMPEX MAGNETIC DIV  
 BOX 190 OPELIKA ALA  
 AMPEX MAGNETIC TAPE PRODUCTS  
 OPELIKA ALA  
 AMPEX PROFESSIONAL PROO CO  
 BOX 5000 REDWOOD CITY CALIF  
 AMPHENOL CANADA LTD  
 349 CARLAW AVE TORONTO ONT CANADA  
 AMPHENOL CONNECTOR  
 1830 S 54TH AVE CHICAGO 50 ILL  
 AMPHENOL WESTERN DIV  
 9201 INDEPENDENCE AVE CHATSWORTH CALIF  
 AMPLIFIER CORP OF AMER  
 398 BROADWAY NEW YORK N Y

AMPLIVOX LTD  
 BERESFORD AVE WEMBLEY MIDDLESEX ENGLAND  
 AMPPOWER PROD INC  
 10207 RIDGELAND CHICAGO RIDGE ILL  
 AMSTRO CORPORATION  
 9 CENTER AVE LITTLE FALLS N J  
 AMTEL AMERICAN MICROWAVE & TELEVISION  
 1369 INDUSTRIAL RD SAN CARLOS CALIF  
 AMTHOR TESTING INST CO  
 45 53 VAN SINDEREN AVE BROOKLYN N Y  
 AMTRON INC MIDLOTHIAN  
 14631 S WAVERLY AVE MIDLOTHIAN ILL  
 AMTRON CORP  
 17 FELTON ST WALTHAM 54 MASS  
 AMULEX ELECTRONICS INC  
 467 CONNECTICUT AVE S NORWALK CONN  
 AMY ACEVES & KING  
 11 W 42 ST NEW YORK N Y  
 ANACONDA ALUMINUM CO  
 BOX 1654 LOUISVILLE KY  
 ANACONDA ALUMINUM CO  
 20-21 WAGARAW RD FAIRLAWN NJ  
 ANACONDA WIRE & CABLE CO  
 25 BROADWAY NEW YORK 4 N Y  
 ANACONDA WIRE & CABLE  
 RIVER ST HASTINGS ON HUDSON N Y  
 ANADEX INSTRUMENT S INC  
 14734 ARMINA ST BOX 472 VAN NUYS CALIF  
 ANALAB INSTRUMENT CORP  
 30 CANFIELD RD CEDAR GROVE N J  
 ANALOGUE CONTROLS INC  
 200 FRANK RD HICKSVILLE N Y  
 ANALYTIC SYSTEMS CO  
 370 N FAIR OAKS AVE PASADENA CALIF  
 ANALYTICAL MEASUREMENTS INC  
 585 MAIN ST CHATHAM N J  
 ANATRAN DIV OF ENDEVCO CORP  
 45 W UNION ST PASADENA CALIF  
 ANCHOR ALLOYS INC  
 966 MEEKER AVE BROOKLYN N Y  
 ELECTRONIC SPECIALTY CO ANCHOR METALS DIV  
 HURST TEXAS  
 ANCHOR PLASTICS CO  
 3636 36ST LONG ISLAND CITY N Y  
 ANCHOR SPEC MFG CO  
 300 HOLLISTER RD TETERBORO N J  
 ANCO INSTR DIV AMER NAME PLANE & MFG CO  
 4254 W ARTHINGTON ST CHICAGO ILL  
 ANDERS ELECTRONICS INC  
 30 BROOK RD NEEDHAM HGTS MASS  
 ANDERSEN LAB INC  
 501 NEW PARK AVE W HARTFORD CONN  
 ANDERSON & SONS INC  
 NORTH ELM ST WESTFIELD MASS  
 ANDERSON AIRCRAFT CO  
 SPRING ST NORTH DIGHTON MASS  
 ANDERSON CONTROLS INC  
 9939 PACIFIC AVE FRANKLIN PARK ILL  
 ANDERSON CONTROLS INC  
 3906 ELM ST MCHENRY ILL  
 ANDERSON ELECTRONICS INC  
 1012 CHESTNUT AVE ALTOONA PA  
 ANDERTON ELECTRONIC LAB  
 129 E 1800 ST BOUNTIFUL UTAH  
 ANDOVER CORP  
 318 N EARL AVE LAFAYETTE IND  
 ANDREA RADIO CORP  
 27 01 BRIDGE PLAZA N LONG ISLAND CITY N Y  
 ANDREW ANTENNA CORP  
 606 BEECH ST WHITBY ONTARIO CAN  
 ANDREW CALIF CORP  
 941 MARYLAND AVE CLAREMONT CALIF  
 ANDREW CORP  
 BOX 807 CHICAGO ILL  
 ANDREWS TOWER INC  
 1620 LAYTON AVE FORT WORTH TEXAS  
 ANDOROFORM INDUSTRIES INC  
 SPRING ST NORTH DIGHTON MASS  
 ANDROMEDA INC  
 11151 VIERS MILL RD WHEATON MD  
 ANELEX CORP  
 150 CAUSEWAY ST BOSTON MASS  
 ANGLER INDUSTRIES  
 107 TRUMBULL ST ELIZABETH N J  
 ANGSTROHM PRECISION INC  
 7341 GREENBUSH AVE NORTH HOLLYWOOD CAL  
 ANKO MFG CO  
 5025 N 124TH ST MILWAUKEE 18 WIS  
 ANNIS CO R B  
 1101 N DELWARE ST INDIANAPOLIS IND  
 ANDOYNE INC  
 1270 N W 165 ST MIAMI BEACH FLA  
 ANSLER MFG CO ARTHUR  
 NEW HOPE PA  
 ANSONIA WIRE & CABLE CO  
 111 MARTIN ST ASHTON R I  
 ANTARA CHEMICALS DIV GEN FILM CORP  
 435 HUDSON AVE NEW YORK N Y  
 ANTENNA & RADOME RESEARCH ASSOC  
 27 BOND ST WESTBURY N Y  
 ANTENNA CORP  
 21341 ROSCOE BLVD CANOGA PARK CALIF  
 ANTENNACRAFT CO  
 1215 AGENCY ST BURLINGTON IOWA  
 ANTENNA DESIGNS INC  
 802 WASHINGTON ST BURLINGTON IOWA  
 ANTENNA PRODUCTS CO DIV OF ALL PROD CO  
 BOX 110 MINERAL WELLS TEXAS  
 ANTENNA SPECIALISTS CO  
 12435 EUCLID AVE CLEVELAND OHIO  
 ANTENNA SYSTEMS INC  
 GRENIER FIELD MANCHESTER N HAMP  
 ANTHONY & CO-J L  
 115 BAKER ST PROVIDENCE R I  
 ANTI CORROSIIVE METAL PRODUCTS CO  
 CASTLETON-ON-HUDSON N Y

# ELECTRONIC MANUFACTURERS—A TO Z

- ANTLAB INC  
6330 PROPRIETORS RD WORTHINGTON OHIO
- ANTON ELECTRONICS LABS  
1226 FLUSHING AVE BROOKLYN 37 NY
- ANTON MACHINE WORKS  
1226 FLUSHING AVE BROOKLYN 37 N Y
- ANTREX CORP  
2001 W WILLOW ST CHICAGO 47 ILL
- AOTO SWAGE PRODS INC  
255 CANAL ST SHELTON CONN
- APAHOUSE CORP OF N E  
1312 BOYLSTON ST BOSTON 15 MASS
- APCO ACCESSORY PRODUCTS CO  
616 W WHITTIER BLVD WHITTIER CALIF
- APCO MOSSBERG CO  
205 LAMB ST ATTLEBORO MASS
- APEL CO SUB RAYTHEON CO  
213 E GRAND AVE S SAN FRAN CALIF
- APEX COIL TRANSFORMER CORP  
1919 S FAIRFIELD AVE CHICAGO 8 ILL
- APEX MACHINE CO  
14 13 118TH ST COLLEGE POINT 56 N Y
- APEX WIRE CABLE CORP  
237 375TH BROOKLYN N Y
- A P M CORP  
41 HONECK ST ENGLEWOOD N J
- APPALACHIAN ELECTRONIC INSTRUMENTS INC  
810 MONROE AVE RONEEVERTE W VA
- APPARATUS DEVELOPMENT CO  
115 MAIN ST WETHERSFIELD 9 CONN
- APPLE FREQUENCY MEASURING SERVICE  
409 UNION AVE BURLINGTON N C
- APPLETON CO INC HARRY  
136 SAN FERNANDO RD LOS ANG CALIF
- APPLIED CONTROL CORP  
1000 MAIN ST HACKENSACK N J
- APPLIED DEVELOPMENT CORP  
12838 WEBER WAY HAWTHORNE CALIF
- APPLIED DEVELOPMENT CORP  
1131 MONTEREY PASS RD MONTEREY PARK CALIF
- APPLIED ELECTRONICS CO  
213 E GRAND AVE SAN FRANCISCO CALIF
- APPLIED ELECTRONICS CORP OF N J  
METUCHEN N J
- APPLIED MAGNETICS CORP  
GOLETA CALIFORNIA
- APPLIED MICROWAVE LAB INC  
106 ALBION ST WAKEFIELD MASS
- APPLETON ELECTRIC CO  
1701 W WELLINGTON AVE CHICAGO ILL
- APPLIED RADIATION CORP  
2404 N MAIN ST WALNUT CREEK CALIF
- APPLIED RESEARCH INC  
76 S BAYLES AVE PORT WASHINGTON N Y
- APPLIED RESEARCH LABS  
3717 PARK PL GLENDALE CALIF
- APPLIED SYSTEMS CORP  
925 E MEADOW DR PALO ALTO CALIF
- APPLIED TECHNOLOGY CORP  
73 03 GRAND AVE MASPETH N Y
- APPLIED TECHNOLOGY INC  
930 INDUSTRIAL AVE PALO ALTO CALIF
- APPLIED DYNAMICS INC  
ANN ARBOR MICH
- APPROVED PLASTICS CO  
1189 VALLEY ROAD STIRLING N J
- APW CO  
72 MAIN ST ROCKAWAY N J
- ARCAN EASTERN LTD  
P O BOX 158 STA C HAMILTON ONT CANADA
- ARCEL DAVIS MFG CO  
3687 S STATE SALT LAKE CITY UTAH
- ARCH GEAR INC  
4336 E 10TH CT HIALEAH FLA
- ARCH GEAR WORKS INC  
97 HOLMES ST QUINCY MASS
- ARCH INSTRUMENT CO  
101 HOLMES ST N QUINCY MASS
- ARCO ELECT INC  
COMMUNITY DRIVE GREAT NECK N Y
- ARCON ELECTRONICS DIV OF ARCON INDUST  
BOX 31 3052 BURNEY PL LOS ALAMITOS CALIF
- AR 6 DA ENGG CO  
135 MAIN ST BELLEVILLE NJ
- ARDE ASSOC ENGRG DIV  
11 HILL ST NEWARK N J
- ARDE PORTLAND INC  
80 SECOND ST SOUTH PORTLAND MAINE
- ARDENTE ACOUSTIC LABS LTD  
MINERVA RD LONDON W 10 ENGLAND
- ARENBERG ULTRASONIC LABORATORY INC  
94 GREEN ST JAMAICA PLAIN 30 MASS
- A R F PRODUCTS INC  
7627 LAKE ST RIVER FOREST ILL
- ARF PRODUCTS INC  
GARDNER RD RATON N M
- ARGONNE ELECT MFG CORP  
111 JERICHO TPKE SYOSSET L I N Y
- ARGOS PRODUCTS CO  
301 MAINS T GENOA ILL
- ARISTO CRAFT DISTINCTIVE MINIATURES  
314 FIFTH AVE NEW YORK 1 N Y
- ARIZONA GEAR MFG CO  
3544 E FORT LOWELL TUCSON ARIZ
- ARKAY INTERNATIONAL INC  
2372 LINDEN BLVD BROOKLYN 8 N Y
- ARK ELECT CORP  
624 DAVISVILLE RD WILLOW GROVE PA
- ARK LES SWITCH CORP  
51 WATER ST WATERTOWN MASS
- ARLIN MFG CO  
12 PERKINS ST P O BOX 296 LOWELL MASS
- ARMCO STEEL CORP  
703 CURTIS ST MIDDLETOWN OHIO
- ARMEL ELECTRONICS INC  
1601 75TH ST N BERGEN N J
- ARMSTRONG CORK CO  
LANCASTER PENNA
- ARMSTRONG RESINS INC  
P O BOX 657 WARSAW IND
- ARMSTRONG WHITWORTH EQUIP  
HUCLECOTE GLOUCESTER ENG
- ARNOLD ENG G CO  
P O BOX G MARENGO ILL
- ARNOLD ENGG CO REPATH PACIFIC DIV  
1551 EAST ORANGETHORPE FULLERTON CALIF
- ARNOLD MAGNETICS CORP  
6050W JEFFERSON BLVD LOS ANGELES CALIF
- ARNOUX CORP  
11924 W WASHINGTON BLVD LOS ANGELES CALIF
- ARRA RESEARCH ASSOCIATES  
27 BOND ST WESTBURY N Y
- ARROW HART & HEGEMAN ELEC CO  
103 HAWTHORN ST HARTFORD 6 CONN
- ARROW MACHINIST & FABRICATORS  
154 E 3RD ST MT VERNON N Y
- ARROW RADIO CO  
1829 DAVENPORT RD TORONTO ONTARIO CANADA
- ARROWHEAD PRODUCTS  
DIV FEDERAL-MOGUL-BEARINGS INC  
4411 KATELLA AVE LOS ALAMITOS CALIF
- AR6T ELECTRONICS INC  
1101 MCALMONT LITTLE ROCK ARK
- ART WIRE & STAMPING CO  
227 HIGH ST NEWARK 2 N J
- ARTISAN ELECTRONICS CORP  
171 RIDGEDALE AVE MORRISTOWN N J
- ARTISAN METAL WORKS CO  
11400 MADISON AVE CLEVELAND 2 OHIO
- ARTOS ENGG CO  
2757 S 28TH ST MILWAUKEE WISC
- ARTRONIC INSTRUMENT CO  
11232 TRIANGLE LA SILVER SPRING MD
- ARTTED CO INC  
367 WORTHINGTON ST SPRINGFIELD 3 MASS
- ARVEY CORP  
300 COMMUNIPAW AVE JERSEY CITY 4 N J
- ARVIN INDUSTRIES INC  
COLUMBUS IND
- ASCOP DIV ELECTRO MECHANICAL RESCH INC  
44 WALLACE RD PRINCETON N J
- ASHEVILLE-SCHOONMAKER MICA CO  
900 JEFFERSON AVE NEWPORT NEWS VA
- ASHLAND ELECTRIC PRODUCTS INC  
3202 QUEENS BLVD LONG ISLAND CITY 1 N Y
- ASKANIA REGULATOR CO  
240 E ONTARIO ST CHICAGO 11 ILL
- ASQUITH CO S A  
427 W CHEVY CHASE DR GLENDALE CALIF
- ASSEMBLY PRODUCTS INC  
75 WILSON MILLS RD CHESTERLAND OHIO
- ASSOC AMER WINDING MACHINERY INC  
750 ST ANNS AVE NEW YORK N Y
- ASSOCIATED COMMODITY CORP  
620 FIFTH AVE NEW YORK 20 N Y
- ASSOCIATED ELECTRICAL INDUSTRIES LTD  
155 CHARING CROSS RD LONDON W C 2 ENGLAND
- ASSOCIATED ELEC IND LTD ELEC APPARATUS DIV  
CARHOLME RD LINCOLN ENGLAND
- ASSOCIATED ELECTRICAL INDUSTRIES LTD  
ELECT ONTARIO SLS DPT NEW PKS LEICSTR ENGLAND
- ASSOCIATED ELECTRICAL INDUSTRIES LTD  
COMPUTER SLS DPT TRFRD PK MNCHSTR ENGLAND
- ASSOCIATED ELECTRICAL INDUSTRIES LTD  
MILITARY RDR SLS DPT BLCKBD RD LEICSTR ENG
- ASSOCIATED ENG & MFG CORP  
210 STONEHOUSE RD GLEN RIDGE N J
- ASSOCIATED ENG CORP  
65 KENT ST BROOKLINE MASS
- ASSOCIATED ENGINEERING CO  
MATTHEWS NO CAR
- ASSOCIATED MFG CO  
4755 N ROCKWELL ST CHICAGO ILL
- ASSOCIATED PRODUCTION CO  
162 N CLINTON ST CHICAGO 6 ILL
- ASSOCIATED RESEARCH INC  
3787 W BELMONT AVE CHICAGO ILL
- ASSOCIATED SPECIALTIES CO  
1751 MAIN ST OREFIELD PA
- ASSOCIATED TESTING LABS  
109 ROUTE 46 WAYNE N J
- ASSOC TESTING LABS INC SOUTHEASTERN DIV  
1112 SOLANA AVE WINTER PARK FLA
- ASTATIC CORP  
250 HARBOR ST CONNEAUT OHIO
- ASTRA TECHNICAL INSTRUMENT CORP  
9905 W JEFFERSON BLVD CULVER CITY CALIF
- ASTRODATA INC  
240 E PALAIS RD ANAHEIM CALIF
- ASTRO DYNAMICS INC  
2ND AVE N W IND PK BURLINGTON MASS
- ASTROLAB INC  
35 COMMERCE ST SPRINGFIELD N J
- ASTROMARINE PRODUCT CORP  
1733 N 33RD AVE MELROSE PARK 1 ILL
- ASTROMATIC DIV CONTROL CO OF AMER  
140 WASHINGTON ST EL SEGUNDO CALIF
- ASTROMETRICS INC  
1108 SANTA BARBARA ST SANTA BARBARA CALIF
- ASTRON CORP  
255 GRANT AVE E NEWARK N J
- ASTRONICS DIV LEAR STEGLER INC  
SANTA MONICA CALIF
- ASTRO SYSTEMS INC  
220 E 23RD ST NEW YORK N Y
- ASTROSONICS INC  
190 MICHAEL DR SYOSSET N Y
- ASTROSYSTEMS INTL INC  
1275 BLOOMFIELD AVE CALDWELL N J
- ASTROTHERM CORP  
1625 BELLEFONTAINE ST INDIANAPOLIS IND
- A T ELECTRONICS INC  
BOX 1841 NEW HAVEN CONN
- ATELIERS DE MONTAGES ELECT  
77 RUE ST CHARLES PARIS 15 EME FRANCE
- ATKINS & MERRILL INC  
POST RD SOUTH SUDBURY MASS
- ATKINSON LAB INC  
7070 SANTA MONICA BLVD LOS ANGELES CALIF
- ATKOMATIC VALVE CO INC  
545 W ABBOTT ST INDIANAPOLIS 29 IND
- ATLANTIC INSTRUMENTS & ELECTRONICS INC  
103 N BEACON ST BOSTON 34 MASS
- ATLANTIC OPTICAL MOULDING CO  
ELLIS ST DUDLEY MASS
- ATLANTIC & PACIFIC WIRE & CABLE CO  
137 GRAND ST NEW YORK NY
- ATLANTIC RESEARCH CORP  
SHIRLEY HWY AT EDSALL RD ALEXANDRIA VA
- ATLANTIC SEMICONDUCTOR INC  
905 MATTISON AVE ASBURY PARK N J
- ATLANTIC TRANSFORMER CORP  
30 HYNES AVE GROTON CONN
- ATLANTIS ELECTRONICS CORP  
1807 STRATFORD DR GARLAND TEXAS
- ATLANTIS ELECTRONIC CORP  
3326 BROADWAY GARLAND TEXAS
- ATLAS COIL CORP  
63 MAIN ST ANSONIA CONN
- ATLAS CONNECTORS CORP  
RIVER RD N ARLINGTON N J
- ATLAS CONTROLS INC  
9 ERIE DRIVE NATICK MASS
- ATLAS ENG CO  
10 CHENEY ST ROXBURY MASS
- ATLAS MINERAL PRODUCTS CO  
151 WALNUT ST HERTZTOWN PA
- ATLAS OVERHEAD DOOR CO  
MILL ST AT READING RR QUAKERTOWN PA
- ATLAS POWDER CO  
TAMAQUA PA
- ATLAS SOUND CORP  
1449 39 ST BROOKLYN 18 N Y
- ATLAS TRANSFORMER CO  
5975 FAIRMOUNT EXT SAN DIEGO CALIF
- ATLEE CORP  
2 LOWELL AVE WINCHESTER MASS
- ATMO SEAL CO  
3475 CARDIFF AVE CINCINNATI OHIO
- ATOCON CORP  
527 N UNION ST GALION OHIO
- ATOMH ELECTRONICS  
7648 SAN FERNANDO RD SUN VALLEY CALIF
- ATOMIC ACCESSORIES INC  
811 W MERRICK RD VALLEY STREAM N Y
- ATOMIC LABS INC  
3086 CLAREMONT AVE BERLELEY CALIF
- ATOMIUM CORP  
575 MIDDLESEX TPKE BILLERICA MASS
- ATTLEBORO REFINING CO  
36 UNION ST ATTLEBORO MASS
- AUBURN INDUSTRIAL PARK  
AUBURN MASS
- AUBURN MFG CO  
PEASE AVE & STACK ST MIDDLETOWN CONN
- AUDAX INC  
109 01 37TH AVE CORONA N Y
- AUDEX CO  
3968 XENWOOD AVE MPLS MINN
- AUDIO ACCESSORIES  
279 BROADWAY AMITYVILLE N Y
- AUDIO CRAFTERS  
1601 BLUFF ROAD MONTEBELLO CALIF
- AUDIO DEVICES INC RECTIFIER DIV  
620 E DYER RD SANTA ANA CALIF
- AUDIO ELECTRONICS  
15858 35TH N E SEATTLE 55 WASH
- AUDIO EQUIPMENT CO  
75 HARBOR ROAD PORT WASHINGTON N Y
- AUDIO EQUIPMENT  
15749 WYOMING AVE DETROIT MICH
- AUDIO INSTRUMENT CO  
135 W 14 ST NEW YORK 11 N Y
- AUDIO MFG CORP  
100 RESEARCH DRIVE STAMFORD CONN
- AUDIOTOMATION LABS  
7230 CLINTON RD UPPER DARBY 14 PA
- AUDIO PRECISION AIDS INC  
SCARBOROUGH PK OSSINING N Y
- AUDIOSEARS CORP  
SHEPARD HILL RD ROXBURY NY
- AUDIOTAPE CORP  
25 PARKER AVE GLENBROOK CONN
- AUDIOTEX MFG CO/DIV G C TETRAN INC  
400 S WYMAN ROCKFORD ILL
- AUDIOTRONICS CORP  
P O BOX 151 N HOLLYWOOD CALIF
- AUDIOVOX INC  
123 WORCHESTER ST BOSTON MASS
- AUERBACH CORP  
1634 ARCH ST PHILA PA
- AUGAT BROS  
33 PERRY AVE ATTLEBORO MASS
- AULT MAGNETICS CO  
3501 48 AVE N MINNEAPOLIS 22 MINN
- AUREX CORP  
315 W ADAMS ST CHICAGO 10 ILL
- AUSTIN ELECTRONICS DIV AUSTIN CO  
76 9TH AVE NEW YORK 11 NY
- AUTH ELECTRIC CO  
34 20 45 ST LONG ISLAND CITY N Y
- AUTHORIZED MFRS SERVICE CO  
919 WYCKOFF AVE BROOKLYN 27 N Y
- AUTOCRAT ELECTRONICS CO  
5024 ELM ST SKOKIE ILL
- AUTO DATA  
BOX 9146 SAN DIEGO CALIF
- AUTOMATED CONTROLS  
1815 MAGNOLIA ALDERWOOD MANOR WASH



AUTOMATIC COIL CO INC  
76 E 2ND ST MINEOLA N Y  
AUTOMATIC CONTROL CO  
995 UNIVERSITY AVE ST PAUL 4 MINN  
AUTOMATIC CONTROLS DIV HAYS MFG CO  
859 WEST 12TH STREET ERIE PA  
AUTOMATIC ELECTRIC CO  
NORTHLAKE ILL  
AUTOMATIC ELECTRIC LAB  
NORTHLAKE ILL  
AUTOMATIC METAL PROD CORP  
323 BERRY ST BROOKLYN N Y  
AUTOMATIC SWITCH CO  
HANDOVER RD FLORHAM PARK N J  
AUTOMATIC TAPE CONTROL INC  
209 E WASHINGTON BLOOMINGTON ILL  
AUTOMATIC TIMING & CONTROLS INC  
KING OF PRUSSIA PENNA  
AUTOMATION COMPONENTS INC  
875 HICKORY ST PECKVILLE PA  
AUTOMATION DEVICES INC  
3125 BRANDES ST ERIE PENNA  
AUTOMATION DYNAMICS CORP  
255 COUNTY RD TENAFLY N J  
AUTOMATION INC  
212 WORCESTER ST WELLESLEY HILLS 82 MASS  
AUTOMATION IND INC MAGNETICS DIV  
INDUSTRIAL PARK BOULDER COLORADO  
AUTOMATION MANAGEMENT INC  
25 BRIGHAM ST WESTBORO MASS  
AUTOMATION PRODUCTS INC  
3030 MAX ROY ST HOUSTON TEX  
AUTONETICS DIV NORTH AMERICAN AVIATION INC  
LA PALMA ANAHEIM CALIF  
AUTO PRODUCTS MFG  
2735 OLIVE ST ST LOUIS MO  
AUTO-SWAGE PRODUCTS INC  
SHELTON CONN  
AUTO TEST INC  
600 S MICHIGAN AVE CHICAGO 5 ILL  
AUTO TEST INC  
411 W 8TH ST NEILLSVILLE WISC  
AUTO TROL CORP  
14500 W 82 AVE ARVADA COLO  
AUTOTRON INC  
3629 N VERMILION ST DANVILLE ILL  
AUTOTRONICS INC  
P O BOX 208 FLORISSANT MO  
AUTRON ENG INC  
1301 WILSHIRE BLVD LOS ANGELES 17 CALIF  
AUTRONICS CORP  
180 N VINEDO AVE PASADENA CALIF  
AVCO CROSLLEY DIV  
BOX 116 EVANDALE OHIO  
AVCO CORP ELECTRONICS & ORDNANCE DIV  
2630 GLENDALE CINCINNATI 41 OHIO  
AVCO LYCOMING DIV  
550 S MIAN ST STRATFORD CONN  
AVCO CORP ORDNANCE DIV  
RICHMOND IND  
AVEY DIV MOTCH & MERRYWEATHER  
25 E 3RD ST COVINGTON KY  
AVIATION INSTRUMENT & GEAR  
2051 W 9TH AVE HIALEAH FLA  
AVIATION INSTRUMENT MFG CORP  
9033 MONROE RD HOUSTON 17 TEX  
AVIEL ELECTRONICS INC  
1755 BERKELEY ST SANTA MONICA CALIF  
AVION FOUNDRY CORP  
PO BOX 397 TARPON SPRINGS FLA  
AVIONICS LTD  
PO BX 200 NIAGARA-ON-THE-LK ONT CANADA  
AVIONICS INC  
425 S CHAPIN ST SOUTH BEND IND  
AVNET CORP  
5877 RODEO RD LOS ANG CALIF  
AVNET ELECTRONICS CORP OF N CALIF  
1262 N LAWRENCE STATION RD SUNNYVALE CAL  
AVNET ELECTRONICS CORP  
70 STATE ST WESTBURY N Y  
AVO LTD  
80 SHORE RD PORT WASH N Y  
AVYRON MFG INC  
10409 MEECH AVE CLEVELAND 5 OHIO  
AXEL ELECTRONICS INC  
134 20 JAMAICA JAMAICA N Y

**B**

BABBITT CHEMICAL CO  
BOX 457 MATTAPoisETT MASS  
BABCOCK & WILCOX CO  
TUBULAR PRODUCTS DIV BEAVER FALLS PA  
BABCOCK & WILCOX BAILEY METER CO  
2980 EUCLID AVE WICKLIFFE OHIO  
BABCOCK & WILCOX DIAMOND POWER SPEC CORP  
BOX-415 LANCASTER OHIO  
BABCOCK ELECT CORP  
1640 MONROVIA AVE COSTA MESA CALIF  
BABCOCK RELAYS  
1640 MONROVIA AVE COSTA MESA CALIF  
BABCO PRODUCTS INC  
28 WATER ST DANVERS MASS  
BACH AURICON INC  
6900 ROMAINE AVE HOLLYWOOD CALIF  
BACH-SIMPSON LTD  
1255 BRYOGES ST LONDON ONT CANADA

BACHE & CO SEMON  
636 GREENWICH ST NEW YORK 14 N Y  
BACON INDUSTRIES  
192 PLEASANT ST WATERTOWN 72 MASS  
BAER CO N S  
1-11 MONTGOMERY ST HILLSIDE 5 N J  
BAILEY METER COMPANY  
1050 IVANHOE RD CLEVELAND 10 OHIO  
BAILEY METER CO  
29801 EUCLID AVE WICKLIFFE OHIO  
BAIRD ATOMIC INC  
WALTHAM MASS  
BAKER CHEMICAL CO J T  
PHILLIPSBURG N J  
BAKER CO  
106 GRANITE ST BIDDEFORD ME  
BAL CORP WILLIAM  
947 NEWARK AVE ELIZABETH N J  
BALCO RESEARCH LABS CAPACITOR DIV  
49-53 EDISON PL NEWARK 2 N J  
BALCRANK INC MACHINE TOOL DIV  
DISNEY ST CINCINNATI 9 OHIO  
ELECTRONICS DIV BALDWIN HAMILTON CORP  
WALTHAM MASS  
BALDWIN MFG CO INC  
140 HOMER ST WATERBURY CONN  
BALDWIN PIANO CO  
1801 GILBERT AVE CINCINNATI 2 OHIO  
BALLANTINE LABS INC  
BOONTON N J  
BALLARD CO IRVING  
407 SANSOME ST SAN FRAN CALIF  
BALLASTRAN CORP  
1701 N CALHOUN ST FT WAYNE IND  
BALTEAU ELECTRIC CORP  
NEW & MEADOW STS STAMFORD N Y  
M S BANCROFT & CO  
209 COOPER ST WESTMONT COLLINGSWOOD N J  
BAR WORK MFG CO INC  
1198 HIGHLAND AVE WATERBURY CONN  
BARBER & HOWARD CO  
EAST AVE WESTERLY R I  
BARBCO INC  
BOX 1222 MILWAUKEE WIS  
BARBER COLMAN CO AIRCRAFT & MISSILE PROD DIV  
ROCKFORD ILL  
BARBER COLMAN CO MOTORS & COMPONENTS DIV  
ROCKFORD ILL  
BARBER COLMAN CO ELECT COMPONENTS DIV  
ROCKFORD ILL  
BARBER LABS ALFRED W  
32 44 FRANCIS LEWIS BLVD FLUSHING N Y  
BARBER-COLMAN CO  
1300 ROCK ST ROCKFORD ILL  
BARBOUR STOCKWELL CO  
205 BROADWAY CAMBRIDGE MASS  
BARCO CHEMICAL PRODUCTS CO  
701 S LASALLE ST CHICAGO ILL  
BARDEN CORP  
200 PARK AVE DANBURY CONN  
BARFIELD INSTRUMENT CORP  
4101 N W 29TH ST MIAMI FLA  
BARIUM & CHEMICALS INC  
WILLOUGHBY OHIO  
BARIUM CHEMICALS INC  
STUEBENVILLE OHIO  
BARKER & WILLIAMSON INC  
CANAL & BEAVER STS BRISTOL PENNA  
BARKER PRODUCTS CO  
WEST BRIDGEWATER MASS  
BARKSDALE VALVES  
5125 ALCOA AVE LOS ANGELES 58 CALIF  
BARNES DEVELOPMENT CO  
213 W BALTIMORE AVE LANSING MI  
BARNES ENGINEERING CO  
30 COMMERCE RD STAMFORD CONN  
BARNES METAL PRODUCTS CO  
4425 W 165TH CHICAGO ILL  
BARNETT INST CO  
430 COMMERCE ST CLARKSVILLE TENN  
BARNETT INSTRUMENT CO  
KRAFT ST CLARKSVILLE TENN  
BARNEY CHENEY CO  
EIGHTH AVE NORTH CASSAOGA COLUMBUS OHIO  
BARNSTEAD STILL & DEMINERALIZER CO  
331 LANESVILLE TERR BOSTON 31 MASS  
BAR RAY PRODUCTS INC  
211 25TH ST BROOKLYN N Y  
BARRETT CO LEON J  
P O BOX 378 WORCESTER 1 MASS  
BARRETT ELECTRONICS CORP  
630 DUNDEE RD NORTHBROOK ILL  
BARRETT ELECT CORP WESTERN DIV  
897 COMMERCIAL ST PALO ALTO CALIF  
BARRETT VARNISH CO  
1532 S 50TH COURT CICERO ILL  
BARRY CONTROLS DIV OF BARRY WRIGHT CORP  
700 PLEASANT ST WATERTOWN MASS  
BARRY ELECTRONICS CORP  
512 BROADWAY NEW YORK N Y  
BARTA GRIFFIN CO  
PO BOX 808 72 COMMERCIAL ST WORST MASS  
BARTH ENGRG & MFG CO INC  
48 ELM ST MERIDEN CONN  
BARTON INSTRUMENT CORP  
580 MONTEREY PASS RD MPINTEREY PK CALIF  
BARWOOD ELECTRONICS INC  
120 S MARYLAND AVE GLENDALE 5 CALIF  
BARWOOD MFG INC L J  
18 WILLIAMS ST EVERETT MASS  
BASCH CO GEORGE  
19 HANSE AVE FREEPORT L I N Y  
PENN CONTROLS INC BASCO DIV  
1007 S 12TH ST WATERTOWN WISC  
BASIC & EXPERIMENTAL PHYSICS  
BOX 689 FALMOUTH MASS

BASLER ELECTRIC CO  
BOX 269 RT 143 HIGHLAND ILL  
BASO DIV PENN CONTROLS INC  
4000 W BURNHAM ST MILWAUKEE WISC  
BASSETT INC REX  
1314 N E 17 CT FT LAUDERDALE FLA  
BAUSCH & LOMB INCORP  
1762 BAUSCH ST ROCHESTER N Y  
BAYLEY INSTRUMENT CO  
PO BOX 538 DANVILLE CALIF  
BAY PRODS DIV AMER METAL WKS INC  
1835 W CAMBRIA ST PHILA 32 PA  
BAY ROY ELECTRONICS INC  
16608 MADISON AVE CLEVELAND OHIO  
BAY STATE ABRASIVE PRODUCTS CO  
12 UNION ST WESTBORO MASS  
BAYSIDE TIMERS  
45-25 162 ST FLUSHING 58 N Y  
B & B ELECTRONICS CORP  
17360 S GRAMERCY PL GARDENA CALIF  
B & C INSULATION PRODUCTS INC  
LINCOLN HWY ISELIN N J  
BEACH-RUSS CO  
622 GRAYBAR BLDG NEW YORK 17 N Y  
BEAD CHAIN MFG CO  
110 MOUNTAIN GROVE ST BRIDGEPORT 5 CONN  
BEAN & CO MORRIS  
HYDE RD YELLOW SPRINGS OHIO  
BEARING INSPECTION INC  
3311 E GAGE AVE HUNTINGTON PK CAL  
BEATTIE-COLEMAN INC  
1000 N OLIVE ST ANAHEIM CALIF  
W A BEAUCHAINE & SONS INC  
P O BOX 127 LAKEPORT N H  
BEAU ELECTRONICS INC  
1066 WOLCOTT ROAD WATERBURY CONN  
BEAVER GEAR WORKS INC  
1025 PARMELEE ST ROCKFORD ILL  
BEAZART ELECTRONICS CO  
7459 DEERING CANOGA PARK CALIF  
BECK CO HAROLO  
3640 N 2 ST PHILA 40 PENNA  
BECKER BROS CARBON CO  
3450 S LARIME AVE CICERO ILL  
BECKER DURHAM  
EAST DURHAM N Y  
BECKER ELECT MFG CORP  
1091 ROCKAWAY AVE VALLEY STREAM N Y  
BECKER ELECTRONICS MFG CORP  
RTE 145 E DURHAM N Y  
BECKLEY MFG CO  
BECKLEY W VA  
BECKMAN & WHITLEY  
993 E SAN CARLOS AVE SAN CARLOS CALIF  
BECKMAN INST INC  
2500 HARBOR BLVD FULLERTON CALIF  
BECKMAN INST SPINCO DIV  
PALO ALTO CALIF  
BECKMAN INST INC BERKELEY DIV  
2200 WRIGHT AVE RICHMOND CALIF  
BECKS INC  
298 E 5 ST ST PAUL MINN  
BEE CHEMICAL CO  
2700 E 170TH ST LANSING ILL  
BEEMER ENG CO  
INDUSTRIAL PARK FT WASHINGTON PA  
BEGEN CO M  
1683 JERROLD ST SAN FRANCISCO 24 CALIF  
BEHLMAN INVAR ELECTRONICS CORP  
1723 CLOVERFIELD BLVD SANTA MONICA CALIF  
BELODEN MFG CO  
415 S KILPATRICK CHICAGO 44 ILL  
BELDING CORTICELLI INST INC  
1407 BROADWAY NEW YORK N Y  
BELFAB CORP  
MUNICIPAL AIRPORT DAYTONA BEACH FLA  
BELFAB CORP  
BOX 1881 DAYTONA BEACH FLA  
BELFAB CORP  
PO BOX 1446 DAYTONA BEACH FLA  
BELFUSE INC  
198 VAN VORST JERSEY CITY N J  
BELL & HOWELL PHOTO PRODUCTS DIVISION  
7100 MCCORMICK RD CHICAGO 45 ILL  
BELL AIRCRAFT CORP  
P O BOX 1 NIAGARA FALLS BLVD BUFFALO 5 N Y  
BELL HELICOPTER CO ELECTRONIC DEPT  
DIV BELL AEROSPACE  
P O BOX 482 FT WORTH TEXAS  
BELL INC F W  
1356 NORTON AVE COLUMBUS 12 OHIO  
BELL SOUND DIV THOMPSON RAMO WOODRIDGE INC  
555 MARION RD COLUMBUS 7 OHIO  
BELLAIRES ELECTRONICS INC  
62 WHITE ST RED BANK N J  
BELLEVILLE HEXEM CORP  
638 UNIVERSITY AVE LOS GATOS CALIF  
BELLOW'S VALVIAR  
PO BOX 631 AKRON 9 OHIO  
BELMONT SMELTING & REFINING WORKS  
330 BELMONT AVE BROOKLYN 7 N Y  
BELOCK INSTRUMENT CORP  
111 01 14 AVE COLLEGE POINT N Y  
BELTRONICS CORP  
344 INTERSTATE RD ADDISON ILL  
BELZ INDUSTRIES DIV EL TRONICS INC  
89 UNION ST MINEOLA N Y  
BENCO TELEVISION ASSOC LTD  
27 TABER RD REXDALE ONT CANADA  
BENDIX CORP BENDIX PACIFIC DIV  
11600 SHERMAN WAY N HOLLYWOOD CALIF  
BENDIX CORP BENDIX SYSTEMS DIV  
ANN ARBOR MICH  
BENDIX CORP IND CONTROLS DIV  
8880 HUBBELL AVE DETROIT 28 MICH  
BENDIX CORP RED BANK DIV  
RT 35 EATONTOWN N J



# ELECTRONIC MANUFACTURERS—A TO Z

BENDIX CORP/SCINTILLA DIV  
DELAWARE AVE SIDNEY N Y  
THE BENDIX CORP CINCINNATI DIV  
3130 WASSON RD CINCINNATI OHIO  
BENDIX COMPUTER DIV THE BENDIX CORP  
5630 ARBOR VITAE LOS ANG CALIF  
BENDIX CORP BENDIX RADIO DIV  
BALTIMORE MD  
BENDIX CORP SEMICONDUCTORS DIV  
HOLMDEL N J  
BENDIX CORP MISHAWAKA DIV  
400 S BEIGER ST MISHAWAKA IND  
BENDIX CORP THE PIONEER CENTRAL DIV  
2734 HICKORY GROVE RD DAVENPORT IOWA  
BENDIX CORP THE FRIEZ INST DIV  
BALTIMORE 4 MD  
BENDIX CORP THE SHEFFIELD CORP SUB  
BOX 893 MTU SPRINGFIELD ST DAYTON OHIO  
BENNETT LAB INC  
1475 POWELL ST EMERYVILLE CALIF  
BENRUS WATCH CO INC  
30 CHERRY AVE WATERBURY CONN  
BENSON LEHNER CORP  
11930 W OLYMPIC BLVD LOS ANG CALIF  
BENSON LEHNER CORP  
14761 CALIFA STREET VAN NUYS CALIFORNIA  
BENSON LEHNER G B LTD  
WEST QUAY RD SOUTHAMPTON ENG  
BENTLEY HAPRIS MFG CO  
CONSHOHOCKEN PA  
BERG MFG CORP  
NEW CUMBERLAND PA  
BERGEN LABS INC  
60 SPRUCE ST PATERSON 1 N J  
BERGEN WIRE ROPE CO  
456 GREGG ST LODI N J  
BERGER BROS CO SPECIAL PRODS DIV  
135 DERBY AVE NEW HAVEN CONN  
BERKELEY DYNAMICS  
BOX 1098 BURLINGAME CALIF  
BERKELEY INSTRUMENTS  
1475 POWELL ST EMERYVILLE 8 CAL  
BERKELEY INSTRUMENT CO  
BOX 146 BERKELEY HGTS N J  
BERKSHIRE LABS  
11-35 KINGSFORD RD HANOVER NEW HAMPSHIRE  
BERKSHIRE TRANSFORMER CORP  
ROUTE 341 KENT CONN  
BERMAN LABS  
112 03 ROCKAWAY BLVD OZONE PK N Y  
BERMITE POWDER  
22216 W SOLEDAD CANYON RD SAUGUS CAL  
BERNARD FRANKLIN CO INC  
FRANKFORD & TORRESDALE AVE PHILA PA  
BERNCO ENGINEERING CORP  
2320 S TIBBS AVE INDIANAPOLIS 41 IND  
BERYLLIUM CORP  
P O BOX 1462 READING PENNA  
BEST MFG CO  
1333 WALNUT ST BOX 2126 KANSAS CITY 42 MO  
BESTCRAFT PRODUCTS CO  
626 BROADWAY NEW YORK 12 N Y  
BETHLEHEM STEEL CO  
BETHLEHEM PA  
BETTER COIL & TRANSFORMER CORP  
GOODLAND INO  
BETTS & BETTS CORPORATION  
POMPERAUG ROAD WOODBURY CONN  
BEVA LABORATORY  
185 FOURTH STREET TRENTON 9 NJ  
BEVIN WILCOX LINE CO  
95 SKINNER ST E HAMPTON CONN  
B & F INSTRUMENTS INC  
3644 N LAWRENCE ST PHILA PA  
B G CORP THE  
321 BROAD AVE RIDGEFIELD NJ  
B & H INSTRUMENT CO INC  
3479 W VICKERY BLDG FT WORTH TEXAS  
BIDDLE CO JAMES G  
1316 ARCH ST PHILADELPHIA 7 PA  
B I F INDUSTRIES  
345 HARRIS AVE PROVIDENCE R I  
BIGGS CO CARL H  
1547 FOURTEENTH ST SANTA MONICA CALIF  
BILL JACK INDUSTRIES  
143 S CEDROS ST SOLANA BEACH CALIF  
BINARY ELECTRONICS INC  
30 48 LINDEN PL FLUSHING N Y  
BIO-RAD LABS  
32ND AND GRIFFIN AVE RICHMOND CALIF  
BIOPHYSICAL INSTRUMENTS INC  
20 HERMAN ST PHILA PA  
BIOPHYSICAL ELECT DIV COMM IND  
221 ROCK HILL RD BALA CYNWYO PA  
BIOS LABS INC  
17 W 60 ST NEW YORK N Y  
BIRD & CO RICHARD H  
1 SPRUCE ST WALTHAM 54 MASS  
BIRO & SONS LTD SYDNEY S  
FLEETS LANE POOLE DORSET ENG  
BIRD ELECTRONIC CORP  
30303 AURORA RD CLEVELAND 39 OHIO  
BIRDAIR STRUCTURES INC  
1800 BROADWAY BUFFALO 12 N Y  
BIRDSELL PRODS AFFL SUSQUEHANNA SCIENCES  
350 N HALSTEAD ST PASADENA CALIF  
BIRMA MFG CO INC  
254 RANO ST BUFFALO 7 N Y  
BIRMINGHAM SOUND REPRODUCERS LTD  
MONARCH WKS POWER LANE STAFFORDSHIRE ENG  
BIRNBACH RADIO CO  
145 HUDSON ST NEW YORK 13 N Y  
THE BIRTCORP CORP INDUSTRIAL DIV  
745 S MONTEREY PASS RD MONTEREY PK CALIF  
BISCHOP DIE ENGRAVING  
1405 16TH ST RACINE WISC

BISHOP ENGINEERING CO INC  
804 S MAIN ST MOUNT AIRY MD  
BISHOP & CO PLATINUM WORKS J  
MALVERN PENNA  
BISHOP MFG CORP  
10 CANFIELD RD CEDAR GROVE NJ  
BITTERMANN ELECTRIC CO  
BARLOW ST CANAAN CONN  
BITWAX CORP  
3445 HOWARD ST SKOKIE ILL  
B & K INSTRUMENTS INC OF BRUEL & KJAER  
3044 W 106 ST CLEVELAND 11 OHIO  
B & K MFG CO  
1801 W BELLE PLAIN AVE CHICAGO 13 ILL  
BLACK & DECKER MFG CO  
E PENNA AVE TOWSON 4 MO  
BLACK & WEBSTER INC  
570 PLEASANT ST WATERTOWN MASS  
BLACK LIGHT EASTERN CORP  
24 KINKEL ST WESTBURY N Y  
BLACK LIGHT PRODUCTS INC  
4868 N SHERIDAN RD CHICAGO ILL  
BLACKBURN ELECTRONIC CORP  
55 W 7 ST WYOMING PA  
BLACKHAWK ENGINEERING CO  
P O BOX 146 JANESVILLE WISC  
BLACKSTONE CORP  
1111 ALLEN ST JAMESTOWN N Y  
BLACO MFG CO  
6541 EUCLID AVE CLEVELAND OHIO  
BLAINE ELECTRONICS INC  
14757 KESWICK ST VAN NUYS CALIF  
BLASS ANTENNA ELECTRONICS CORP  
11-1134TH AVE LONG ISLAND CTY 6 N Y  
BLAW-KNOX CO/BLAW-KNOX EQUIP DIV  
PITTSBURGH 38 PENNA  
BLEHART CO L D  
10 FISKE PL MT VERNON N Y  
BLICKMAN INC  
201 GREGORY AVE WEEHAWKEN N J  
BLILEY ELECTRIC CO  
UNION STATION BLDG ERIE PA  
BLINN CO DELBERT  
P O BOX 757 POMONA CALIF  
BLISS ELECTRONIC CORP  
BOX 366 SUSSEX NJ  
BLOCK ASSOC  
395 PUTNAM AVE CAMBRIDGE MASS  
BLOCKSON & CO  
5TH CANAL ST MICHIGAN CITY IND  
BLOOMINGDALE RUBBER CO  
P O BOX 191 ABERDEEN MD  
BLOWERS INC  
12655 WESTERN AVE BLUE ISLAND ILL  
BLUE M ELECTRIC CO  
138 E CHATHAM ST BLUE ISLAND ILL  
BOOINE ELECTRIC CO  
2500 BRADLEY PLACE CHICAGO ILL  
BOEHME INC H O  
915 BROADWAY NEW YORK 10 N Y  
BOEMM CO R A  
1218 OJAMOND AVE BETHEL CONN  
BOEING AIRPLANE CO  
DEPT 8200 WICHITA 1 KANSAS  
BOESCH MFG CO  
45 RIVER ST DANBURY CONN  
BOETSCH BROS  
115 CEDAR ST N ROCHELL N Y  
BOGART MFG CORP  
315 SIEGEL ST BROOKLYN N Y  
BOGUE ELECTRIC MFG CO  
52 IOWA AVE PATERSON 3 NJ  
BOLTA PRODUCTS DIV GENERAL TIRE & RUBBER CO  
70 GARDEN ST LAWRENCE MASS  
BOMAC LABS INC  
SALEM RD BEVERLY MASS  
BOMYTE CO  
GREEN ST SILVERDALE PA  
BON DE ELECTRONIC LABS INC  
361 363 RANTOUL ST BEVERLY MASS  
BONE ENGG CORP  
701 BROADWAY GLENDALE CALIF  
BONNY MFG CORP  
146 MAIN ST MAYNARD MASS  
BOOKER & WALLSTAD DIV THERMOTEC INC  
3330 GORHAM AVE MINN MINN  
BOONSHAFT & FUCHS INC  
HATBORO INDL PARK HATBORO PA  
BOONTON ELECTRONICS CORP  
738 SPEEOWELL AVE MORRIS PLAINS N J  
BOONTON HOLDING CO INC  
300 MYRTLE AVE BOONTON N J  
BOONTON RADIO CORP  
INTERVALE RD BOONTON N J  
BOOTH CO ARTHUR E  
265 S ALEXANDRIA AVE LOS ANGELES 4 CALIF  
BOOTS AIRCRAFT NUT CO  
NEWTON TURNPIKE NORWALK CONN  
THE BORDEN CO CHEMICAL DIV  
1 CLARK ST NO ANDOVER MASS  
BORDEN CHEMICAL CO DIV BORDEN CO  
P O BOX 4428 COMPTON CALIF  
BORDEN CHEMICAL CO  
5000 LANGDON ST BOX 9522 PHILA PA  
BORG EQUIP DIV AMPHENOL BORG ELECT CORP  
120 MAIN ST JANESVILLE WISC  
BORG-WARNER CONTROLS  
3300 NEWPORT BLVD BOX 1679 SANTA ANA CALIF  
BORO PRECISION PRODUCTS CORP  
76 14 WOODSIDE AVE ELMHURST N Y  
BOSCO ELECT INC  
56 ROUTE 10 HANOVER N J  
BOSTON AUTO GAGE CO  
70 WEST ST PITTSFIELD MASS  
BOSTON GEAR WORKS  
QUINCY 71 MASS

BOSTON INSULATED WIRE & CABLE CO  
65 BAY ST BOSTON MASS  
BOULEVARD ELECTRONICS INC  
1229 WASHINGTON BLVD CHICAGO ILL  
BOULVARD RECORDING STUDIOS INC  
632 N DEARBORN ST CHICAGO ILL  
BOURNS INC  
6135 MAGNOLIA AVE RIVERSIDE CALIF  
BOURNS INC TRIMPOD DIV  
1200COLUMBIA AVE RIVERSIDE CAL  
BOURNS LABS INC  
118 HAYWARD AVE AMES IOWA  
BOW SOLDER PRODUCTS CO  
251 FREEMAN ST BROOKLYN N Y  
BOWMAR INSTRUMENT CORP  
8000 BLUFFTON RD FT WAYNE IND  
BOWMAR INSTRUMENT TIC DIV  
531 MAIN ST ACTON MASS  
BOZAK MFG CO R T  
587 CONNECTICUT AVE S NORWALK CONN  
BOY-MAR ELECTRICAL SERVICE CO  
1271 MISSION ST SAN FRANCISCO 3 CALIF  
B & R TOOL & DIE CO  
947 INDUSTRIAL AVE PALO ALTO CALIF  
BRABENDER INST INC C W  
50 E WESLEY ST S HACKENSACK N J  
BRACH MFG CORP DIV GEN BRONZE CORP  
200 CENTRAL AVE NEWARK 3 N J  
BRAD THOMPSON INDUSTRY INC  
83 810 TAMARISK ST INDIO CALIF  
BRADFORD COMPONENTS INC  
65 SOUTH AVE SALAMANCA N Y  
BRADLEY ELECTRONICS CO INC  
68 FIRST ST NEW ROCHELLE N Y  
BRADLEY SEMICONDUCTORS CORP  
275 WELTON ST HAMDEN CONN  
BRADY CO W H  
727 W GLENDALE AVE MILWAUKEE 9 WISC  
BRAILSFORD & CO  
670 MILTON RD RYE N Y  
BRAININ CORP C S  
320 WASHINGTON ST MT VERNON N Y  
BRAMCO INC SUB LEDEX INC  
COLLEGE & SOUTH PIQUA OHIO  
BRAM METALLURGICAL-CHEMICAL CO  
820 65 AVE PHILADELPHIA 26 PA  
BRAND REX DIV AMER ENKA CORP  
18120 S BROADWAY GARDENA CALIF  
BRAND REX DIV AMER ENKA CORP  
ROUTE 6 N WINDHAM CONN  
BRAND REX DIV AMER ENKA CORP  
HAYWARD RD W ACTON MASS  
BRANSON CORP  
41 S JEFFERSON RD WHIPPANY N J  
BRANSON INSTRUMENTS INC  
37 BROWN HOUSE RD STAMFORD CONN  
BRAUN KNECHT HEIMANN CO  
601 ONEIL AVE BELMONT CALIF  
BRAUN TOOL & INSTRUMENT CO INC  
140 FIFTH AVE HAWTHORNE N J  
BREEZE CORPS  
700 LIBERTY AVE UNION NJ  
BREON LABS  
1520 EVERGREEN RD WILLIAMSPORT PA  
BREL PRODUCTS CORP  
601 W 26TH ST NEW YORK N Y  
BREW & CO RICHARD O  
90 AIRPORT RD CONCORD N H  
BRIDGE ELECTRONICS CO INC  
408 WARREN ST BEVERLY N J  
BRIDGEPORT BRASS CO  
30 GRAND ST BRIDGEPORT 2 CONN  
BRIGHT RADIO LABS INC  
222 E 2ND ST MINEOLA LI N Y  
BRIGHT STAR BATTERY  
CLIFTON N J  
BRILMAYER LAB E W  
330 FIFTH AVE PELHAM N Y  
BRINKMANN INSTRUMENTS INC  
115 CUTTER MILL RD GREAT NECK N Y  
BRISTOL BRASS CORP  
58D BROAD ST BRISTOL CONN  
BRISTOL CO  
PO BOX 1790 WATERBURY CONN  
BRISTOL CO  
2040 N HAWTHORNE MELROSE PARK ILL  
BRISTOL CO  
6800 E ACCO ST LOS ANGELES CALIF  
BRISTOL MOTORS DIV VOCALINE CO AMERICA INC  
OLO SAYBROOK CONN  
BRITISH RADIO ELECTRONICS LTD  
1833 JEFFERSON PL NW WASHINGTON DC  
BRITTON ELECTRONICS CORP  
35 10 36TH AVE LONG ISLAND CITY N Y  
BROADWAY COIL CO  
5638 BROADWAY CHICAGO 40 ILL  
BRON-SHOE CO  
269 E BROAD ST COLUMBUS 15 OHIO  
BROOKS INSTRUMENT CO INC  
HATFIELD PENNA  
BROOKS & PERKINS INC  
1950 W FORT ST DETROIT MICH  
BROOKS RADIO & TV CORP  
84 VESEY ST NEW YORK 7 N Y  
BROOKS RESEARCH  
499 WEST COMMERCIAL ST EAST ROCHESTER NY  
BROOKS ROTAMETER CO  
P O BOX 432 LANSDALE PA  
BROWN & SHARPE MFG CO  
235 PROMENADE ST PROVIDENCE R I  
BROWN BROCKMEYER CO  
1000 S SMITHVILLE RD DAYTON OHIO  
BROWN ENG CO INC  
1100 MERIDIAN ST HUNTSVILLE ALA  
BROWN INC DAYTON T  
1305 STRONG RO COPIAGUE N Y

BROWNING LABS INC  
100 UNION AVE LACONIA N H  
BRUBAKER ELECTRONICS INC  
11800 OLYMPIC BLVD LOS ANG CALIF  
BRUMBERGER CO  
34 34TH ST BROOKLYN N Y  
BRUNING CO INC CHARLES  
1800 W CENTRAL RD MT PROSPECT ILL  
BRUNO NEW YORK INDUSTRY CORP  
460 W 34 ST NEW YORK 1 NY  
BRUNSWICK INSTRUMENTS  
P O BOX 813 NEW BRUNSWICK N J  
BRUSH BERYLLIUM CO READING DIV  
SHOEMAKERSVILLE PENNA  
BRUSH BERYLLIUM CO  
9209 EUCLID AVE CLEVELAND OHIO  
BRUSH INSTRUMENTS  
37TH & PERKINS CLEVELAND OHIO  
BRYANT COMPUTER PRODUCTS DIV EX-CELLO CORP  
850 LADD ROAD WALLED LAKE MICH  
BRYN INSTRUMENT CO  
7026 6TH AVE BROOKLYN N Y  
BTU ENGG CORP  
179 BEAR HILL RD WALTHAM 54 MASS  
BUCHANAN ELECTRICAL PROD CORP  
HILLSIDE N J  
BUCK EPGG FO  
37 MARCY ST FREEHOLD N J  
BUCKBEE MEARS CO  
245 E 6TH ST ST PAUL MINN  
BUCKBEE MEARS CO TONI BUILDING  
4TH & ROSABEL ST ST PAUL MINN  
BUCKEYE IRON & BRASS WORKS  
324 E 3RD ST DAYTON OHIO  
BUD RADIO INC  
2118 E 55TH ST CLEVELAND 3 OHIO  
BUDD CO POLYCHEM DIV  
NEWARK DELAWARE  
BUDD ELECTRONICS A DIV OF THE BUDD CO  
43 22 QUEENS ST LONG ISLAND CITY N Y  
BUDD STANLEY CO  
175 EILEEN WAY SYOSSET N Y  
BUDELMAN ELECTRONICS CORP  
375 FAIRFIELD AVE STAMFORD CONN  
BUFFALO INSTRUMENT CORP  
1780 ELMWOOD AVE BUFFALO NY  
H H BUGGIE DIV BURNDY CORP  
P O BOX 817 TOLEDO OHIO  
BUHL OPTICAL CO  
1009 BEECH AVE PITTSBURGH 33 PA  
BUILDING BLOCKS ELECTRONIC CO  
2506 GERRITSEN AVE BROOKLYN 29 N Y  
BULLARD  
286 CANFIELD AVE BRIDGEPORT 9 CONN  
BULOVA WATCH CO ELECT DIV  
40 01 61 ST WOODSIDE N Y  
BUNDY ELECTRONICS CORP  
171 FAYAN PL NEWARK 12 N J  
BUNNELL & CO J H  
81 PROSPECT ST BROOKLYN 1 N Y  
BURDICK CORP  
635 PLUMB ST MILTON WISC  
BUREAU OF ENGRAVING INC INDUSTRY DIV  
500 S 4TH ST MINN MINN  
BUREAU OF ENGRAVING INC  
219 NORTH 2ND ST MINNEAPOLIS 15 MINN  
BURGESS BATTERY CO  
FOOT OF EXCHANGE ST FREEPORT ILL  
BURGESS BATTERY CO DIV SERVEL CANADA LTD  
415 BUTTREY ST NIAGARA FALLS ONT CANADA  
BURGESS CELLULOSE CO GRADE O MAT DIV  
FREEPORT ILL  
BURGMASER CORP  
15001 S FIGUEROA GARDENA CALIF  
BURKE & JAMES INC  
321 S WABASH AVE CHICAGO 4 ILL  
BURKLYN CO  
3429 GLENDALE BLVD LOS ANG CALIF  
BURLING INSTRUMENT CO  
16 RIVER RD CHATHAM N J  
BURMAC ELECTRONICS CO  
142 LONG BEACH RD ROCKVILLE CENTRE N Y  
BURMAC ELECTRONICS CO INC  
24 CENTRAL DR FARMINGDALE N Y  
BURNDY CORP  
MILFORD CONN  
BURNDY-ESCON INC  
NORWALK CONN  
BURNDY ESCON INC  
725 BRANCH AVE PROVIDENCE 4 R I  
BURNDY CORP OMATON DIV  
NORWALK CONN  
BURNELL & CO INC  
10 PELHAM PKWY PELHAM MANOR NY  
BURNETT RADIO LAB W W L  
4814 IDAHO ST SAN DIEGO 16 CALIF  
BURNLEY BATTERY & MFG CO  
103 CLAY ST NORTH EAST PA  
BURR BROWN RESEARCH CORP  
BOX 6444 TUCSON ARIZ  
BURROUGHS CORPORATION ELECTRO DATA DIVISION  
460 SIERRA MADRE VILLA PASADENA CALIFORNIA  
BURROUGHS CORP MILITARY ELCTRNC CMPTR DIV  
14300 TIREMAN AVENUE DETROIT 28 MICHIGAN  
BURROUGHS CORPORATION PLYMTH MFG ENG DIV  
41100 PLYMOUTH ROAD PLYMOUTH MICHIGAN  
BURROUGHS CORP ELEC COMP DIV  
BOX 1226 PLAINFIELD N J  
BURROUGHS CORP CONTROL INSTR DIV  
67 35TH STREET BROOKLYN 32 NY  
BURROUGHS CORP ELECTRONIC INSTRS DIV  
1209 VINE STREET PHILADELPHIA 7 PA  
BURTON MFG CO TRANS ELECTRONIC DIV  
8910 WINNETKA AVE NORTHRIDGE CALIF  
BURTON INSTRUMENT DIV BURTON MFG CO  
8910 WINNETKA AVE NORTHRIDGE CALIF

BUSH TRANSFORMER CORP  
707 N ST ENDICOTT N Y  
BUSHNELL ELECTRIC  
345 HESS ST BUSHNELL ILL  
BUSSMANN MFG CO DIV MCGRAW EDISON  
UNIVERSITY AT JEFFERSON ST LOUIS MO  
BUTCHER CO L H  
3628 E OLYMPIC BLVD LOS ANG CALIF  
BV GENERAL ARMATURE & MFG CO  
P O BOX 370 LOCK HAVEN PA  
B/W CONTROLLER CORP  
2200 E MAPLE BIRMINGHAM MICH  
B W MFG INC PHILLIPS RADIO DIV KOKOMO IND  
321 S UNION ST KOKOMO IND  
B-W MFGERS INC PHILLIPS RADIO DIV  
721 N WEBSTER ST KOKOMO IND  
BY-BUK CO  
4314 W PICO BLVD LOS ANGELES 19 CALIF  
BYREX CORP  
50 HUNT ST NEWTON MASS  
BYTREX CORP  
50 HUNT ST NEWTON 58 MASS

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CABLE & WIRE PRODUCTS CO  
CHICAGO RD SWANTON OHIO  
CABLE DESIGNS INC  
66 RUSHMORE ST WESTBURY LI N Y  
CABLE SPEC OF CONN  
95 KITTS LANE NEWINGTON CONN  
CABRAL MOTORS INC  
51 VICTORY LANE LOS GATOS CALIF  
CADELL-BURNS MFG CO  
40 E 2 ST MINEOLA N Y  
CADILLAC GAGE CO  
25760 GROESBECK HWY WARREN MICH  
CADRE INDUSTRIES CORP  
ENDICOTT N Y  
CAIG LABS INC  
46 STANWOOD RD NEW HYDE PARK N Y  
CALATROL ELECTRONIC INC  
3492 PICKETT ST SAN DIEGO 10 CALIF  
CALBEST ELECTRONICS CO  
4801 EXPOSITION BLVD LOS ANGELES 16 CALIF  
CALCON MFG CO  
100 OAKLAND AVE WASHINGTON PA  
CALCOR SPACE FACILITY INC  
1010 W PHILADELPHIA WHITTIER CAL  
CALCULAGRAPH CORP INC  
272 RIDGEDALE AVE BOX 72 MANOVER NJ  
CALEDONIA ELECTRONICS & TRANSFORMER CORP  
MAPLE ST CALEDONIA N Y  
CALFAX INC  
115 MAIN ST EL SUBUNGO CALIF  
CALIDYNE CO INC SUB LING-ALTEC ELECTRONICS  
120 CROSS ST WINCHESTER MASS  
CALIF MAGNETIC CONTROL CORP  
11922 VALERIO ST HOLLYWOOD CALIF  
CALIF TECHNICAL INDUSTRY DIV TETRON INC  
1421 OLD COUNTY RD BELMONT CALIF  
CALIFONE CORP  
5922 BOWCRDFT ST LOS ANGELES 16 CALIF  
CALIFORNIA COMPUTER PRODS INC  
305 MULLER AVE ANAHEIM CALIF  
CALIFORNIA COMPUTER PROD INC  
8714 CLETA ST DOWNEY CALIF  
CALIF ELECTRO SCIENTIFIC CORP  
1214 PARK LANE SANTA ANA CALIF  
CALIFORNIA INSTRUMENTS CORP  
3511 MIDWAY DR SAN DIEGO CALIF  
CALIFORNIA RESISTOR CORP  
1631 COLORADO AVE SANTA MONICA CALIF  
CALIFORNIA CHASSIS CO  
5445 E CENTURY BLVD LYNWOOD CALIF  
CALLINS INDUSTRIES INC  
P O BOX 356 GREENFIELD TENN  
CALMAG DIV CALIF MAGNETIC CONT CORP  
11922 VALERIO ST N HOLLYWOOD CALIF  
CALTRON PRODUCTS CO  
3518 PICO BLVD LOS ANG CALIF  
CALVERT ELECTRONICS INC  
536 BROADWAY NEW YORK N Y  
CALVIDEO ELECTRONICS INC  
18601 S SANTA FE AVE COMPTON CALIF  
CAMBLOCK CORP SUB WALTHAM PREC INST  
221 CRESCENT ST WALTHAM MASS  
CAMBRIDGE FILTER CORP  
738 E ERIE BLVD SYRACUSE N Y  
CAMBRIDGE INSTRUMENT CO INC  
OSSINGE NEW YORK  
CAMBRIDGE PANELYTE MOLDED PLASTICS CO  
WEST PIKE RD CAMBRIDGE OHIO  
CAMBRIDGE PATTEN WORKS  
55 FIRST ST CAMBRIDGE MASS  
CAMBRIDGE SCIENTIFIC INDUSTRY INC  
18 POPLAR ST CAMBRIDGE MD  
CAMBRIDGE SYSTEMS INC  
50 HUNT ST NEWTON MASS  
CAMBRIDGE THERMIONIC CORP  
443 CONCORD AVE CAMBRIDGE MASS  
CAMCAR SCREW & MFG CO DIV TETRON INC  
600 18 AVE ROCKFORD ILL  
CAMDALE PRECISION INC  
28300 GROESBECK HWY ROSEVILLE MICH  
CAMERA MART INC  
1845 BROADWAY NEW YORK 23 N Y

CAMLOC FASTENER CORP  
22 SPRING VALLEY RD PARAMUS N J  
CAMPBELL INDUSTRIES INC  
DOVER N H  
CAMPBELL INDUSTRIES INC  
NORTH AURORA ILL  
CAMPBELL X RAY CORP  
108 CUMINGTON ST BOSTON MASS  
CANPRO CO  
3131 ALLIANCE RD N E CANTON 1 OHIO  
CANADAIR LTD  
PO BOX 6087 MONTREAL P O CANADA  
CANADIAN APPLIED RESCH DV A V ROE CANADA LTD  
BOX 4004 TERM A TORONTO ONT CANADA  
CANADIAN ASTATIC LTD  
2273 DANFARTH AVE TORONTO ONT CANADA  
CANADIAN AVIA ELECTS  
6214 COTE DE LIESSE RD ST LRNT QUE CANADA  
CANADIAN MARCONI CO  
2442 TRENTON AVE MONTREAL 16 CAN  
CANADIAN RADIUM URANIUM DV CANRAO PRES IND  
43 W SIXTEENTH ST NEW YORK N Y  
CANADIAN RESEARCH INSTITUTE  
85 CURLEW DRIVE DON MILLS ONT  
CANNON CD C F  
SPRINGWATER N Y  
CANNON ELECT CANADA LTD  
160 BARTLEY DR TORONTO ONT CANADA  
CANNON ELECTRIC CO EASTERN DIV  
PINGREE & LEAVITT STS SALEM MASS  
CANNON ELECTRIC CO  
2801 AIRLINE PHOENIX ARIZ  
CANNON MFG CO INC L J  
653 S MELROSE ST PLACENTIA CALIF  
CANOGA ELECT CORP  
1533D OXNARD ST VAN NUYS CALIF  
CAPCON INC  
61 STANTON ST NEW YORK 2 N Y  
CAPEHART CORP DYNAMIC ELECTRONICS DIV  
87046 123TH ST RICHMOND HILL 18 LI NY  
CAPITOL CITY MFG CO  
857 KING AVE COLUMBUS OHIO  
CAPITOL MACHINE CO  
36 BALMFORTH AVE DANBURY CONN  
CAPPS & CO  
20 ADDISON PL VALLEY STREAM L I N Y  
CAPTIVE SEAL CORP  
121 CLINTON RD CALDWELL N J  
CAPTRAN CORP  
1910 N ELSTON AVE CHICAGO ILL  
CAPTRONICS INC  
9 CRICKET TERRACE ARDMORE PA  
CARAD CORP  
3581 JUNIPERO SERRA BLVD PALO ALTO CALIF  
CARBOLINE CO  
32 HANLEY IND CT ST LOUIS MO  
CARBONE CORP  
MYRTLE AVE BOONTON N J  
CARBONNEAU INDUSTRIES INC  
100 LEXINGTON AVE S W GRAND RAPIDS 4 MICH  
ELECTRONICS DIV CARBORUNDUM CO  
LATROBE PA  
CARBORUNDUM CO THE REFRACTORIES DIV  
LATROBE PA  
CARBORUNDUM CO GLOBAR PLANT  
P O BOX 339 NIAGARA FALLS N Y  
CARDINAL CONTROL CO INC  
KENSINGTON RD KENSINGTON CONN  
CARDION ELECTRONICS INC  
65 RUSHMORE ST WESTBURY NEW YORK  
CARDOX DIV CHEMETRON CORP  
MONEE ILL  
CARDWELL CONDENSER CORP  
30 E MONTAUK HWY LINDENHURST N Y  
CAREY ELECTRONIC ENG  
1887 CLIFTON AVE SPRINGFIELD OHIO  
CARLETON AVIATION CO INC  
EAST AURORA N Y  
CARLING ELECTRIC INC  
505 NEW PARK AVE W HARTFORD 10 CONN  
CAROLINA COMPONENTS INC  
721 ROSEWOOD DR COLUMBIA S C  
CAROLINA MEDICAL ELECTRONICS INC  
3712 REYNOLDA RD WINSTON SALEM NC CAR  
CARLSTEDT RESEARCH INC  
2501 E 68TH ST LONG BEACH CALIF  
CARMA MANUFACTURING CO  
1879 MULLIN AVE TORRANCE CALIF  
CARMER INDUSTRIES  
22 N 26TH ST KENILWORTH NJ  
CARMODY CORP  
2360 WEHRLE DR BUFFALO 21 N Y  
CAROL CABLE DV CRESCENT CO INC  
20 CENTRAL AVE PAWTUCKET R I  
CAROL ELECT DIV WEECO INC  
315 W STEPHEN ST MARTINSBURG VA  
CAROLINA INDUSTRY PLASTICS DIV ESSEX WIRE CORP  
MT AIRY S C  
CAROLINA WELDS PLANT  
900 N GEORGE ST GOLDSBORO N C  
CARPENTER MFG CO INC  
P O BOX 217 DEWITT N Y  
CARPENTER STEEL CO  
FRONT & BERN STS READING PA  
CARPENTER STEEL CO ALLOY TUBE DIV  
SPRINGFIELD RD UNION NJ  
CARROLL PRESSED METAL INC  
133 DEWEY ST WORCESTER MASS  
CARRUTHERS & FERNANDEZ MFG CO  
1501 COLORADO AV BX 1470 SANTA MONICA CAL  
CARSON MFG CO INC  
INDIANAPOLIS INO  
CARSTEDT RESEARCH  
2501 E 68TH ST LONG BEACH CALIF  
CARTER MFG CORP  
23 WASHINGTON ST HUDSON MASS



# ELECTRONIC MANUFACTURERS—A TO Z

- CARTER MOTOR CO  
2760 W GEDRGE ST CHICAGO ILL
- CARTER CO J C  
671 W 17TH ST COSTA MESA CALIF
- CARTER PARTS CO  
3401 W MADISON ST SKOKIE ILL
- CARTER PRINCETON ELECTR DIV  
178 ALEXANDER ST PRINCETON N J
- CARTRISEAL CORP  
3515 W TOUHY AVE LINCOLNWOOD ILL
- CARVIL TECHNICAL CERAMICS INC  
801 23RD ST UNION CITY N J
- CASCADE RESEARCH DIV  
9249 SAN FERNANDO RD W LOS ANGELES CALIF
- CASTLE ENGINEERING CO  
SENECA CASTLE NEW YORK
- CASWELL ELECTRONICS CORP  
414 QUEENS LANE SAN JOSE CALIF
- CATALIN CORP OF AMERICA  
1 PARK AVE NEW YORK 16 N Y
- CATALYST RESEARCH CORP  
6101 FALLS RD BALTIMORE MD
- CATHODEON  
CHURCH ST CAMBRIDGE ENGLAND
- CATON INDUSTRIES  
646 W FIRST AVE ROSELLE N J
- CAVITRON ELECTRON OSCILLATOR CO  
2755 BRISTOL ST COSTA MESA CALIF
- C B C ELECTRONICS CO  
2601 N HOWARD ST PHILA PA
- C & D BATTERIES DIV ELECTRIC AUTOLITE CO  
ATTICA IND
- C & D BATTERIES DIV ELECT AUTOLITE CO  
PENNNSBURG PENNA
- CEDAR ENG DIV CONTROL DATA CORP  
5806 W 36TH ST ST LOUIS PK MINN
- CEETRONICS  
PO BOX 92 ALGER MICH
- CELCO CONSTANTINE ENG LABS CO  
P O BOX 553 MAHWAH N J
- CELCO CONSTANTINE ENG LAB CO PACIFIC DIV  
1150 E 8TH ST UPLAND CALIF
- C E M CO INC  
24 SCHOOL ST DANIELSON CONN
- CENTIMEG ELECTRONICS  
312 IMPERIAL HWY EL SEGUNDO CALIF
- CENTRALAB DIV GLOBE UNION  
3450 HOPKINS MILWAUKEE WISC
- CENTRALAB DIV GLOBE UNION INC  
FORT DODGE IOWA
- CENTRALAB DIV GLOBE-UNION INC  
900 E KEEFE AVE MILWAUKEE 1 WISC
- CENTRALAB DIV GLOBE UNION  
5150 N 32ND ST MILWAUKEE WISC
- CENTRALAB DIV GLOBE UNION  
3238 N BREMEN MILWAUKEE WISC
- CENTRAL COIL CORP  
857 N QUEENS AVE LINDENHURST N Y
- CENTRAL DYNAMICS LTD  
147 HYMUS BLVD PTE CLAIRE QUE CANADA
- CENTRAL ELECTRONIC MFRS  
2 RICHWOOD PL DENVER N J
- CENTRAL ELECTRONICS INC  
1247 W BELMONT AVE CHICAGO 13 ILL
- CENTRAL PORCELAIN CO  
911 RAILROAD ST COLUMBIANA OHIO
- CENTRAL RESEARCH LABS  
RED WING MINN
- CENTRAL SCIENTIFIC CO OF CANADA LTD  
146 KENDAL AVE TORONTO 4 ONT CANADA
- CENTRAL SCIENTIFIC CO  
1700 IRVING PARK RD CHICAGO ILL
- CENTRAL TRANSFORMER CO  
900 W JACKSON BLVD CHICAGO 7 ILL
- CENTRAL TRANSFORMER CORP  
ARCADIA FLA
- CENTROL ENG CO  
119 E LEXINGTON INDEPENDENCE MO
- CENTURY COIL CORP  
1522 N CLYBOURN AVE CHICAGO 10 ILL
- CENTURY ELECT INST INC  
1333N UTICA TULSA OKLA
- CENTURY ELECT CO  
1806 PINE ST ST LOUIS MO
- CENTURY ELECT CO  
111 ROOSEVELT AVE MINEOLA N Y
- CENTURY ELECTRONICS IN INSTS INC  
SUB CENTURY GEOPHYSICAL CORP  
6540 E APACHE ST BOX C TULSA OKLA
- CENTURY LIGHTING INC  
521 W 43 ST NEW YORK N Y
- CENTURY LIGHTING INC  
1477 N E 129TH ST N MIAMI FLA
- CENTURY PROJECTOR CORP  
3202 QUEENS BLVD LONG ISLAND CITY N Y
- CERAMASEAL INC  
P O BOX 25 NEW LEBANON CENTER N Y
- CERAMATRONICS INC  
364 HIGHLAND AVE PASSAIC N J
- CERAMCO INC CHEMISTS  
175 RIDGE ST NEWARK N J
- CERAMICS INTERNATIONAL CORP  
39 SIDING PLACE MAHWAH N J
- CERBERUS AG WERK ELEKTROENTECHNIK  
MANNEDORF SWITZERLAND
- RONSON METALS CORP CERTUM METAL ALLOYS DIV  
45 MFRS PL NEWARK N J
- CERRO SALES CORP  
300 PARK AVE NEW YORK N Y
- CERTIFIED RADIO LABS  
5507 13 AVE BROOKLYN N Y
- C E S ELECTRONIC PRODUCTS INC  
5026 NEWPORT AVE SAN DIEGO CALIF
- CETRON ELECTRONIC CORP  
715 HAMILTON ST GENEVA ILL
- CFI CORP  
1 COTTAGE PLACE MINEOLA N Y
- CGH SUPPLY  
415 E BEACH INGLEWOOD CALIF
- CHACE CO W M  
1600 BEARD AVE DETROIT 9 MICH
- CHADWICK-HELMUTH CO  
472 E DUARTE RD MONROVIA CALIF
- CHALCO ENGINEERING CORP  
15126 S BROADWAY GARDENA CALIF
- CHAMPION DEARMONT TOOL CO  
5 MAIN ST MEADVILLE PENNA
- CHANNEL INDUSTRIES INC  
427 OLIVE ST P O BOX 1408 SANTA BARB CALIF
- CHANNEL MASTER CORP  
ELLENVILLE N Y
- CHARLESTON RUBBER CO  
STARK INDUSTRIAL PARK CHARLESTON S C
- CHART-PAK INC  
321 RIVER RD LEEDS MASS
- CHASE BRASS & COPPER CO MILL DIV  
236 GRAND ST WATERBURY CONN
- CHASE MTL SERV DIV CHASE BRASS & COPPER CO  
236 GRAND ST WATERBURY 20 CONN
- CHASSIS-TRAK CORP  
7502 S LA CIENEGA BLVD INGLEWOOD CALIF
- CHATHAM CONTROLS CORP  
93 RIVER ST CHATHAM N J
- CHATHAM ELECTRONICS DIV-TUNG-SOL ELECTRIC IN  
630 W MT PLEASANT AVE LIVINGSTON N J
- CHATILLON SONS JOHN  
85 CLIFF ST NEW YORK N Y
- CHEMALLOY ELECTRONICS CORP  
GILLESPIE AIRPORT SANTEE CALIF
- CHEMCUT DIV CENTRE CIRCUITS INC  
BOX 799 STATE COLLEGE PA
- CHEM ELECTRO RESEARCH INC  
14706 ARMINA ST VAN NUYS CALIF
- CHEMICAL COMMERCE  
123 SUSSEX AVE NEWARK N J
- CHEMICAL DEVELOPMENT CORP  
ENDICOTT ST DANVERS MASS
- CHEMICAL ELECTRONIC ENG  
PO BOX 203 MATAWAN NJ
- CHEMICAL PLATING CO  
120 BRUCE AVE STRATFORD CONN
- CHEMPLAST INC  
3 CENTRAL AVE EAST NEWARK NJ
- CHEMTRONIC CORP  
2950 POSTER CREIGHTON DR NASHVILLE TENN
- CHERRY ELECT PROD CORP  
1650 DEERFIELD RD HIGHLAND PARK ILL
- CHESAPEAKE INSTRUMENT CORP  
SHADYSIDE MD
- CHESTER CABLE CORP  
CHESTER N Y
- CHET ENGINEERING CO  
8140 ORION VAN NUYS CALIF
- CHICAGO AERIAL INDUSTRIES  
BARRINGTON ILL
- CHICAGO CONDENSER CORP  
3255 W ARMITAGE AVE CHICAGO ILL
- CHICAGO DYNAMIC INDUSTRIES INC  
1725 DIVERSEY BLVD CHICAGO 14 ILL
- CHICAGO ELECTRONIC ENGG CO  
3223 W ARMITAGE AVE CHICAGO 47 ILL
- CHICAGO GASKET CO  
1271 W NORTH AVE CHICAGO 22 ILL
- CHICAGO MINIATURE LAMP WORKS  
4435 RAVENSWOOD AVE CHICAGO ILL
- CHICAGO RIVET & MACHINE CO  
950 S 25 AVE BELLWOOD ILL
- CHICAGO SCREW CO DIV STANDARD SCREW CO  
2701 WASHINGTON BLVD BELLWOOD ILL
- CHICAGO TELEPHONE OF CALIF  
1010 SYCAMORE AVE S PASADENA CALIF
- CHICAGO TELEPHONE O FCALIF INC  
105 PASADENA AVE BOX 269 S PASADENA CALIF
- CHICAGO THRIFT ETCHING  
1555 N SHEFFIELD AVE CHICAGO ILL
- CHICOPEE MILLS  
47 WORTH ST NEW YORK N Y
- CHISHOLM INDUST LTD  
ELECT AVE PORT MOODY B C CANADA
- CHOMERICS INC  
341 VASSAR ST CAMBRIDGE MASS
- CHRISTIAN PRECISION MFG  
12TH & FEDERAL STS CAMDEN N J
- CHRISTIE ELECTRIC CORP  
3410 W 67 ST LOS ANGELES 43 CALIF
- CHROMALLOY CORP  
WEST NYACK NY
- CHRONO LOG CORP  
2583 WEST CHESTER PIKE BROOMALL PENNA
- CHRYSLER CORP MISSILE DIV  
P O BOX 2628 DETROIT MICHIGAN
- CHU ASSOCIATES  
BOX 387 WHITCOMB AVE LITTLETON MASS
- CICOIL CORP  
13833 SATICOY ST VAN NUYS CAL
- CIMCO WIRE & CABLE CO  
303 CRESCENT AVE ALLENDALE N J
- CIMRON CORP  
1152 MORENA BLVD SAN DIEGO CALIF
- CINAUDAGRAPH INC  
7334 N CLARK ST CHICAGO 26 ILL
- CINCH MFG CO CINCH JONES DIV  
1026 S HOMAN AVE CHICAGO ILL
- CINCINNATI CLEANING & FINISHING MACHINERY CO  
SHARONVILLE OHIO
- CINCINNATI CLEANING & FINISHING MACHINERY  
1100 HAGEMAN ST CINCINNATI OHIO
- CINN MILLING MACH CO CIMASTRA DIV  
4752 MARBORGH CINCINNATI OHIO
- CINCINNATI MILLING MACHINE CO  
MARSBURG AVE CINNATI DHTO
- CINCINNATI SHAPER CO  
BOX 111 CINN OHIO
- CINCINNATI SUB-ZERO PRODUCTS  
3932 READING RD CINCINNATI 29 OHIO
- CINCINNATI TIME RECORDER CO  
1733 CENTRAL AVE CINCINNATI 14 OHIO
- CINEMA ENGINEERING DIV AEROVOX CORP  
1100 CHESTNUT ST BURBANK CALIF
- CINEMATIC DEVELOPMENTS CO  
P O BOX 151 MENA ARKANSAS
- CIRCON COMPONENTS CORP  
SANTA BARBARA MUNICIPAL AIRPORT GOLETA CAL
- CIRCUIT INSTRUMENT DIV INTL RESISTANCE CO  
2801 72ND ST N ST PETERSBURG FLA
- CIRCUITRYNE CORP  
480 MERMAID ST LAGUNA BCH CALIF
- CIRCUITS INC  
1445 TOLLAND TPK MANCHESTER CONN
- CIRCUIT STRUCTURES LAB  
2414 S BROADWAY SANTA ANA CALIF
- CITY CHEMICAL CORP  
132 W 22 ST NEW YORK N Y
- CITY MARKING DEVICES CORP  
69 MURRAY ST NEW YORK N Y
- C-THRU RULER CO  
827 WINDSOR ST HARTFORD CONN
- CK COMPONENTS INC  
101-103 MORSE ST NEWTON 58 MASS
- CLAIREX CORP  
8 W 30ST NEW YORK N Y
- CLARAGE FAN CO  
KALAMAZOO MICH
- C P CLARE & CO  
3101 W PRATT BLVD CHICAGO 45 ILL
- CLARE & CO P J  
FAIRVIEW N C
- CLARE CERAMICS INC  
E MAIN ST CARY ILL
- CLARK CONTROLLER CO  
1146 E 152 ST CLEVELAND OHIO
- CLARK CONTROLLER CO  
4755 E 49TH ST LOS ANGELES CALIF
- CLARK CRYSTAL CO  
2 FARM RD MARLBORO MASS
- CLARK ELECTRONIC LABS  
BOX 165 PALM SPRINGS CALIF
- CLARKE H JOY CO  
27003 KNICKERBOCKER RD BAY VILLAGE OHIO
- CLARK SEMICONDUCTOR CORP  
WALNUT AVE CLARK N J
- CLARKSON LABORATORIES INC  
1450 FERRY ST CAMDEN N J
- CLAROSTAT MFG CO  
WASHINGTON ST DOVER N H
- CLARY CORP  
408 JUNIPERO ST SAN GABRIEL CALIF
- CLAUSS CUTLERY CO  
223 PROSPECT ST FREMONT OHIO
- CLEAR BEAM ANTENNA CORP  
21341 ROSCOE BLVD CANOGA PARK CALIF
- CLEARTONE REPRODUCTION CORP  
23-14 122ND ST COLLEGE POINT N Y
- CLEGG LABS DIV CLEGG INC  
RT 53 MT TABOR N J
- CLEVELAND CONTAINER CO  
6201 BARRERTON AVE CLEVELAND 2 OHIO
- CLEVELAND ELECTRONICS INC  
1974 E 61ST ST CLEVELAND 3 OHIO
- CLEVELAND FABRICATING CO  
7424 BESSEMER AVE CLEVELAND OHIO
- CLEVELAND GRAPHITE BRONZE DIV CLEVITE CORP  
CALDWELL OHIO
- CLEVELAND INSTRUMENT CO  
6220 E SCHAFF RD CLEVELAND 31 OHIO
- CLEVELAND METAL SPEC CO  
1783 E 21 ST CLEVELAND OHIO
- CLEVELAND METAL SPECIALTIES CO  
15516 INDUSTRIAL PKWY CLEVELAND OHIO
- CLEVELAND WELDS PLANT  
1133 E 152 ST CLEVELAND OHIO
- CLEVITE ELECT COMPONENTS DIV CLEVITE  
232 FORBES RD BEDFORD OHIO
- CLEVITE HARRIS PRODS INC  
LOCKWOOD RD MILAN OHIO
- CLEVITE ORONANCE DIV CLEVITE CORP  
540 E 105TH ST CLEVELAND 8 OHIO
- CLEVITE ORONANCE DIV CLEVITE CORP  
232 FORBES RD BEDFORD OHIO
- CLEVITE TRANSISTOR PALO ALTO PLT  
1801 PAGE MILL RD PALO ALTO CALIF
- CLEVITE TRANSISTOR  
200 SMITH ST WALTHAM MASS
- CLIFTON PRECISION PRODUCTS CO INC  
BROADWAY AT MARPLE CLIFTON HGTS PA
- CLIFTON PRECISION  
COLORADO SPRINGS COLO
- CLIMET INSTRUMENTS INC  
570 SAN XAVIER AVE SUNNYVALE CALIF
- CLIPPARD INSTRUMENT LAB  
7390 COLERAIN AVE CINN OHIO
- CLIPPARD INSTRUMENT INC  
513 E WASH ST PARIS TENN
- CLOUGH BRENGLE CO  
6014 BROADWAY CHICAGO ILL
- CLOVER INDUSTRIES INC  
578-588 YOUNG ST TONAWANDA N Y
- CLOWES CERAMICS CORP  
3711 CALHOUN AVE CHATTANOOGA TENN
- CLUM MFG CO  
611 NATIONAL MILWAUKEE WISC
- CLY DEL MFG CO INC  
P O BOX 1367 WATERBURY 20 CONN
- C M MFG & MACHINRY CO  
103 DEWEY ST BLOOMFIELD NJ
- CO ENGINEERING CO  
P O BOX 194 BOONTON N J
- COAST COIL CO  
5333 W WASHINGTON BLVD LOS ANGELES CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

COAST PRO-SEAL & MFG CO  
2235 BEVERLY BLVD LOS ANGELES 57 CALIF

COAX DEVICES  
BDX 5 CHELSEA 50 MASS

COAXIAL COMPONENTS CORP  
391 LUOLOW ST STAMFORD CONN

COREHN INC  
PASSAIC AVE CALDWELL N J

COGNITRONICS CORP  
549 PLEASANTVILLE RD BRIARCLIFF MANOR N Y

COHAN EPNER CO  
142 W 14 ST NEW YORK 11 N Y

COHU ELECTRONICS INC KIN TEL DIV  
5725 KEARNY VILLA RO SAN DIEGO CALIF

COHU ELECTRONICS INC MASSA DIV  
280 LINCOLN ST HINGHAM MASS

COIL COMPANY OF AMERICA  
212 WASHINGTON ST NDRTHVALE N J

COIL ENG & MFG  
MARKLE IND

COIL ENG & MFG CO  
ROANOKE IND

COIL WINDING EQUIP CO  
RAILROAD PLAZA OYSTER BAY N Y

COILCRAFT INC  
CARY ILL

COILS ELECTRONICS CO  
2939-49 N 2ND ST PHILA PA

COLBER CORP  
26 BUFFINGTON ST IRVINGTON 11 N J

COLE RADIO WORKS  
84 WESTVILLE AVE CALDWELL N J

COLEMAN CABLE & WIRE CO  
1900 N RIVER RO RIVER GROVE ILL

COLEMAN ELECTRONIC SYSTEMS  
3210 CENTRAL AVE SANTA ANA CAL

COLEMAN ELECTRONICS INC  
133 EAST 162ND ST GARDENA CALIF

COLEMAN INSTRUMENTS INC  
42 MADISON ST MAYWOOD ILL

COLIN CAMPBELL CO INC  
MIRY BROOK RD DANBURY CONN

COLLECTRON CORP  
304 E 45TH ST NEW YORK 17 N Y

COLLINS CORP G L  
2820 E HULLETT ST LONG BEACH CALIF

COLLINS ELECTRONICS INC  
STEVENSVILLE MO

COLLINS MICROFLAT CO INC  
3249 W EL SEGUNDO BLVD HAWTHORNE CALIF

COLLINS RADIO CO  
1930 HILINE DR DALLAS 7 TEXAS

COLLINS RADIO CO OF CANADA LTD  
11 BERMONDSEY RD TORONTO ONT CAN

COLLINS RADIO CO  
19700 SAN JOAQUIN RD NEW PORT BEACH CALIF

COLLINS RADIO TEXAS DIV  
1200 ALMA RD RICHARDSON TEXAS

COLLINS RADIO CO  
315 2ND AVE S E CEDAR RAPIDS IOWA

COLLYER INSULATED WIRE CO  
249 ROOSEVELT AVE PAWTUCKET R I

COLMAN ELECTRONIC PRODUCTS INC  
1017 N E 3RD AVE AMARILLO TEX

COLONIAL ALLOYS CO  
RIDGE AVE & CRAWFORD STS PHILA PA

COLORADO INSTRUMENT INC  
GARDEN OFFICE CTR BROOMFIELD COLO

COLORADO RESEARCH CORP  
BROOMFIELD COLO

COLUMBIA ELECT MFG CO  
4519 HAMILTON AVE CLEVELAND OHIO

COLUMBIA METAL BOX CO  
260 E 143 ST NEW YORK 51 N Y

COLUMBIA PRODUCTS CO  
6625 SHAKESPEARE RD COLUMBIA S C

COLUMBIA PROD CO  
R F O 3 COLUMBIA S C

COLUMBIA TECHNICAL CORP  
24 30 BKLYN QUEENS WOODSIDE N Y

COLUMBIA RECORDS  
799 7 AVE NEW YORK N Y

COLUMBIA RESEARCH LABS  
MACOADE BLVD & BULLENS LA WOODLYN PA

COLUMBIA WIRE & SUPPLY CO  
2850 TRVING PARK RD CHICAGO ILL

COLUMBIAN CARBON CO MAPICO IRON OXIDE  
MONMOUTH JUNCTION N J

COLUMBIAN ROPE CO  
AUBURN NY

COLUMBUS ELECT MFG CO  
621 N HAMILTON RD

COLUMBUS ELECTRONICS CORP  
1000 SAW MILL RIVER RD YONKERS N Y

COLUMBUS PROCESS CO  
2851 SOUTHEASTERN AVE COLUMBUS IND

COLUMN MACHINE CO  
MOULTON ST GEORGETOWN MASS

COLVIN LABS INC  
364 GLENWOOD AVE E ORANGE N J

COMAR ELECTRIC CO  
3349 ADDISON ST CHICAGO 18 ILL

COMBINED ELECT INC  
4616 W 26TH ST CHICAGO ILL

COMCO PLASTICS INC  
9834 JAMAICA AVE RICHMOND HILL N Y

COMERFORD MFG CO  
880 S ROSE PL ANAHEIM CALIF

COMET LTD  
WALDEGGSTRASSE 72  
LIEBEFELD BERNE SWITZERLAND

COMMER PLASTICS & SUPPLY CO  
630 BROADWAY NEW YORK N Y

COMMERCIAL PLASTICS CO  
945 GEORGE ST CHICAGO ILL

COMMERCIAL RADIO SOUND CORP  
652 1 AVE NEW YORK N Y

COMMERCIAL RESINS DIV INTERPLASTICS CORP  
102 W FAIRFIELD AVE ST PAUL 7 MINN

COMMONWEALTH METAL CRAFTS  
NORTH AVE & AMORY STS WAKEFIELD MASS

COMMUNICATIONS CO  
300 GRECO AVE CORAL GABLES FLA

COMMUNICATION ACCESSORIES CO  
U S 50 HWY LEES SUMMIT MO

COMMUNICATION ASSOCIATES INC  
NEW HYDE PARK L I N Y

COMMUNICATION ELECTRONIC INC  
4908 HAMPDEN LN BETHESDA 14 MD

COMMUNICATION EQUIPMENT & ENGRG CO  
5646 W RACE AVE CHICAGO 44 ILL

COMMUNICATION MEASUREMENTS LABS  
350 LELAND AVE PLAINFIELD N J

COMMUNICATIONS ELECTRONICS CO  
2803 EIGHTH AVE W SEATTLE 99 WASH

COMMUNICATIONS PRODUCTS CO  
MARLBORO N J

COMMUNITY ENGG CORP  
BOX 824 STATE COLLEGE PA

COMPONENTS INC  
5MITH ST BIDEFORD MAINE

COMPONENTS FOR RESEARCH INC  
979 COMMERCIAL ST PALO ALTO CALIF

COMPACT CONTROLS CO INC  
1633 N HALSTED ST CHICAGO 14 ILL

COMPONENTS CORP  
106 MAIN ST DENVERILLE N J

COMPTON CORP  
778 PLEASANT ST BELMONT 79 MASS

COMPONENT RESEARCH CO INC  
3019 S ORANGE DR LOS ANGELES 16 CALIF

COMPUOYNE CORP  
HATBORO PENNA

COMPUTER CONTROL CO INC WESTERN DIV  
2251 BARRY AVE LOS ANGELES CALIF

CAMPAGNE GENERALE DE METROLOGIE  
ANNEXY HAUTE SAVOIE FRANCE

COMPUTER COMPONENTS INC  
88-06 VAN WYCK EXP JAMAICA 18 N Y

COMPUTER CONTROL CO INC EASTERN DIV  
983 CONCORD ST FRAMINGHAM MASS

COMPUTER DIODE CORP  
250 GARIBALDI AVE LOOI NJ

COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC  
1610 MAGNOLIA MONROVIA CALIF

COMPUTER EQUIPMENT CORP  
11612 OLYMPIC BLVD LOS ANGELES CALIF

COMPUTER INSTRUMENTS CORP  
92 MADISON AVE HEMPSTEAD N Y

COMPUTER LOGIC CORP  
11800W OLYMPIC BLVD LOS ANGELES 64 CALIF

COMPUTER MEASUREMENTS CO  
12970 BRADLEY AVE SYLMAR CALIF

COMPUTER PRODUCTS INC  
1717 F STREET S BELMAR N J

COMPUTER SYSTEMS INC  
CULVER RD NONMOUTH JUNCTION N J

COMPUTER TEST CORP  
RTE 38 & LONGWOOD AVE CHERRY HILL N J

COMPUTING DEVICES OF CANADA LTD  
P O BOX 508 OTTAWA ONTARIO CANADA

COM TRONICS INC  
3409 VENICE BLVD LOS ANG CALIF

CON-ELCO  
1711 S MOUNTAIN AVE MONROVIA CALIF

CONANT LABS  
BOX 3997 BETHANY STA LINCOLN 5 NEBR

CONAP INC  
184 E & UNION ST ALLEGANY N Y

CONAX CORP  
2300 WALDEN AVE BUFFALO N Y

CONCO  
300 GRECO CORAL GABLES FLA

CONDENSER PROD DIV NEW HAVEN CLOCK & WATCH  
BOX 1046 BROOKSVILLE FLA

CONDOR ELECTRONICS INC  
620 ORVIS ST SAN JOSE CALIF

CONDUCTORLAB INC  
GROTON MASS

CONFORMING MATRIX CORP  
830 NEW YORK AVE TOLEDO 11 OHIO

CONLEY ELECTRONICS CORP  
8225 CHRISTIANA AVE SKOKIE ILL

CONN LTD C G  
555 E JACKSON BLVD ELKHART IND

CONN MARINE INSTRUMENT CO  
ESSEX CONN

CONN VALLEY ENTERPRISES  
P O BOX 188 ESSEX CONN

CONN-CRAFT CO  
301 FAIRLAWN AVE WATERBURY 5 CONN

CONNECTICUT ELECTRONIC PROD  
18 LAKE ST MERIDEN CONN

CONN HARD RUBBER CO  
P O BOX 1911 NEW HAVEN 9 CONN

CONNECTICUT HARD RUBBER CO  
407 EAST ST NEW HAVEN CONN

CONNECTICUT INSTRUMENT CORP  
80 DANBURY RD WILTON CONN

CONNECTICUT VALLEY CHEMICALS INC  
49 W 57TH ST NEW YORK 19 N Y

CONNECTOR CORPORATION OF AMERICA  
12959 SHERMAN WAY N HOLLYWOOD CALIF

CONNECTOR CORP  
6027 N KEYSTONE AVE CHICAGO 30 ILL

CONNOLLY & CO WALLACE E  
PO BOX 295 MENLO PARK CALIF

CONNOR SPRING MFG CO  
390L S BROADWAY PL LOS ANGELES 37 CALIF

CONOFLOW CORP  
2100 ARCH ST PHILA PENNA

CONRAC INC  
19217 E FODTHILL BLVO GLENDORA CALIF

CONRAD CARSON ELECTRONICS INC  
1347 BROADWAY EL CAJON CAL

CONRAD & MOSER  
2 BORDEN AVE LONG ISLAND CITY 1 N Y

CONRAD INC  
141 JEFFERSON ST HOLLAND MICH

CONSOLIDATED AIRBORNE SYSTEMS INC  
900 3RD AVE NEW HYDE PARK N Y

CONSOLIDATED AVIONICS CORP  
80D SHAMES DR WESTBURY N Y

CONSOLIDATED CERAMICS & METALIZING CORP  
FLEMINGTON N J

CONSOLIDATED CONTROLS CORP  
4 DURANT AVE BETHEL CONN

CONSOLIDATED DIESEL ELECTRIC CORP  
880 CANAL ST STAMFORD CONN

CONSOLIDATED ELECT CORP  
360 SIERRA MADRE VILLA PASADENA CALIF

CONSOLIDATED ELECTODYNAMICS CORP  
1775 MT READ BLVO ROCHESTER N Y

CONSOLIDATED MINING SMELTING OF CANADA LTD  
TRAIL BC CANADA

CONSOLIDATED MOLDED PRODUCTS CORP  
309 CHERRY ST SCRANTON 2 PENNA

CONSOLIDATED REACTIVE METLS INC  
115 HOYT ST MAHARONECK N Y

CONSOLIDATED RESISTANCE CO OF AMERICA  
44 PROSPECT ST YONKERS 1 N Y

CONSOLIDATED SYSTEMS CORP  
1500 S SHAMROCK AVE MONROVIA CALIF

CONSOLIDATED VACUUM CORP  
1775 MT READ BLVD ROCHESTER N Y

CONSOLIDATED WIRE & ASSOCIATED COS  
1635 S CLINTON ST CHICAGO 16 ILL

CONSTANTA CO OF CANADA LTO  
280 REGINA AVE MONTREAL CANADA

CONSTANTIN CO L L  
ROUTE 46 LOOI NJ

CONTACT INC  
BOX 6 HUDSON N HAMPSHIRE

CONTACTS INC  
1100 SILAS DEANE HWY WETHERSFIELD 9 CONN

CONTINENTAL CONNECTOR CORP  
34-63 56 ST WOODSIDE 77 NY

CONTINENTAL OVEICE CORP  
12515 CHAORON AVE HAWTHORNE CALIF

CONTINENTAL-DIAMONO FIBRE CORP  
NEWARK DELA

CONTINENTAL ELECTRIC CO  
325 FERRY ST NEWARK 5 N J

CONTINENTAL ELECTRONICS CORP  
2724 LEONIS BLVD LOS ANGELES 58 CALIF

CONTINENTAL ELECTRONICS CORP  
302 OAKLANO ST BROOKLYN 22 N Y

CONTINENTAL ELECTRONIC MFG CO  
85 LING TEMCO-VOUGHT INC

4212 S BUCKNER BLVO DALLAS TEXAS

CONTINENTAL ELECT CORP OF CALIF  
LOS ANGELES CALIF

CONTINENTAL PRECISION PROD  
1026 E 179TH ST NEW YORK N Y

CONTINENTAL SCREW CO  
459 MT PLEASANT ST NEW BEDFORD MASS

CONTINENTAL SENSING INC  
1960 N RUBY ST MELROSE PARK ILL

CONTINENTAL TECHNICAL SERVICE INC  
19 W FOURTH ST OAYTON OHIO

CONTINENTAL WIRE CORP  
322 N CHERRY ST WALLINGFORD CONN

CONTINENTAL X RAY CORP  
1536 N CLYBOURN AVE CHICAGO ILL

CONTINENTAL-WIRT ELECTRONICS CORP  
5221 GREENE ST PHILA 44 PA

CONTROL CIRCUITS INC  
66 MARLBOROUGH ST PORTLAND CONN

CONTROL CORP  
718 CENTRAL AVE NE MINNEAPOLIS 14 MINN

CONTROL DATA CORP  
501 PARK AVE MINN MINN

CONTROL DEVICES  
925 S ETON BIRMINGHAM MICH

CONTROL DYNAMICS  
7420 FULTON AVE N HOLLYWOOD CALIF

CONTROL ELECT CO INC  
10 STEPAR PLACE HUNTINGTON STA N Y

CONTROL EQUIPMENT CORP  
19 KEARNEY RD NEEDHAM HEIGHTS 94 MASS

CONTROL LOGIC INC  
11 MERCER RD NATICK MASS

CONTROLLEO ATMOSPHERE ENCLOSURES MFG CO  
P O BOX 615 ORANGE CALIF

CONTROLLED ATMOSPHERE ENCLOSURES MFG CO  
1061 E 8 ST JACKSONVILLE FLA

JERVIS B WEBB CO CONTROL ENG CO DIV  
8900 ROSELAWN DETROIT MICH

CONTROL INDICATING CORP  
BRADLEY FIELD WINDSOR LOCKS CONN

CONTROL MFG CO  
ST PAUL MINN

CONTROLMAG LABS  
2459 SUSQUEHANNA RD ROSLYN PA

CONTROL PRODUCTS INC  
280 RIDGEDALE AVE E HANOVERIA N J

CONTROL SCIENCE CORP  
5150 DUKE STREET ALEXANDRIA VIRGINIA

CONTROL SWITCH DIV CONTROLS CO OF AMERICA  
4218 W LAKE ST CHICAGO 24 ILL

CONTROL SWITCH DIV CONTROLS CO OF AMERICA  
DELMAR DR FOLCROFT PA

CONTROL TECHNOLOGY CO  
41 16 295T L I C NEW YORK

CONTROLIER CORP  
DAVENPORT FLA

# ELECTRONIC MANUFACTURERS—A TO Z

CONTROLS CO OF AMER ELECTRON DV  
811 W BROADWAY BOX 937 TEMPE ARIZ

CONTROLS CO OF AMER  
2450 N 32 ST MILWAUKEE WISC

CONTROLS FOR RADIATION INC  
130 ALEWIFE BROOK PKWY CAMBRIDGE 40 MASS

CONTRONICS IN  
43 LEON ST BOSTON MASS

CONVAIR ASTRONAUTICS  
BOX 1128 SAN DIEGO 17 CALIF

COOK BATTERIES  
3850 OLIVE ST DENVER COLO

COOK CO FRANK R  
3850 OLIVE ST DENVER 7 COLO

COOK CO KEN  
9929 W SILVER SPRING RD MILWAUKEE 18 WISC

COOK ELECTRIC CO DATA STOR DIV  
8100 N MONTICELLO AVE SKOKIE ILL

COOK ELECTRIC CO NUCLEDYNE DIV  
3412 RIVER RD FRANKLIN PARK ILL

COOK ELECT CO WIRECOM DIV  
2700 N SOUTHPORT AVE CHICAGO ILL

COOK RESEARCH LABS  
P O BOX 696 MENLO PARK CALIF

COOK TECHNOLOGICAL CENTER DIV  
6401 OAKTON ST MORTON GROVE ILL

COOL FIN ELECTRONICS CORP  
1717 N POTRERO AVE S EL MONTE CALIF

COOPER CO D C  
1467 S MICHIGAN AVE CHICAGO 5 ILL

CO-OPERATIVE INDUSTRIES INC  
100 OAKDALE RD CHESTER NJ

COOPERTRONIX  
939 INDUSTRIAL PALO ALTO CALIF

COORS PORCELAIN CO  
600 9TH ST GOLDEN COLO

COOPER & SONS INC JOSEPH B  
180 VARICK ST NEW YORK N Y

COPPERWELD STEEL CO FLEXO WIRE DIV  
70 W FIRST ST OSWEGO N Y

COPPUS ENGRG CORP  
344 PARK AVE WORCHESTER MASS

COPYMATION INC  
5650 N WESTERN AVE CHICAGO 45 ILL

CORBETT SCIENCE LABS F W  
3115 VENICE BLVD LOS ANG CALIF

CORBIN CORP  
76 PRIMROSE LA LEVITTOWN NJ

CORDIN CO THE  
226 W HAVEN AVE SALT LAKE CITY 15 UTAH

CORDO CHEMICAL CORP  
34 SMITH ST NORWALK CONN

CORE TRONICS INC  
241 N DAY ST ORANGE N J

CORNELL-DUBILIER ELECTRIC CORP  
4144 GLENCOE AVE VENICE CALIF

CORNELL-DUBILIER ELECT DIV  
921 PROVIDENCE HWY NORWOOD MASS

CORNELL-DUBILIER ELECTRIC CORP  
1605 RODNEY FR BLVD NEW BEDFORD MASS

CORNELL DUBILIER ELECTRONICS DIV  
118 E JONES ST FUQUAY SPRINGS NC

CORNELL-DUBILIER ELECTRONICS DIV SANFORD PLT  
2652 DALRYMPLE BOX 2070 SANFORD NO CAR

CORNELL DUBILIER ELECTR DIV  
289 W RIVER ST PROVIDENCE 4 R I

CORNING GLASS WORKS  
CORNING N Y

CORNING GLASS WORKS ELECTRICAL PRODUCTS DIV  
HOUGHTON PARK CORNING NY

CORNING GLASS WORKS  
RALEIGH N C

CORNISH WIRE CO DIV GENERAL CABLE CORP  
730 3RD AVE NEW YORK 17 N Y

CORONA ENGG SERVICE  
94 52 CORONA AVE ELMHURST N Y

CORRIGAN COMMUNICATIONS INC  
3015 S KILSON DR SANTA ANA CALIF

CORRUGATED PAPER PRODUCTS  
2233 UTICA AVE BROOKLYN 34 N Y

CORSON ELECTRIC MFG CORP  
WATROUS ST E HAMPTON CONN

CORSON ELECTRIC MFG CORP  
540 39 ST UNION CITY N J

COSMIC INC  
3206 GRACE ST WASHINGTON D C

COSMIC RADIATION LABS  
1645 MONTAUK HWY BELLPORT N Y

COSMIC RADIO CORP  
853 WHITTIER ST NEW YORK 59 N Y

COSMO PLASTICS CO  
3239 W 14 ST CLEVELAND OHIO

COTO COIL CO  
65 PAVILION AVE PROVIDENCE R I

COTTRELL PAPER CO INC  
888 PURCHASE ST FALL RIVER MASS

COUCH ORDNANCE INC  
3 ARLINGTON ST N QUINCY MASS

COURTIER PROD DIV MODEL ENGG & MFG INC  
N LAKE ST BOYNE CITY MICH

COUSINO ELECT CORP  
1941 FRANKLIN AVE TOLEDO OHIO

COVEL MFG CO  
P O BOX 116 BENTON HARBOR MICH

COX & CO  
115 E 23 ST NEW YORK 10 N Y

COX INSTRUMENTS DIV GEORGE C NANKERVIS CO  
15300 FULLERTON AVE DETROIT MICH

CP ELECTRONICS INC  
2851 SOUTHEASTERN AVE COLUMBUS IND

CRAFT LABS  
209 AYLIFFE AVE WESTFIELD N J

CRAIG SYSTEMS INC  
360 MERRIMACK ST LAWRENCE MASS

CRAMER DIV GIANNINI CONTROLS CORP  
CENTERBROOK CONN

CRANE ELECTRONICS CO  
1401 FIRESTONE SANTA BARB A P GOLETA CAL

CRANE PACKING CO  
6400 OAKTON ST MORTON GROVE ILL

CRANE SYST & CONTROLS GROUP  
HOOKSETT INDUST PARK MANCHESTER N H

CRATEX MFG INC  
1600 ROLLINS RD BURLINGAME CALIF

CRESCENT CO  
20 CENTRAL AVE PAWTUCKET R I

CRESCENT COMMUNICATIONS CORP  
43 HEMPSTEAD ST N LONDON CONN

CRESCENT ENGG & RESEARCH CO  
5440 N PECK RD EL MONTE CALIF

CRESCENT EAST ENGR & RES CO  
363 W GLENSIDE AVE GLENSIDE PA

CREST ULTRASONICS CORP  
MERCER CTY AIRPORT TRENTON 8 N J

CRITTENDEN TRANSFORMER WORKS  
13011 S SPRING ST LOS ANG CALIF

CRITTENDEN TRANSFORMER WORKS  
1220 N ADEAU ST LOS ANG CALIF

CRONAME INC  
6283 HOWARD ST CHICAGO ILL

CROSS CO H  
3229 BERGENLINE AVE UNION CITY N J

CROUSE HINDS CO  
BOX 131 SYRACUSE NY

CROVEN LTD  
500 BEECH ST WHITBY ONT CANADA

CROWN CONTROLS CORP  
40 44 S WASHINGTON NEW BREMEN OHIO

CROWN ENG DIV DATA TECH INC  
3821 COMMERCIAL N E ALBUQUERQUE NEW MEXICO

CROWN INTL DIV INTL RADIO & ELECT CORP  
1718 HISHAWKA RD ELKHART IND

CROWN TOOL & INST INC  
810 N CASS ST WABASH IND

CROYOGENICS INC  
STAFFORD VA

CRUCIBLE STEEL CO OF AMERICA  
P O BOX 2518 PITTSBURGH 30 PENNA

CRYONETICS CORP  
NORTHWEST IND PK BURLINGTON MASS

CRYO THERM INC  
FOGELSVILLE PA

CRYSTAL RESEARCH PRODUCTS  
W MADSON & PROSPECT AVE DUMONT NJ

CRYSTALONICS INC  
249 5TH ST CAMBRIDGE MASS

CRYSTALONICS INC SEMICONDUCTOR PRODS  
147 SHERMAN ST CAMBRIDGE 40 MASS

CRYSTAL-X CORP  
SECOND & PINE STS DARBY PA

CRYS TECH INC  
1534 E CHESTNUT ST SANTA ANA CALIF

CTS CORP  
ELKHART IND

CTS INC  
P O BOX 152 BERNE IND

CTS OF ASHEVILLE INC  
MILLS GAP ROAD SKYLAND NORTH CAROLINA

CTS OF CANADA LTD  
80 THOMAS ST STREETSVILLE ONT CAN

CUBEX CO  
3322 TONIA AVE ALTADENA CALIF

CUBIC CORP  
5575 KEARNY VILLA RD SANDIEGO CALIF

CULBERTSON PRODUCTS INC  
25 SAMSON AVE MADISON N J

CUMMINS CHICAGO CORP  
4740 RAVENSWOOD CHICAGO ILL

CUMMINS PORTABLE TOOLS DIV JOHN OSTER MFG CO  
5055 N LYDELL AVE MILWAUKEE 17 WISC

CUNNINGHAM INDUST INC  
56 HUBBARD AVE STAMFORD CONN

CUNNINGHAM SON & CO INC JAMES  
HONEYE FALLS N Y

CUNNINGHAM SONS & CO JAMES  
33 LITCHFIELD ST ROCHESTER N Y

CURRY ARTS  
522 GREEN RIDGE ST SCRANTON PENNA

CURTIS DEVELOPMENT & MFG CO  
3218 N 33 ST MILWAUKEE 16 WISC

CURTIS DEVELOPMENT & MFG CO  
3276 N 33RD ST MILWAUKEE 16 WISC

CURTIS INSTRUMENTS INC  
351 LEXINGTON AVE MT KISCO N Y

ELECTRONICS DIV CURTISS WRIGHT  
E PATERSON N J

CURTISS WRIGHT CORP  
9733 COORS RD NW BX 10044 ALBUQUERQUE N M

CURTISS-WRIGHT CORP ELECTRONICS DIV  
35 MARKET ST EAST PATERSON NJ

CURTISS-WRIGHT CORP WRIGHT AERONAUTICAL DIV  
WOOD RIDGE NJ

CUSH CRAFT  
621 HAYWARD ST MANCHESTER N H

CUSTOM COMPONENTS INC  
P O BOX 248 CALDWELL N J

CUSTOM ELECT MFG CORP  
5009 E ADMIRAL PLACE TULSA OKLA

CUSTOM GEAR CO  
648 COLLEGE SOUTH BEND IND

CUSTOM PRODUCTS CORP  
606 LINDLEY ST BRIDGEPORT CONN

CUSTOM SCIENTIFIC INSTRUMENTS INC  
541 DEVON ST KEARNEY NJ

CUTLER HAMMER INC  
436 W 12 ST MILWAUKEE WISC

CUTLER METAL PRODUCTS CO  
1025 LINE ST CAMDEN N J

CYBETRONICS INC  
132 CALBARY ST WALTHAM MASS

CYCLE EQUIPMENT CO  
17480 SHELburne WAY LOS GATOS CALIF

CYCLE TRANSFORMER CORP  
356 GLENWOOD AVE ORANGE N J

## D

DACO INSTRUMENT CO  
TILLARY & PRINCE STS BROOKLYN 1 N Y

DAGE ELECTRIC CO  
HURRICANE RD FRANKLIN INDIANA

THOMPSON RAMO WOOLDRIDGE INC DAGE DIV  
W 10 ST MICHIGAN CITY IND

DAHLSTROM METALLIC DOOR CO  
BUFFALO 2 STS JAMESTOWN N Y

DAISLEY CO INC RAY  
585 W HOFFMAN AVE LINDENHURST N Y

DALE ELECTRONICS INC DIV OF LIONEL CORP  
BOX 488 COLUMBUS NEBR

DALE ELECTRONICS INC STOUX DV  
DIV OF LIONEL CORP YANKTON S D

DALES CO FRANKLIN  
185 E MILL ST AKRON OHIO

DALES MFG CO  
WABASSO FLA

DA-LITE SCREEN CO  
WARSAW IND

DALLONS LABS  
120 KANSAS ST EL SEGUNDO CALIF

DALLONS SEMICONDUCTORS DIV DALLONS LABS INC  
5066 SANTA MONICA BLVD LOS ANGELES 29 CAL

DALMO VICTOR CO DIV TEXTRON INC  
1515 INDUSTRIAL WAY BELMONT CAL

DALTRONICS INC  
100 MANTON AVE PROVIDENCE R I

DALWELD CO INC  
15 BERTEL AVE MT VERNON N Y

DAMON ENGINEERING INC  
240 HIGHLAND AVE NEEDHAM HEIGHTS 94 MASS

DAMON RECORDING STUDIOS  
117 W 14 ST KANSAS CITY 5 MO

DAMP CHASER INC  
BOX 1641 1404 SPARTANBURG HWY  
HENDERSONVILLE N CAROLINA

DANA LAB INC  
630 YOUNG ST SANTA ANA CALIF

DANIELS INC C R  
DANIELS MO

DANLY MACHINE SPECIALITIES INC  
2100 S LARAMIE AVE CHICAGO 50 ILL

DANLY MACHINE SPEC INC  
2100 S 54TH AVE CICERO ILL

DANO ELEC CO  
93 MAIN ST WINSTED CONN

DANTE ELECTRIC MFG CO  
BANTAM CONN

DARCO IND INC  
2151 ROSECRANS AVE EL SEGUNDO CALIF

DARE INC  
BOX 312 TROY OHIO

DATA CONTROL SYSTEMS INC  
E LIBERTY ST DANBURY CONN

DATA DISPLAY INC  
1820 COMO AVE ST PAUL MINN

OATA INSTRUMENTS  
12838 SATICOY N HOLLYWOOD CALIF

DATALOG DIVISION AIR LOGISTICS CORP  
2415 AMSLER ST TORRANCE CALIF

DATAMEC CORP  
345 MIDDLEFIELD RD MOUNTAIN VIEW CALIF

DATA SENSORS INC  
13112 CRENSHAW BLVD GARDENA CALIF

DATA SYSTEMS NORDEN OV UNITED AIRCRAFT  
3501 HARBOR BLVD COSTA MESA CALIF

DATA SYSTEMS INC  
20535 MACK AVE GROSSE POINTE WOODS MICH

DATA TECH  
238 MAIN ST CAMBRIDGE MASS

DATA TECHNOLOGY CORP  
BOX 10935 PALO ALTO CALIF

DATA TECHNOLOGY INC  
3821 COMMERCIAL NE ALBUQUERQUE N MEX

DATAMETRICS INC  
87 BEAVER ST WALTHAM MASS

DATAPULSE INC  
509 HINDRY AVE INGLEWOOD CALIF

DATASCAN INC  
P O BOX 785 CLIFTON N J

DATASTROBE CORP  
1275 BLOOMFIELD AVE W CALDWELL N J

DATA TRONIX CORP  
415 GREEN ST NORRISTOWN PA

DATX CORP  
1307 MYRTLE AVE MONROVIA CALIF

DATRAN DIV AUTO INDUST INC  
3501 LOMITA BLVD TORRANCE CALIF

DATRAX DIV W W HENRY CO  
4443 E SLAUSON AVE MAYWOOD CALIF

DAVEN CO  
ROUTE 10 LIVINGSTON NJ

DAVIDOFF CHARLES  
198 BROADWAY NEW YORK 38 NY

DAVIDSON OPTRONICS INC  
2223 ROMONA BLVD W COVINA CALIF

DAVIES HOLDING CO HARRY  
1428 WELLS ST CHICAGO ILL

DAVIES SUPPLY & MFG CO  
4160 HERAMEC ST ST LOUIS 16 MO

DAVIS & CO J W  
9212 DENTON DR DALLAS TEXAS



# ELECTRONIC MANUFACTURERS—A TO Z

DAVIS ELECTRIC CO  
230 SPRING AVE CAPE GIRARDEAU MO

DAVISON CHEMICAL CO  
BOX 488 POMPTON PLAINS N J

DAWE INSTRUMENTS LTD  
WESTERN AVE LONDON ENG

DAWELD CO INC  
13 BERTEL AVE MOUNT VERNON N Y

DAYMARC CORP  
180 BEAR HILL RD WALTHAM 54 MASS

DAY-RAY PRODUCTS INC  
1133 MISSION ST S PASADENA CALIF

DAYSTROM INC MILITARY ELECTRONICS DIV  
ARCHBALD PENNA

DAYSTROM INC TRANSICOIL DIV  
WORCESTER PA

DAYSTROM INC POTENTIOMETER DIV  
ARCHBALD PENNA

DAYSTROM INC CONTROL SYSTEMS DIV  
4455 MIRAMAR RD LAJOLLA CALIF

DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV  
614 FRELINGHUYSEN AVE NEWARK 12 N J

DAYSTROM TRANSISTOR CORP  
WORCESTER PENNA

DAYSTROM WESTON INDUST DIV DAYSTROM INC  
MANCHESTER RD POUGHKEEPSIE N Y

DAYTON AIRCRAFT PRODUCTS INC  
812 NW 1ST AVE FORT LAUDERDALE FLA

DAYTON AVIATION RADIO & EQUIP CO  
BOX 312 BUSINESS RT 25 TROY OHIO

DAYTON ELECT PROD CO INC  
117 EAST HELENA STREET DAYTON & OHIO

DAYTRONIC CORP  
223 227 JEFFERSON ST DAYTON OHIO

DBM RESEARCH CORP  
P O BOX 521 COCOA BEACH FLA

DEARBORN ELECTRONIC LABS INC  
P O BOX 3431 ORLANDO FLA

DEBELL & RICHARDSON INC  
WATER ST HAZARDVILLE CONN

DECCO INC  
2025 FARRINGTON DALLAS TEX

DECHERT DYNAMICS CORP  
PALMYRA PENNA

DECIBEL PRODUCTS INC  
3184 QUEBEC DALLAS TEXAS

DECIMETER PRODUCTS CO  
STAR ROUTE BOX 67 LITTLETON COLO

DECITRON ELECTRONICS CORP  
850 SHEPHERD AVE BROOKLYN 8 N Y

DECKER CORP  
45 MONUMENT RD BALA CYNWYD PENNA

DECO ELECTRONICS INC  
1000 CONNECTICUT AVE N W WASHINGTON D C

DECOURSEY ENGG LAB  
11828 W JEFFERSON BLVD CULVER CITY CALIF

DEE ELECTRIC CO  
1708 BELMONT AVE CHICAGO ILL

DEFIANCE PRINTED CIRCUIT CORP  
144 COMMERCIAL ST MALDEN MASS

DEITZ CO S J  
9 E WESLEY ST S HACKENSACK NJ

DEJUR-AMSCO CORP ELECTRONICS DIV  
45-01 NORTHERN BLVD LONG ISLAND CITY 1 N Y

DE LANDRI PRECISION ELEMENTS CO INC  
39 SCHOOL ST YONKERS N Y

DEL ELECTRONICS CORP  
521 HOMESTEAD AVE MT VERNON N Y

DELCO APPLIANCE DIV GMC  
P O BOX 230 ROCHESTER 1 N Y

DELCO RADIO DIV GMC  
700 FIRMIN ST KOKOMO IND

DELCO REMY DIV GENERAL MOTORS CORP  
2401 COLUMBUS AVE ANDERSON IND

DELCON CORP  
943 INDUSTRIAL AVE PALO ALTO CALIF

DELMAR ENG LAB  
6901 IMPERIAL HWY LOS ANG CALIF

DELMHORST INSTRUMENT CO  
601 CEDAR ST BOONTON N J

DELS TUMBLING SERVICE  
232 N ROSEMARY DEARBORN 6 MICH

DELSEN CORP  
719 W BROADWAY GLENDALE 4 CALIF

DELTA COILS INC  
1128 MADISON AVE PATERSON N J

DELTA DESIGN INC C O NON LINEAR SYSTEMS INC  
DEL MAR AIRPORT DEL MAR CAL

DELTA ELECT CO  
MARION IND

DELTA ELECTRONICS INC  
4206 WHEELER AVE ALEXANDRIA VA

DELTA F INC  
113 E STATE ST GENEVA ILL

DELTA SEMICONDUCTORS  
835 PRODUCTION PL NEWPORT BCH CALIF

DELTA SONICS INC  
12918 CERISE AVE HAWTHORNE CALIF

DELTA T SEMICONDUCTOR CO  
139 FOUNDRY ST WAKEFIELD MASS

DELTIME INC  
608 FAYETTE AVE MAMORONECK N Y

DELTRON CO INC  
14736 ARMINA ST VAN NUYS CALIF

DELTRON INC  
4TH & CAMBRIA STS PHILA PA

DELTRON INC  
2905 N LEITHGOW ST PHILADELPHIA 33 PA

DELUXE COILS INC  
HUNTINGTON IND

DELVATEX CORP  
34 PARKER AVE TRENTON 9 N J

DEMENT LABS  
1717 E 19TH AVE PORTLAND OREGON

DEMORNAY BONARDI CORP  
780 S ARROYO PKWY PASADENA CALIF

DENNISON MFG CO  
300 HOWARD ST FRAMINGHAM MASS

DENRAD MFG CO INC  
309 W WOODARD ST DENISON TEXAS

DENSON ELECTRONICS CORP  
P / BOX 122 ROCKVILLE CONN

DEPENDABLE PRINTED CIRCUIT CORP  
827 BLACK OAK RIDGE WAYNE NJ

DERBY LUMINESCENTS LTD OF LONDON ENG  
C/O UNITED MINERAL & CHEMICAL CORP  
16 HUDSON ST NEW YORK 13 NY

DERINGER METALLURGICAL CORP  
8131 MONTICELLO AVE SKOKIE ILL

DERO ELECTRONICS  
10 WOODS AVE ROOSEVELT NY

A L DERY & SONS TOOL & DIE CI  
MAIN ST PINE MEADOWS CONN

DESIGN TOOL CO  
1055 STEWART AVE GARDEN CITY N Y

DESMOND STEPHAN MFG CO  
BOX NO 30 URBANA OHIO

DESPATCH OVEN CO  
619 S E 8 ST MINNEAPOLIS MINN

DESTRON CO  
25914 CHALMETTE ROLLING HILLS EST CALIF

DE-TEC-TRONIC CORP  
2512 N HALSTED ST CHICAGO 14 ILL

DETROIT DESIGNING & ENG CO  
1429 MAGNOLIA LONG BEACH 13 CALIF

DETROIT HOIST & MACHINE CO  
8201 MORROW ST DETROIT 11 MICH

DETROIT POWER SCREWDRIVER CO  
2813 W FORT ST DETROIT MICH

DEUTSCH CO ELECTRONIC COMPONENTS DIV  
MUNICIPAL AIRPORT BANNING CALIF

DEUTSCH CO THE  
BLDG 74 KINSTON MUNICIPAL A/P KINSTON N C

DEVCO DIV R E PHELONCO INC  
70 MAPLE ST E LONGMEADOW MASS

DEVCO ENGG INC  
PIER LANE WEST CALDWELL N J

DEVELCO INC  
440 PEPPER ST PALO ALTO CALIF

DEVELOPMENT ASSOCIATES  
2600 DE LA VINA SANTA BARBARA CALIF

DEVELOPMENT ENGG CO  
9 CROSS ST NORWALK CONN

DEVELOPMENTAL ELECT CORP  
3340 W EL SEGUNDO BLVD HAWTHORNE CALIF

DEVISE DEVELOPMENT CORP  
428 BOSTON POST RD WESTON MASS

DEVISE SEALS INC  
11684 TUXFORD ST SUN VALLEY CALIF

DEV TEK INC  
5720 PRECISION RD ORLANDO FLA

DEWALD RADIO MFG CORP  
DIV OF UNITED SCIENTIFIC LABS  
35 15 37 TH AVE LONG ISLAND N Y

DEWEY & ALMY CHEMICAL CO  
6050 W 51 ST CHICAGO ILL

DEWITT DEVELOPMENT CO  
3008 W 127 ST BLUE ISLAND ILL

DI-ACRO CORPORATION  
300 8TH AVE LAKE CITY MINN

DIAL PRODUCTS CO  
19 COTTAGE ST BAYONNE N J

DIALIGHT CORP  
60 STEWART AVE BROOKLYN 37 N Y

DIAMOND ANTENNA & MICROWAVE CORP  
35 RIVER ST WINCHESTER MASS

DIAMOND CHAIN CO INC  
402 KENTUCKY AVE IND IND

DIAMOND COILS INC  
540 39 ST UNION CITY N J

DIAMOND POWER SPECIALTY CORP ELECTRONIC DIV  
BOX 415 LANCASTER OHIO

DIAMOND TOOL ENGG CO  
108 MASSACHUSETTS AVE BOSTON 15 MASS

DIAMOND TOOL & HORSESHOE CO  
4602 4706 GRAND AVE W DULUTH MINN

DIAMONITE PRODUCTS MFG CO  
DIV U S CERAMIC TILE CO SHREVE OHIO

DI-AN CONTROLS INC  
944 DORCHESTER AVENUE DORCHESTER MASS

DIAPHLEX DIV  
2700 N SOUTHPORT CHICAGO 14 ILL

DIATRON INC  
BOX 3426 BELLAIRE TEXAS

DICE CO J W  
16 HIGHWOOD AVE ENGLEWOOD N J

DICKSON ELECTRONICS CORP  
248 WELLS FARGO AVE SCOTTSDALE ARIZ

DICON CORP  
P O BOX 177 PORT WASHINGTON N Y

DICTAPHONE CORP  
375 HOWARD AVE BRIDGEPORT CONN

DIE-FORM CIRCUITS INC  
6045 W OGDEN AVE CHICAGO 50 ILL

DIEBEL DIE & MFG CO  
6505 OAKTON ST MORTON GROVE ILL

DI EHL MFG CO  
FINDERNE AVE SOMERCILLE N J

DIELECT INC  
CORAL ST BOX 44 FORDS N J

DIELECTRIC MATERIALS CO  
1811 W BRYN MAWR AVE CHICAGO ILL

DIELECTRIC PRODUCTS ENGG CO  
RAYMOND ME

DIELECTRIC PRODUCTS ENGG CO  
BRIDGETON ME

DIE TECH CORP  
29 MARBLE AVE PLEASANTVILLE N Y

DIETZ CO HENRY G INC  
12-16 ASTORIA BLVD LONG ISLAND CITY 2 N Y

DIETZ CO S J  
9 E WESLEY ST HACKENSACK N J

DIETZ DESIGN INC  
GRANDVIEW MO

DIGITAL DESIGN CORP  
BOX 21 CLAY N Y

DIGITAL DEVELOPMENT CORP  
7541 EADS AVE LA JOLLA CALIF

DIGITAL ELECTRONICS INC  
2200 SHAMES DR WESTBURY L I N Y

DIGITAL EQUIPMENT CORP  
146 MAIN ST MAYNARD MASS

DIGITAL SYSTEMS INC  
1008 E EDNA PLACE COVINA CALIF

DIGITECH INC  
382 DANBURY RD WILTON CONN

DIGITECH INC  
130 WATER ST S NORWALK CONN

DIGITOOOL CORP  
5300 BROADWAY RD HOUSTON TEXAS

DIGITRAN CO DIV ENDEVCO  
855 S ARROYO PARKWAY PASADENA CALIF

DIGITROL SYSTEMS INC  
TYRELL RD MILLBROOK N Y

DIGITRONICS CORP  
ALBERTSON AVE ALBERTSON L I N Y

DILECTRIX CORP  
ALLEN BLVD & GRAND AVE FARMINGDALE LI N Y

DILECTRON DIV BESTRAN CORP  
2669 S MYRTLE AVE MONROVIA CALIF

DILL PRODUCTS INC  
371 E MAIN ST NORRISTOWN PA

DILLON & CO INC W C  
14620 KESWICK ST VAN NUYS CALIF

DIMCO-GRAY CO  
207 E 6 ST DAYTON 2 OHIO

DIMENSIONS INC  
7314 20TH AVE BROOKLYN 4 N Y

DINION COIL CO  
CALEDONIA N Y

DIOTRON INC  
3650 RICHMOND ST PHILA PENNA

DIRIGO COMPASS & INSTRUMENT CO  
BOEING F111 BOX 37 SEATTLE WASH

DISC INSTRUMENTS INC  
3014 B SO HALLADAY ST SANTA ANA CALIF

DIT-MCO INC ELECTRONICS DIV  
911 BROADWAY KANSAS CITY MO

DI-TRAN CORPORATION  
11307 HINDRY AVE LOS ANGELES 45 CALIF

DITTMORE FREYMUTH CORP  
2517 E NORWICH ST MILWAUKEE WISC

DIXON CORP  
BURNSIDE BRISTOL R I

DIXON CRUCIBLE CO JOSEPH  
167 WAYNE ST JERSEY CITY 3 N J

DJORDJEVIC ENG CO  
1933 N DAMEN CHICAGO ILL

DKE ELECTRIC BASES CORP  
27 WRIGHT ST NEWARK NJ

DMETER MFG CO  
22 24 LARKIN PLAZA YONKERS N Y

THE DOALL CO  
254 N LAUREL AVE DES PLAINES ILL

DOCKENDORFF & CO INC  
606 LINDLEY ST BRIDGEPORT CONN

DODGE FIBERS CORP  
JOHN ST HOOSICK FALLS N Y

DOLIN METAL PRODUCTS INC  
315 LEX95706N AVE BROOKLYN N Y

DOLINKO & WILKENS INC  
1907 SUMMIT AVE UNION CITY N J

DON BOSCO ELECT SUB OF HOWELL ELECT MOTORSCO  
LITTELL RD HANOVER N J

DONGAN ELECTRIC MFG CO  
2987 FRANKLIN ST DETROIT MICH

DON LAN ELECTRONICS CORP SUB QUANTATRON INC  
2520 COLORADO AVE SANTA MONICA CAL

DONMAR PRODUCTS INC  
P O BOX 8396 DENVER 10 COLO

DONNELLY MFG CO  
580 WINTER ST WALTHAM MASS

DORE CO JOHN L  
PO BOX 7772 HOUSTON 7 TEX

DORMEYER CORP  
700 N KINGSBURY AVE CHICAGO ILL

DORMEYER INDUSTRIES  
3418 MILWAUKEE AVE CHICAGO 41 ILL

DORMEYER INDUSTRIES  
KENTLAND INDIANA

DORNE & MARGOLIN  
29 N Y AVE WESTBURY N Y

DORSETT ELECTRONICS  
119 W BOYD NORMAN OKLA

DOSS ELECTRONIC RES INC  
820 BALTIMORE AVE KANSAS CITY MO

DOSSERT MFG CORP  
249 HURON ST BROOKLYN 22 N Y

DOTCO INC  
HICKSVILLE OHIO

DOTY ACOUSTICAL ELECTRONIC LABS  
TOBYHANNA PENNA

DOUBLE E PRODUCTS CO  
208 STANDARD ST EL SEGUNDO CALIF

DOUGLAS ELECTRONICS  
1429 OREGON ST BERKELEY 2 CALIF

DOUGLAS MICROWAVE CO  
252 E 3 ST MT VERNON N Y

DOUGLAS ROESCH COMMUNICATIONS  
2727 SAN FERNANDO ROAD LOS ANGELES 65 CAL

DOW CORNING CORP  
BOX 592 MIDLAND MICH

DOW KEY CO  
P O BOX 711 THIEF RIVER FALLS MINN

DOW KEY CO INC  
RT 3 59 THIEF RIVER FALLS MINN

D & R PILOT PLANTS INC  
WATER ST HAZARDVILLE CONN



# ELECTRONIC MANUFACTURERS—A TO Z

DRAKE CO R L  
 540 RICHARD ST MIAMISBURG OHIO  
 DRAKE MFG CO  
 4626 N DCDTT AVE CHICAGO ILL  
 DRESSER BARNES CORP  
 250 N VINEDO AVE PASADENA CALIF  
 DRESSER ELECT SIE DIV  
 10201 WESTHEIMER RD HOUSTON TEXAS  
 DRESSER ELECTRIC CO  
 2705 WIGHT ST DETROIT 7 MICH  
 DRESSER ELECT HST DIV  
 555 N 55T GARLAND TEXAS  
 DRESSER-IDECO CO  
 8909 S VERMONT AVE LOS ANGELES 44 CALIF  
 DREXEL DYNAMICS CORP  
 MAPLE AVE HORSHAM PA  
 DRICO INDUSTRIAL CORP  
 100 8TH ST PASSAIC N J  
 DRIVER CO WILBUR B  
 1875 MCCARTER HWY NEWARK 4 N J  
 DRIVER HARRIS CO  
 HARRISON N J  
 DRY SCREEN PROCESS INC  
 1016 MADISON AVE PITTSBURGH 12 PA  
 DRYOMATIC CORP  
 BOX 591 715 FAYETTE ST ALEXANDRIA VA  
 DUBROW ELECTRONIC INDUSTRIES INC  
 235 PENN ST BURLINGTON N J  
 DU-CO CERAMICS CO  
 BOX 278 SAXONBURG PA  
 DUDEK & CO R C  
 407 MAPLE DR BEVERLY HILLS CALIF  
 DUKANE CORP  
 ST CHARLES ILL  
 DUMONT AIRPLANE & MARINE INSTRUMENT INC  
 PO BOX 92 CLEARFIELD PENNA  
 DUMONT LABS INC ALLEN B  
 75D BLOOMFIELD AVE CLIFTON NJ  
 DUMORE CO  
 1300 17TH ST RACINE WISC  
 DUNCAN ELECT INC  
 3865 FAIRVIEW RD COSTA MESA CALIF  
 DUNHAM-BUSH INC  
 W HARTFORD CONN  
 DUNLFE CORP  
 1023 S PUSCHECK RD BELLWOOD ILL  
 DUNN ENG CORP  
 38 HENRY ST CAMBRIDGE MASS  
 DUNTON CO MW  
 7 GOFF ST PROVIDENCE R I  
 DUOTONE CO  
 LOCUST ST KEYPORT N J  
 DU PONT DE NEMOURS & CO E I  
 WILMINGTON 98 DEL  
 DURA BUSINESS MACHINES INC  
 322000 STEPHENSON HWY MADISON HGTS MICH  
 DURAKOOL INC  
 1010 N MAIN ST ELKHART IND  
 DURALITH CORP  
 1025 RACE ST PHILADELPHIA 7 PA  
 DURAMARK INC  
 P O BOX 231 PORT WASHINGTON N Y  
 DURAMIC PRODUCTS INC  
 426 COMMERCIAL AVE PALISADES PARK N J  
 DURANT MFG CO  
 15 THURBERS AVE PROVIDENCE 5 RI  
 DURANT MFG CO  
 1912 N BUFFUM ST MILWAUKEE 1 WIS  
 DURANT MFG CO  
 12TH & CLARK STS WATERTOWN WISC  
 DURA PLASTICS OF N Y INC  
 49 RICHMONDVILLE AVE WESTPORT CONN  
 DURATRON CORP  
 154 W 14TH ST NEW YORK 11 NY  
 DUREZ PLASTIC DIV-HOOKER CHEMICAL CORP  
 1926 WALCK RD NORTH TONAWANDA N Y  
 DURO MATIC PRODUCTS CO  
 8509 HIGUERA ST CULVER CITY CAL  
 DURO SPECIALTY CO  
 811 BOSTON ST LYNN MASS  
 DWYER ELECTRONICS CO  
 AIRPORT RD BOX 452 NASHUA N HAMPSHIRE  
 DWYER MFG CO F W  
 P O BOX 373 MICHIGAN CITY IND  
 DX RADIO PRODUCTS CO  
 23DD W ARMITAGE AVE CHICAGO 47 ILL  
 DYMEC DIV OF HEWLETT PACKARD CO  
 395 PAGE MILL RD PALO ALTO CALIF  
 DYMO CORP  
 1476 66TH ST EMERYVILLE CALIF  
 DYNACO INC  
 3912 POWELTON AVE PHILA 4 PA  
 DYNACOR INC  
 10431 METROPOLITAN AVE KENSINGTON MD  
 DYNA-EMPIRE INC  
 1075 STEWART AVE GARDEN CITY L I N Y  
 DYNATR ELECTRONICS INC  
 7564 BROADWAY LEMON GROVE CALIF  
 DYNALECTRON CORP MATTERN DIV  
 7444 WILSON AVE CHICAGO 7 ILL  
 DYNAMETRICS CORP  
 NORTHWEST INDUST PARK BURLINGTON MASS  
 DYNAMIC AIR ENGG INC  
 7412 MAIE AVE LOS ANGELES 1 CALIF  
 DYNAMIC CONTROLS CO  
 2225 MASSACHUSETTS AVE CAMBRIDGE MASS  
 DYNAMIC GEAR CO INC  
 175 DIXON AVE AMITYVILLE N Y  
 DYNAMIC INSTRUMENT CORP  
 E BETHPAGE RD PLAINVIEW N Y  
 DYNAMIC MEASUREMENTS CO  
 DAVISVILLE & TERWOOD RD WILLOW GROVE PA  
 DYNAMICS INST CO  
 583 MONTEREY PASS RD MONTEREY PK CALIF  
 DYNAMU MAGNETRONICS CORP DIV MAICO ELECT INC  
 21 N 3 ST MINNEAPOLIS MINN

DYNAPAR CORP  
 437 E STEWART MILWAUKEE WISC  
 DYNAPLEX CORP  
 P O BOX 341 PRINCETON N J  
 DYNAPOWER SYSTEMS CORP  
 2222 S CENTINELA AVE LOS ANGELES 64 CALIF  
 DYNASCIENCES CORP  
 FORT WASHINGTON PA  
 DYNASONICS CORPORATION  
 200 MICHAEL DRIVE SYDSEY NY  
 DYNATRON LAB  
 553 E DAWSON DR CAMARILLO CALIF  
 DYNATRONIC INST CORP ELECTR DIV  
 LAB LINE INSTRUMENTS INC  
 307D W GRAND AVE CHICAGO 22 ILL  
 DYNATRONICS CABLE ENGG CORP  
 136 SAN FERNANDO RD LOS ANG CALIF  
 DYNATRONICS INC  
 P O BOX 2566 ORLANDO FLA  
 DYNAVOX CORP  
 40-90 21ST ST LONG ISLAND CITY 1 N Y  
 DYNEL INC  
 12923 S SPRING ST LOS ANG CALIF  
 DYNISCO DIV AMERICAN BRAKE SHOE CO  
 42 CARLETON ST CAMBRIDGE MASS  
 DYTRONICS CO  
 BOX 3676 COLUMBUS OHIO  
 DYTRONICS INC DIV OF TAYLOR CORP  
 ROCHESTER 53 MICHIGAN  
 DZUS FASTENER CO  
 125 UNION ST WEST ISLIP N Y

## E

EAGLE ELECTRIC MFG CO  
 2310 BRIDGE PLAZA 50 LONG ISLAND CITY 1 NY  
 EAGLE ELECTRIC MFG CO INC  
 2814-18 W FULLERTON AVE CHICAGO 47 ILL  
 EAGLE SIGNAL CO DIV GAMEWELL CO  
 202 20 ST MOLINE ILL  
 EAGLE-PICHER CO AMERICAN BLDG  
 AMERICAN BLDG CINCINNATI 1 OHIO  
 EALING CORP  
 33 UNIVERSITY RD CAMBRIDGE MASS  
 EASTERN AIR DEVICES  
 391 CENTRAL AVE DOVER N H  
 EASTERN CHEMICAL CORP  
 34 SPRING ST NEWARK N J  
 EASTERN ETCHING & MFG CO  
 GRAPE ST CHICOPEE MASS  
 EASTERN INDUSTRIES DIV OF L F E INC  
 100 SKIFF ST HAMDEN CONN  
 EASTERN SMELTING & REFINING CORP  
 109 W BROOKLINE ST BOSTON 18 MASS  
 EASTERN SPECIALTY CO  
 3617 N 8 ST PHILA 4D PA  
 EASTERN TECHNICAL ASSOC INC  
 MAIN ST NORTH ACTION MASS  
 EATON MFG CO DYNAMIC DIV  
 3122 14TH AVE KENOSHA WISC  
 EATON MFG CO RELIANCE DIV  
 25 CHARLES AVE SE MASSILLON OHIO  
 EBAUCHES A DEP SEMICONDUCTEURS  
 FAUBOURG HOPITAL NEUCHATEL SWITZERLAND  
 EBERLINE INSTRUMENT CORP  
 805 EARLY ST SANTA FE NEW MEXICO  
 EBERT ELECTRONICS CORP  
 212-26 JAMAICA AVE QUEENS VILLAGE 28 N Y  
 EBY CO H H  
 4700 GERMANTOWN AVE PHILADELPHIA 44 PA  
 EBY SALES CO  
 148-D5 ARCHER AVE JAMAICA 35 NY  
 ECKEL CORP  
 155 FANCETT ST CAMBRIDGE 38 MASS  
 ECKEL VALVE CO  
 1425 FIRST ST SAN FERNANDO CALIF  
 ECLIPSE ENG CO  
 226 S GLASGOW AVE INGLEWOOD CALIF  
 ECLIPSE-PIONEER DIV BENDIX CORP  
 TETERBORO N J  
 ECM CORP  
 816D ORION AVE VAN NUYS CALIF  
 EDAL INDUSTRIES INC  
 64 FRANKLIN ST NEW HAVEN 11 CONN  
 EDAL INDUSTRIES INC  
 4 SHORT BCH RD EAST HAVEN 12 CONN  
 EDCLIFF INSTRUMENTS  
 1711 S MOUNTAIN AVE MONROVIA CALIF  
 EDCO ENG & DEV CORP  
 2225 E FRANKLIN MINN MINN  
 EDER INSTRUMENT CO INC  
 2293 N CLYBOURN AVE CHICAGO ILL  
 EDERER ENGG CORP  
 2931 1ST AVE S SEATTLE WASH  
 EDGERTON GERMESHAUSEN & GRIER INC  
 BLDG 226 SANTA BARBARA AIRPORT GOLETA CAL  
 EDGERTON GERMESHAUSEN & GRIER  
 16D BROOKLINE AVE BOSTON MASS  
 EDISON INDUST THOMAS A INST DIV  
 45 LAKESIDE AVE W ORANGE N J  
 EDKO ELECTRONICS ENGG CO  
 397 BEDFORD AVE BROOKLYN 11 NY  
 E D L CO  
 BOX 2508 5929 DUNES HWY GARY IND  
 EDO CANADA LTD  
 BOX 97 CORNWALL ONT CANADA  
 EDO CORP  
 13 1D 111 ST COLLEGE POINT L I N Y

EDP CORPORATION  
 3501 SD ORANGE BLDDSSOM TRAIL DRLANDO FLA  
 EDROY PRODUCTS CO  
 480 LEXINGTON AVE NEW YORK N Y  
 EDUCATIONAL ELECTRONICS CO  
 1227 LOYOLA AVE CHICAGO 26 ILL  
 EFCON INCORP SUB GENERAL INST  
 GARDEN CITY L I N Y  
 EGAN LABORATORY  
 107-56 113TH ST RICHMOND HILL 19 N Y  
 E H RESEARCH LAB INC  
 163 ADELIN ST OAKLAND CALIF  
 EIDSON ELECTRONIC CO  
 1902 N 3 ST TEMPLE TEXAS  
 EISLER ENGG CO  
 750 S 13 ST NEWARK 3 N J  
 EISLER TRANSFORMER CO INC  
 24 N SALEM ST DOVER N J  
 EISLER TRANSFORMER CO INC  
 16 N SALEM ST DOVER N J  
 EITEL-MC CULLOUGH INC  
 301 INDUSTRIAL WAY SAN CARLOS CALIF  
 EITEL-MCCULLOUGH INC  
 798 SAN MATEO AVE SAN BRUNO CALIF  
 ELASCO INC  
 5 PRESCOTT ST RDXBURY 19 MASS  
 ELASTIC STOP NUT CORP OF AMERICA  
 2330 VAUXHALL RD UNION N J  
 ELASTIC STOP NUT CORP OF AMER  
 ELIZABETH DIVISION  
 1027 NEWARK AVE ELIZABETH 3 N J  
 ELCO CORP  
 M ST BELOW ERIE AVE PHILA 24 PA  
 ELCO ELECTRONICS  
 MICHIGAN CITY IND  
 ELCO TOOL & SCREW CORP  
 1111 SAMUELSON RD ROCKFORD ILL  
 ELCOR INC  
 1225 W BROAD ST FALLS CHURCH VA  
 ELDEMA CORP  
 1805 BELCROFT AVE EL MONTE CALIF  
 ELBORADO ELECT CO  
 2821 10 ST BERKELEY CALIF  
 ELDRRE COMPONENTS INC  
 187 N WATER ST ROCHESTER 4 N Y  
 ELECT MECHANICAL RES INC  
 SARASOTA FLA  
 ELECT STORAGE BATTERY MISSILE BATTERY DIV  
 2510 LOUISBURG RD RALEIGH N C  
 ELECT STORAGE BATTERY CO DIV EXIDE IND  
 2 PENN CENTER PLAZA PHILA PA  
 ELECTRA MFG CO  
 800 N 21ST ST INDEPENDENCE KANSAS  
 ELECTRA MFG CO  
 4051 BROADWAY KANSAS CITY MO  
 ELECTRA SCIENTIFIC CORP  
 ELECTRA WAY FULLERTON CALIF  
 ELECTRAC INC  
 1001 ARLEE PL ANAHEIM CALIF  
 ELECTRADA CORP  
 11244 PLAYA ST CULVER CITY CAL  
 ELECTRABAL PRINTED ELECT  
 1105 SECOND ST ENCINITAS CALIF  
 ELECTRABAL PRINTED ELECT CORP  
 NEEDHAM HTS MASS  
 ELECTRAMATIC INC  
 3324 HIAWATHA AVE MINN MINN  
 ELECTRAN MFG CO  
 1901 CLYBOURN AVE CHICAGO ILL  
 ELECTREND PRODUCTS CORP  
 BOX 11D ST JOSEPH MICH  
 ELECTRI WIRE ASSEMBLIES  
 700 W VIRGINIA MILWAUKEE WISC  
 ELECTRIC AUTO-LITE CO  
 WIRE & CABLE DIV PORT HURON MICH  
 ELECTRIC AUTO-LITE CO  
 HAZELTON PENNA  
 ELECTRIC AUTOLITE CO THE  
 901 N SELBY ST EL SEGUNDO CALIF  
 THE ELECTRIC AUTOLITE CO  
 P O BOX 366 HAZELTON PENNA  
 ELECTRIC AUTOLITE DIE CASTING CO  
 1ST & CLAY STS WOODSTOCK ILL  
 ELECTRIC AUTOLITE CO  
 PENNSBURG PA  
 ELECTRIC AUTOLITE CO  
 VINCENNES IND  
 ELECTRIC CORDS & SUPPLY CORP  
 413 E THIRD ST LOS ANG CALIF  
 ELECTRIC DESIGN & MFG CO  
 722 JEFFERSON ST BURLINGTON IOWA  
 ELECTRIC EYE EQUIPMENT CO  
 1948 E FAIRCHILD ST DANVILLE ILL  
 ELECTRIC INDICATOR CO INC  
 CAMP AVE SPRINGDALE CONN  
 ELECTRIC MACHINERY MFG CO  
 800 CENTRAL AVE MINNEAPOLIS 13 MINN  
 ELECTRIC MOTORS & SPECIALTIES  
 KING & HAMPHER ST GARRETT IND  
 ELECTRIC POWER DOOR CO INC  
 MINNEAPOLIS MINN  
 ELECTRIC REGULATOR CORP  
 PEARL ST NORWALK CONN  
 ELECTRIC SOLDERING IRON CO  
 W FLM ST DEEP RIVER CONN  
 ELECTRIC SPECIALTY CO  
 207 SOUTH ST STAMFORD CONN  
 ELECTRIC STORAGE BATTERY CO EXIDE IND DIV  
 RISING SUN & ADAMS AVES PHILA PA  
 ELECTRIC STORAGE BATTERY CO  
 5335 WESTERN BLVD S CHICAGO 9 ILL  
 ELECTRIC STORAGE BATTERY CO  
 251D LOUISBURG RD RALEIGH N C  
 ELECTRIC TACHOMETER CORP  
 68TH & UPLAND STS PHILA PENNA  
 ELECTRIC TERMINAL CORP  
 PO BOX 2217 PROVIDENCE 5 RI

- ELECTRICAL INSULATION CO INC  
1245 MARCONI BL COPIAGUE N Y
- ELECTRICAL INSTRUMENT CORP  
200 HARVARD AVE STAMFORD CONN
- ELECTRICAL INDUSTRIES  
691 CENTRAL AVE MURRAY HILL NJ
- ELECTRICAL PRODUCTS RES & DEV CO INC  
1206 CHERRY ST TOLEDO 4 OHIO
- ELECTRICAL REFRACTORIES CO  
E CLARK ST E PALESTINE OHIO
- ELECTRICAL SERVICE CO  
1271 MISSION ST SAN FRANCISCO CALIF
- ELECTRICAL SPECIALTY CO  
2820 E 12ST LOS ANG CALIF
- ELECTRICAL SPECIALTY CO  
158 ELEVENTH ST SAN FRAN CALIF
- ELECTRICAL UTILITIES CO  
2427 ST VINCENTS AVE LA SALLE ILL
- ELECTRICAL WINDINGS INC  
2015 N KOLMAR AVE CHICAGO ILL
- ELECTRO-AIR CLEANER CO INC  
OLIVIA & SPROUL ST MCKEES ROCKS PA
- ELECTRO ASSEMBLIES INC  
4444 N KEDZIE AVE CHICAGO 25 ILL
- ELECTRO CAPACITORS CO  
10132 EDES AVE OAKLAND 3 CAL
- ELECTRO-CERAMICS INC  
120 STATE ST NEW HAVEN CONN
- ELECTRO CERAMICS INC  
2645 S 2ND W SALT LAKE CITY UTAH
- ELECTRO CHEMICAL ENGRAVING CO INC  
1100 BROOK AVE BRONX N Y
- ELECTRO CHEMICAL ENGG & MFG CO  
750 BROAD ST EMMAS PA
- ELECTRO CHEMICAL DIV REPUBLIC FOIL INC  
SALISBURY NC
- ELECTROCHEMICAL INDUSTRIES INC  
35 ARMORY ST WORCESTER 3 MASS
- ELECTRO CIRCUITS INC  
176 WALKER STREET LOWELL MASS
- ELECTRODATA DIV BURROUGHS CORP  
460 SIERRA MADRE VILLA PASADENA CALIF
- ELECTRO-DEVELOPMENT CO  
14701 KESWICK ST VAN NUYS CALIF
- ELECTRO DEVELOPMENT CORP  
4530 UNION BAY PL NE SEATTLE 5 WASH
- ELECTRO DEVICES INC  
75 ADAMS ST NEWTON MASS
- ELECTRO DEVICES INC  
4 GODWIN AVE PATERSON N J
- ELECTRODYNAMIC INSTRUMENT CORP  
1841 OLD SPANISH TR HOUSTON 25 TEX
- ELECTRO ENGG WORKS  
401 PRED A ST SAN LEANDRO CALIF
- ELECTRO-ETCH CIRCUITS INC  
7112 SO VICTORIA AVE LOS ANGELES 43 CALIF
- ELECTRO FLEX HEAT INC  
83 WOODBINE ST HARTFORD CONN
- ELECTROFLOR INC  
7356 SANTA MONICA BL LOS ANGELES CALIF
- ELECTROID CORP  
107 PROGRESS ST UNION N J
- ELECTRO IMPULSE LAB INC  
208 RIVER ST RED BANK N J
- ELECTRO INSTRUMENT INC  
8611 BALBOA AVE SAN DIEGO 11 CALIFORNIA
- ELECTRO INTERNATIONAL INC  
GREENWOOD ACRES SECOND ST ANNAPOLIS MD
- ELECTRO KINETICS CORP  
909 BORDER AVE TORRANCE CALIF
- ELECTRO LOGIC CORP  
110 W 131 ST LOS ANGELES 61 CALIF
- ELECTROL SPECIALTIES CO  
441 CLARK ST S BELOIT ILL
- ELECTROMAGNETIC PROBE CO  
3800 CASH DRIVE WINSTON SALEM NO CAR
- ELECTROMAGNETIC TECHCORP  
1375 CALIF AVE PALO ALTO CALIF
- ELECTROMATH CORP  
115 PLEASANT AVE ROOSEVELT N Y
- ELECTROMATIC EQUIP CO  
562 ALBERMARLE RD CEDARHURST N Y
- ELECTROMATION CO  
4234 GLENCOE AVE VENICE CALIF
- ELECTRO MECHANICAL CORP  
375 FAIRFIELD AVENUE STAMFORD CONNECTICUT
- ELECTRO-MECHANICAL INSTRUMENT CO  
8 & CHESTNUT ST PERKASIE PA
- ELECTRO MECHANICAL RESEARCH INC  
BOX 3041 A SARASOTA FLA
- ELECTRO MECHANICAL RESEARCH  
BOX 44 PRINCETON NJ
- ELECTRO MECHANICAL SPEC  
528 LAMBERT RD WHITTIER CALIF
- ELECTRO MECHANICS CORP  
P O BOX 5061 HIGH POINT N C
- ELECTRO MEC INSTRUMENT CORP  
47 51 33RD ST LONG ISLAND CITY 1 N Y
- ELECTRO MED INC  
4748 FRANCE AVE N MINNEAPOLIS MINN
- ELECTRO-MEDICAL LAB INC  
5 WOODSTOCK RD VT
- ELECTRO MEDICAL ENGG CO  
703 MAIN ST BURBANK CALIF
- ELECTRO-MINIATURES CORP  
604 HUYLER ST SOUTH HACKENSACK NJ
- ELECTROMODE  
P O BOX 1052 ROCHESTER 3 N Y
- ELECTRO MOTIVE MFG CO INC  
WILLIMANTIC CONN
- ELECTRO NETIC STEEL INC  
9535 RIVER ST SCHILLER PARK ILL
- ELECTRO NEUTRONICS INC  
940 DWIGHT WAY BERKELEY 2 CALIF
- ELECTRONEX INDUSTRIAL LABORATORIES  
2459 SUSQUEHANNA RO ROSLYN PA
- THE ELECTRO NUCLEAR SYS CORP  
9449 SCIENCE CENTER DR MINN MINN
- ELECTRO PHYSICS CO  
297 BROADWAY NEW YORK 7 N Y
- ELECTRO PHYSICS LABS  
1900 WALKER AVE MONROVIA CALIF
- ELECTRO PRODUCTS LABS INC  
4501 N RAVENSWOOD AVE CHICAGO 4 ILL
- ELECTRO PROD LABS INC  
6125 W HOWARD ST CHICAGO 48 ILL
- ELECTRO PRODUCTS INC  
15050 SCHAFFER HWY DETROIT MICH
- ELECTRO RACK INC  
1341 S CLAUDINA ST ANAHEIM CALIF
- ELECTRO RADIATION INC  
11916 W PICO BLVD LOS ANGELES 64 CAL
- ELECTRO SCIENTIFIC IND INC  
7524 S W MACAOM AVE PORTLAND ORE
- ELECTRO SEAL CORP  
946 NORTH AVE OES PLAINES ILL
- ELECTRO-SECURITY CORP  
275 MAIN ST WEBSTER MASS
- ELECTRO SOLID CONTROLS INC  
8001 BLOOMINGTON FREEWAY MINN MINN
- ELECTRO-SONIC LABS  
35-54 36 ST LONG ISLAND CITY 6 N Y
- ELECTROSPACE-CORP  
12 G MORRIS AVE GLEN COVE N Y
- ELECTRO SPACE FAB INC  
CENTRE AVE TOPTON PA
- ELECTRO SWITCH CORP  
KING AVE WEYMOUTH 88 MASS
- ELECTRO-TEC CORP  
1 HENDERSON DRIVE WEST CALDWELL NJ
- ELECTRO TEC CORP VIRGINIA DIV  
BOX 219 BLACKSBURG VA
- ELECTRO TECHNICAL PRODUCTS  
DIV SUN CHEMICAL CORP  
113 E CENTRE ST NUTLEY N J
- ELECTRO TECHNIQUES  
11301 E OCEAN AVE LA HABRA CALIF
- ELECTRO-THERMO CERAMICS INC  
7510 5TH AVE SO SEATTLE 8 WASH
- ELECTRO VISION LAB  
41-08 45TH ST LONG ISLAND CITY 1 N Y
- ELECTRO VOICE INC  
CARROLL CECIL STS BUCHANAN MICH
- ELECTRO WELD CO  
55 GOFFLE ROAD HAWTHORNE N J
- ELECTRO WINDERS CO INC  
854 W FRONT ST COVINA CAL
- ELECTRON CORP  
747 S CENTRAL EXPWY RICHARDSON TEXAS
- ELECTRONANTICS CORPORATION  
BLDG 111 MAYNARD IND CTR MAYNARD MASS
- ELECTRON ARC DIV IONICS INC  
244 BROAD ST LYNN MASS
- ELECTRON BEAM DEVICES CORP  
105 E MAIN ST PLAINVILLE CONN
- ELECTRON ENTERPRISES  
6917 W STANLEY AVE BERWYN ILL
- ELECTRON HEATING CORP  
80 HICKS AVE MEDFORD 55 MASS
- ELECTRON OHIO INC  
1111 POWER AVE CLEVELAND 14 OHIO
- ELECTRONIC APPLICATIONS INC  
194 RICHMOND HILL AVE STAMFORD CONN
- ELECTRONIC APPLICATIONS INC  
80 DANBURY RD RTE 7 WILTON CONN
- ELECTRONIC ASSEMBLY CO INC  
5 PRESCOTT ST ROXBURY 19 MASS
- ELECTRONIC ASSISTANCE CORP  
20 BRIDGE AVE RED BANK N J
- ELECTRONIC ASSOCIATES INC  
LONG BRANCH & NABERAL AVES LONG BRANCH NJ
- ELECTRONIC BATTERIES INC  
28 34 35 ST BROOKLYN 32 N Y
- ELECTRONIC BRAZING CO  
140 GLENRIDGE AVE MONTCLAIR N J
- ELECTRONIC CHEMICAL CORP  
813 COMMUNIPAW AVE JERSEY CITY 4 N J
- ELECTRONIC CIRCUITS  
641 N LA PEER DR LOS ANGELES 69 CAL
- ELECTRONIC COILS INC  
P O BOX 1665 SPRINGFIELD MASS
- ELECTRONIC COMPONENTS DIV TELECOMPUTING CORP  
838 SATICOY ST NO HOLLYWOOD CALIF
- ELECTRONIC COMMUNICATION EOPT CO  
1249 W LDYOLA AVE CHICAGO 26 ILL
- ELECTRONIC COMMUNICATIONS  
1501 72ND ST N ST PETERSBURG FLA
- ELECTRONIC COMM & COMP DES & DEV CORP  
503 MCCARTER HWY NEWARK N J
- ELECTRONIC COMPONENTS CORP  
311 W MULBERRY ST WATSEKA ILL
- ELECTRONIC COMPONENTS  
520 INTERSTATE RD ADDISON ILL
- ELECTRONIC COMPUTER CORP  
BOX 177 PIPER CITY ILL
- ELECTRONIC COMPUTER CO  
618 MAPLE ST CONSHOHOCKEN PA
- ELECTRONIC CONNECTORS INC  
84 45 ABINGTON RO KEW GARDENS 15 N Y
- ELECTRONIC CONTRACTORS INC  
2101 SE 6 AVE PORTLAND 14 ORE
- ELECTRONIC CONTROL CORP  
15341 DALE DETROIT MICH
- ELECTRONIC CONTROLS INC  
62 SOUTHFIELD AVE STAMFORD CONN
- ELECTRONIC CONTROLS SYSTEMS INC  
P O BOX 47 FAIRMONT W VA
- ELECTRONIC COUNTERS INC  
164 ELLEN WAY SYOSSET LI N Y
- ELECTRONIC CRAFTSMEN INC  
3305 RUTGERS ST W HYATTSVILLE MD
- ELECTRONIC CREATIONS CORP  
1668 WEBSTER AVE NEW YORK 57 N Y
- ELECTRONIC CRYSTALS CORP  
31 N COBURN ST ORLAND FLA
- ELECTRONIC DESIGN & DEVELOP CO  
60 PENNINGTON ST NEWARK N J
- ELECTRONIC DEVELOPMENT CORP  
423 W BROADWAY BOSTON 27 MASS
- ELECTRONIC DEVELOPMENT LABS  
71 NASSAU ST N Y N Y
- ELECTRONIC DEVICES CORP  
4212 PONCE DE LEON CORAL GABLES 46 FLA
- ELECTRONIC DEVICES INC  
50 WEBSTER AVE N ROCHELLE N Y
- ELECTRONIC ENGG CO  
362 W BOWERY ST AKRON OHIO
- ELECTRONIC ENTERPRISES INC  
65 7 AVE NEWARK N J
- ELECTRONIC ENGG CO OF CALIF  
1601 CHESTNUT SANTA ANA CALIF
- ELECTRONIC EQUIPMENT SUPPLY CO  
249 N 48TH ST LINCOLN NEB
- ELECTRONIC FITTINGS CORP  
RT 7 AT DANBURY AIRPORT DANBURY CONN
- ELECTRONIC INSTRUMENT CO INC  
3300 NORTHERN BLVD LONG ISLAND CITY N Y
- ELECTRONIC INDUSTRY INC  
18 MARSHALL ST NORWALK CONN
- ELECTRONIC INTL CO  
145 MAGNOLIA BLVD BURBANK CALIF
- ELECTRONIC MACHINE PARTS INC  
128 11 18TH AVE COLLEGE POINT N Y
- ELECTRONIC MEASUREMENTS CO INC  
EATONTOWN N J
- ELECTRONIC MEASUREMENTS CORP  
625 BROADWAY NEW YORK 12 N Y
- ELECTRONIC MECHANICAL PROD CO  
929 ATLANTIC AVE ATLANTIC CITY NJ
- ELECTRONIC MEMORIES INC  
9430 BELLANCA AVE LOS ANGELES 45 CALIF
- ELECTRONIC MODULES CORP  
1949 GREENSPRING DR TIMONIUM MD
- ELECTRONIC HOLDING CORP  
42 CHURCH ST PAWTUCKET R 1
- ELECTRONIC PARTS MFG CO  
508 25 ST UNION CITY NJ
- ELECTRONIC PLASTICS CORP  
16 SALEM ST WAKEFIELD MASS
- ELECTRONIC PRODUCTS DIV POST MACHINERY  
140 ELLIOT ST BEVERLY MASS
- ELECTRONIC PROCESS CORP  
990 VARIAN ST SAN CARLOS CAL
- ELECTRONIC PROCESSES CORP OF CALIF  
436 BRYANT ST SAN FRAN CALIF
- ELECTRONIC PRODUCTION & DEVELOPMENT  
501 N PRAIRIE AVE HAWTHORNE CALIF
- ELECTRONIC PRODUCTS CO  
DIV OF VICTOREEN INST CO  
111 E 3RD ST MOUNT VERNON N Y
- ELECTRONIC PRODUCTS CORP  
2315 CECIL AVE BALTIMORE 18 MARYLAND
- ELECTRONIC RECTIFIERS INC  
2102 SPANN AVE IND IND
- ELECTRONIC RESEARCH CO  
KANSAS CITY MO
- ELECTRONIC RESEARCH ASSOCIATES INC  
67 FACTORY PL CEDAR GROVE NJ
- ELECTRONIC SECRETARY INDUSTRIES INC  
1101 S PRAIRIE AVE WAUKESHA WISC
- ELECTRONIC SPECIALTY CO ELECTIC SPEC DIV  
207 SOUTH ST STAMFORD CONN
- ELECTRONIC SPECIALTY CO  
TECHNICRAFT DIVISION  
THOMASTON CONNECTICUT
- ELECTRONIC SPECIALTIES MFG CORP  
100 LAMARTINE ST WORCESTER MASS
- ELECTRONIC SYSTEMS  
7309 VARNA AVE N HOLLYWOOD CALIF
- ELECTRONIC SYSTEMS ENGG CO  
2838 WILSHIRE BLVD OKLAHOMA CITY OKLA
- ELECTRONIC TECHNOLOGY RESEARCH INC  
2153 MOORE SAN DIEGO IO CALIF
- ELECTRONIC TIMERS CO  
PANA ILL
- ELECTRONIC TRAINING AIDS CO  
P O BOX 53 CAMBRIDGE 41 MASS
- ELECTRONIC TRANSFORMERS CORP  
29 PARK PL PASSAIC N J
- ELECTRONIC TRANSISTORS CORP  
153-13 NORTHERN BLVD FLUSHING 34 N Y
- ELECTRONIC TUBE COIL CO  
557 EAGLE ROCK AVE ROSELAND NJ
- ELECTRONIC TUBE & INST DIV  
GENERAL ATRONICS CORP  
1200 E MERHAID LANE PHILA PA
- ELECTRONICS & ORONANCE DIV AVCO CORP  
CINCINNATI OHIO
- ELECTRONICS BATTERIES INC  
28 34 35 ST BROOKLYN N Y
- ELECTRONICS CORP OF AMERICA  
1 MEMORIAL DR CAMBRIDGE 42 MASS
- ELECTRONICS CORP OF AMER  
104 ADVANCE RD TORONTO ONTARIO CANADA
- ELECTRONICS DEVELOPMENT CO  
3743 CAHUENGA BLVD N HOLLYWOOD CALIF
- ELECTRONICS DEVELOPMENT INC  
521 MARLYN AVE BOX 813 STATE COLLEGE PA
- ELECTRONICS INTL CO INC  
20 N LEE ST OKLAHOMA CITY 2 OKLA
- ELECTRONICS INC OF PA  
2440 MARYLAND AVE WILLOW GROVE PA
- ELECTRONICS INC  
127 SUSSEX AVE NEWARK N J
- ELECTRONICS OF CLEARFIELD INC  
PO BOX 792 CLEARFIELD PA
- ELECTRONICS MISSILES & COMMUNICATIONS INC  
262 E THIRD ST MT VERNON N Y



# ELECTRONIC MANUFACTURERS—A TO Z

ELECTRONICS RESEARCH INC  
P O BOX 327 EVANSVILLE IND

ELECTRONICS SYSTEMS INC  
105 CHAUNCEY ST BOSTON 11 MASS

ELECTRON PRODS DIV MARSHALL IND  
1960 WALKER AVE MONROVIA CALIF

ELECTRON RESEARCH INC  
530 W 12TH ST ERIE PENNA

ELECTRONS INC  
127 SUSSEX AVE NEWARK 3 N J

ELECTRON TECHNOLOGY INC  
626 SCHUYLER AVE KEARNY N J

ELECTROPAC INC  
PETERBOROUGH N H

ELECTROPOT INC  
3155 W SEGUNDO BLVD HAWTHORNE CALIF

ELECTROSONIC ENGINEERING CO  
2120 PONTIUS AVE LOS ANGELES 25 CALIF

ELECTROSONICS INTERNATIONAL INC  
150 BURNSIDE ST PHILADELPHIA 27 PA

ELECTROVART INC  
240 MADISON AVE NEW YORK 16 N Y

ELEKTRON STANDARD INC  
RTE 5 SOUTH WINDSOR CONN

ELEMATIC EQUIPMENT CORP  
6731 S CHICAGO AVE CHICAGO 37 ILL

ELGENCO INC  
1231 COLORADO AVE SANTA MONICA CALIF

ELGIN MICRONICS DIV ELGIN NAT WATCH CO  
366 BLUFF CITY BLVD ELGIN ILL

ELGIN NATIONAL WATCH CO  
366 BLUFF CITY BLVD ELGIN ILL

ELECTRONICS DIV ELGIN NATL WATCH CO  
2435 N NAOMI ST BURBANK CALIF

ELGIN LABS INC  
WATERFORD PA

ELIN DIV INTL ELECT RESCH CORP  
145 W MAGNOLIA BLVD BURBANK CALIF

ELION INSTRUMENTS INC  
ROUTE 130 NORTH BURLINGTON N J

ELITE ELECTRONICS ENGRG CO  
5100 S ASHLAND AVE CHICAGO 9 ILL

ELJAY CORP  
2908 HERBERT ST BALTIMORE MD

ELK ELECTRONICS LABS INC  
333 W 52 ST NEW YORK 19 N Y

ELLIOTT BROS LONDON LTD RADAR DIV  
ELSTREE WAY BOREHAMWOOD HERTS ENGLAND

ELLIOTT BROS LTD  
BOREHAMWOOD HERTS ENGLAND

ELLIS & WATTS PRODUCTS INC  
P O BOX 33 CINCINNATI 36 OHIO

ELLIS ASSOCIATES  
67 LINCOLN AVE PELHAM N Y

ELLISON DRAFT GAGE CO  
548 W MONROE ST CHICAGO 6 ILL

ELM INSTRUMENT  
30 CHASNER ST HAMPSTEAD LI NY

ELM MFG CO INC  
PO BOX 14 HASTINGS ON HUDSON NY

ELMWOOD SENSORS INC  
1655 ELMWOOD AVE CRANSTON R I

ELPAC INC  
4270 ARTESIA ST FULLERTON CALIF

EL PRODUCTS CORP  
P O B 41 NEW YORK 63 N Y

EL-RAD MFG CO  
4300 N CALIFORNIA AVE CHICAGO 18 ILL

ELSCO SYSTEMS INC  
4516 STONE WAY N SEATTLE 3 WASH

ELZEE METAL PRODUCTS CO  
775 39 ST BROOKLYN 32 N Y

EMARCO CORP  
1950 NEVA DRIVE DAYTON 14 OHIO

EMCEE ELECTRONICS INC  
1202 ARNOLD AVE NEW CASTLE DEL

EMERSON & CUMING INC  
869 WASHINGTON ST CANTON 1 MASS

EMERSON & CUMING INC WESTERN DIV  
604 W 182ND ST GARDENA CALIF

EMERSON ELECTRIC  
8100 W FORISSANT AVE ST LOUIS 21 MO

EMERSON ELECTRIC MFG CO ELECT & AVIONICS DIV  
8100 FLORISSANT AVE ST LOUIS 36 MO

EMERSON PLASTICS CORP  
SEABURY AVE & BUTLER PL BRONX 61 N Y

EMERSON-RITTENHOUSE CO INC  
68 EAST ST HONEYEYE FALLS N Y

EMI COSSOR ELECTRONICS  
WOODSIDE DARTMOUTH NOVA SCOTIA

EMI US  
1750 VINE ST LOS ANG CALIF

EMI US LTD GENERAL COMM DIV  
FORT ATKINSON WISC

EMI/US  
13259 SHERMAN WAY NO HOLLYWOOD CALIF

E M J MFG CO  
760 REED SANTA CLARA CALIF

EMMCO PLASTIC FAB DIV  
M MC CARTHY MACHINE CO  
68 VINE ST EVERETT MASS

EMMCO PLASTICS CORP  
MILL STREAM IND PARK ANDOVER MASS

EMMERT MFG CO  
1051 E MAIN ST WAYNESBORO PA

EMPIRE DEVICES PRODUCTS CORP  
37 PROSPECT ST AMSTERDAM NY

EMPIRE ELECTRONICS CO INC  
60 SPRUCE ST PATERSON 1 NJ

ENDECO ENGG DEVELOPMENT CO OF LOS ANGELES  
8021 LONG BEACH VIKING WY LONG BEACH 8 CAL

ENDERES DIV MUTER CO  
GUTTENBERG IOWA

ENDEVO CORP  
161 E CALIFORNIA BLVD PASADENA CALIF

ENDEVO CORP  
801 S ARROYO PKWY PASADENA CALIF

ENDICOTT COIL CO INC  
24 CHARLOTTE ST BINGHAMTON NY

ENERGY CONVERSION INC  
336 MAIN ST CAMBRIDGE 42 MASS

ENERTRAN INC  
2710 NUTTAM AVE FORT WAYNE IND

ENFAB INC  
312 E BROKAW RD SAN JOSE CALIF

ENFLO CORP  
FELLOWSHIP RD ROUTE 73 MAPLE SHADE N J

ENG NORTHWEST  
2309 SNEILING MINN MINN

ENG SPECIALITIES INC  
LAKEVILLE MINN

ENGELHARD INDUSTRIES  
INDUST EQUIPT DIV  
850 PASSAIC AVE E NEWARK NJ

ENGELHARD INDUSTRIES INC  
113 ASTOR ST NEWARK N J

ENGELMANN MICROWAVE CO  
MOUNTAIN LAKES N J

ENGINEERED ELECTRONICS CO  
1441 E CHESTNUT AVE SANTA ANA CALIF

ENGINEERED MAGNETICS  
13041 CERISE AVE HAWTHORNE CALIF

ENGINEERED PLASTICS INC  
GIBSONVILLE NO CAR

ENGINEERED YARNS  
100 PULASKI ST WARWICK R I

ENGINEERING ASSOCIATES  
434 PATTERSON RD DAYTON 19 OHIO

ENGG & MFG CORP OF TEXAS  
PO BOX 14216 DALLAS 34 TEXAS

ENGIS EQUIP CO  
431 E DEARBORN ST CHICAGO ILL

ENGLERHARD HANOVIA INC  
100 CHESTNUT ST NEWARK N J

ENGLER INSTRUMENT CO  
250 CULVER JERSEY CITY 5 N J

ENGLISH ELECTRIC VALVE CO LTD  
CHELMSFORD ESSEX ENGLAND

ENSCO INC  
3100 ELDRIDGE ST SALT LAKE CITY UTAH

ENSGIN COIL CO  
2520 S PULASKI CHICAGO 23 ILL

ENTHONE INC  
442 ELM ST NEW HAVEN 8 CONN

ENTRON INC  
4902 LAWRENCE ST BLADENSBURG MD

ENVIRON LAB INC  
9725 GIRARD AVE 5 MINN 31 MINN

ENVIRONMENTAL EQUIPMENT CO  
369 LINDEN ST BROOKLYN 27 N Y

E O ELECTRONICS INC  
14 MORRIS AVE MOUNTAIN LAKES NJ

EDN CORP  
175 PEARL ST BROOKLYN 1 N Y

EONETICS  
3800 COMASSET BURBANK CALIF

EPCO PRODUCTS INC  
2500 ATLANTIC AVE BROOKLYN 7 NY

EPCO PRODUCTS INC  
BOX 298 WMLKILL NY

EPIC INC  
150 NASSAU ST NEW YORK 38 N Y

EPOXYCAST ELECTRONIC CASE CO  
46 PROSPECT ST YONKERS N Y

EPOXYLITE CORP THE  
P O BOX 3397 50 EL MONTE CALIF

EPOXY PRODUCTS DIV JOS WALDMAN & SONS  
133 COIT ST IRVINGTON NJ

EPPLEY LAB INC  
12 SHEFFIELD AVE NEWPORT RI

EPRAID INC  
1206 CHERRY ST TOLEDO 4 OHIO

EPSCO INC  
275 MASSACHUSETTS AVE CAMBRIDGE 39 MASS

EQUIPMENT AND SERVICE CO  
7118 ENVOY CT DALLAS 7 TEXAS

EQUIPTO DIV AURORA EQUIPMENT CO  
AURORA ILL

EQUIPTO ELECTRONICS CORP  
319 N WEBSTER ST NAPERVILLE 6 ILL

ERA DYNAMICS  
CEDAR GROVE NJ

ERA RESEARCH INC  
1009MONTANA AVE SANTA MONICA CALIF

FRASER CO  
1068 S CLINTON ST SYRACUSE 4 NY

ERCA TOOL DIE & STAMPING CO  
19 ASH ST BROOKLYN 22 N Y

ERCO RADIO LABS INC  
637 STEWART AVE GARDEN CITY NY

ERCONA CORP  
16 W 46TH ST NEW YORK 36 N Y

ERCO ENGG CORP  
136 OFFICIAL RD ADDISON ILL

ERIC ELECTRONICS INC  
1823 COLORADO SANTA MONICA CAL

ERICSON MFG CO  
1660 HAYDEN AVE CLEVELAND OHIO

ERIE ELECTRONICS DIV  
ERIE PA

ERIE PACIFIC  
12932 S WEBER WAY HAWTHORNE CALIF

ERIE RESISTOR OF CANADA LTD  
7 FRASER AVE TRENTON ONT CANADA

ELECTRONICS DIV ERIE RESISTOR CORP  
644 W 12TH ST ERIE PA

ERIE RESISTOR CORP  
644 W 12 ST ERIE 6 PA

ERIE TECHNICAL CERAMICS INC  
BOX 677 STATE COLLEGE PENNA

ERIKSON SPECIALIZED TOOL CO  
P O BOX 424 PICO CALIF

ERWOOD INC  
1770 W BERTEAU AVE CHICAGO 13 ILL

ESC ELECTRONICS CORP  
534 BERGEN BLVD PALISADES PARK NJ

ESCO GROUP DIV ELECTRONIC SPECIALTY CO  
5121 SAN FERNANDO RD LOS ANGELES 39 CALIF

ESPEY MFG & ELECTRONICS CORP  
CONGRESS BALLSTON AVES SARATOGA SPRINGS NY

ESSEX ELECTRONICS DIV NYTRONICS INC  
550 SPRINGFIELD AVE BERKELEY HEIGHTS N J

ESSEX ELECTRONICS OF CANADA LTD  
99 WRAGGE ST TRENTON ONT CANADA

ESSEX MFG CO  
8213 GRAVOIS AVE ST LOUIS 23 MO

ESSEX WIRE CORP  
1601 WALL ST FT WAYNE 6 IND

ESS GEE INC  
15 HAVENS ST ELMSFORD NY

ESTERLINE ANGUS INSTRUMENT COMPANY INC  
PO BOX 596 INDIANAPOLIS 6 IND

E-T-A PRODUCTS CO OF AMERICA  
6284 N CICERO AVE CHICAGO 46 ILL

E T C INCORPORATED  
990 E 67ST CLEVELAND OHIO

ETCHING CORP OF CALIF  
DIV ALLEGRI TECH INC  
865 HINCKLEY ROAD BURLINGAME CALIF

EUBANKS ENG CO  
260 N ALLEN AVE PASADENA CALIF

EUGENE ENGINEERING CO INC  
1217 HYDE PARK AVE HYDE PARK 36 MASS

EUREKA X-RAY TUBE CORP  
3250 N KILPATRIC AVE CHICAGO 41 ILL

EUTECTIC WELDING ALLOYS NEW ENG DIV INC  
167 BRIGHTON AVE BOSTON MASS

EUTECTIC WELDING ALLOYS CORP  
538 20TH ST OAKLAND CALIF

EUTECTIC WELDING ALLOYS CORP  
40 40 172 ST FLUSHING N Y

EWALD INSTRUMENTS  
ROUTE 7D KENT CONN

EWEN KNIGHT CORP  
EAST NATICK MASS

EXACT ELECTRONICS INC  
PO BOX 234 HILLSBORO OREGON

EXACT ENGG MFG INC  
PO BOX 447 OCEANSIDE CALIF

EXACT WEIGHT SCALE CO  
938 E TOWN ST COLUMBUS 13 OHIO

EXACTEL INSTRUMENT CO  
89 ALICE AVE MOUNTAIN VIEW CALIF

EX-CELL-LO CORP  
1200 OAKMAN BLVD DETROIT MICH

EXCELLEX ELECTRONICS INC  
88 06 VAN WYCK EXPWY JAMAICA 18 N Y

EXECUTONE INC  
47 37 AUSTELL PL LONG ISLAND CITY 1 N Y

EYELEMATIC INC  
STRAITS TURNPIKE OAKVILLE CONN

EYELET TOOL CO  
76 ROGERS ST CAMBRIDGE MASS

E-Z-HOOK TEST PRODUCTS  
1336 WOODBURN AVE COVINGTON KY

E-Z-WAY TEMPLATES  
PO BOX 535 RESEDA CALIF

E-Z WAY TOWERS INC  
5901 E BROADWAY BX 5767 TAMPA 5 FLA

## F

FABRA PRINT INC  
1531 E FRANKLIN MINNEAPOLIS 4 MINN

FABRI-TFK INC  
PO BOX 645 AMERY WIS

FABRI TEK CIRCUITS INC  
1111 E EXCELSIOR BLVD HOPKINS MINN

FACTORY SERVICE CO  
4615 N 21ST ST MILWAUKEE 9 WISC

FAE INSTRUMENT CORP  
16 NORDEN LANE HUNTINGTON STA L I N Y

FAPNIR BEARING CO  
9000 DIRECTORS ROW DALLAS TEXAS

FAPNIR BEARING CO  
NEW BRITAIN CONN

FAIR RITE PRODUCTS CORP  
COMMERCIAL ROW WALKKILL N Y

FAIRBANKS CO  
393 LAFAYETTE ST NEW YORK 3 N Y

FAIRBANKS WIRE CO  
WALNUT ST NEWBURGH N Y

FAIRCHILD CONTROLS CORP COMPONENTS DIV  
225 PARK AVE HICKSVILLE L I N Y

FAIRCHILD CONTROLS CORP  
6111 E WASHINGTON BLVD LOS ANGELES CALIF

FAIRCHILD SPACE & DEFENSE PRODS  
DIV FAIRCHILD CAMERA & INST CORP  
300 ROBBINS LA SYDDET N Y

FAIRCHILD RECORDING EQUIPMENT CO  
10-40 45 AVE LONG ISLAND CITY 1 N Y

FAIRCHILD SEMICONDUCTOR CORP  
545 WHISMAN RD MOUNTAIN VIEW CALIF

FAIRCHILD SEMICONDUCTOR CORP  
4300 REDWOOD HWY SAN RAFAEL CALIF

FAIRMOUNT CHEMICAL CO INC  
136 LIBERTY ST NEW YORK N Y

FALCON DIV GEN THERMODYNAMICS  
150 BALLARDVAE ST NO WILMINGTON MASS

FALSTROM CO  
12 FALSTROM COURT PASSAIC N J

FANSTEEL METALLURGICAL CORP  
2200 SHERIDAN RD N CHICAGO ILL



FARADAY INC  
ADRAIN MICH  
FARADYNE ELECT CORP  
471 CORTLANDT ST BELLEVILLE NEW JERSEY  
FARINON ELECTRIC  
935 WASHINGTON ST SAN CARLOS CALIF  
FARMER ELECTRIC PRODUCTS CO  
TECH CIRCLE NATICK MASS  
FARMER ELECTRIC PRODUCTS CO  
2300 WASHINGTON ST NEWTON LOWER FALLS MASS  
FARRALL INSTRUMENT CO  
BOX 658 GRAND ISLAND NEB  
FARRANO OPTICAL CO INC  
BRONX BLVD & E 238TH ST NEW YORK  
FARRELL CO  
1243 N 26TH ST PHILA PA  
FARRINGTON ELECT INC  
7019 EDSALL RO ALEXANDRIA VA  
FARWELL METAL FABRICATING  
83 W FAIRFIELD AVE ST PAUL 7 MINN  
FASCO INDUSTRIES INC  
255 N UNION ST ROCHESTER N Y  
JOHN E FAST CO DIV VICTOREEN INST CO  
3580 N ELSTON AVE CHICAGO 18 ILL  
FAULTLESS CASTER CORP  
1427 N GARVIN ST EVANSVILLE 7 INO  
FEAY CO NEAL  
133 LA PATERA AVE COLETA CALIF  
FECKER INC J W  
6592 HAMILTON AVE PITTSBURGH PA  
FEDERAL ANTI CAPACITY SWITCH CORP  
BOX 25 LANCASTER N Y  
FEDERAL ENG & MFG CORP  
1004 6TH ST N W WASHINGTON D C  
FEDERAL EQUIPMENT CO  
38 BRAOY ST SAN FRANCISCO 3 CALIF  
FEDERAL LAB INC  
SALTSBURG PA  
FEDERAL MACHINE CO  
835 GARFIELD AVE JERSEY CITY 5 N J  
FEDERAL MFG & ENGG CORP  
1055 STEWART AVE GARDEN CITY LI N Y  
FEDERAL MFG & ENG CORP TV SPECIALTY DIV  
1055 STEWART AVE GARDEN CITY N Y  
FEDERAL SCIENTIFIC CORP  
615 W 131ST ST NEW YORK 27 NY  
FEDERAL SCREW PRODUCTS INC  
3917 N KEDZIE AVE CHICAGO 18 ILL  
FEDERAL STAMPING CO  
7347 ATOLL AVE N HOLLYWOOD CALIF  
FEDERAL TOOL ENGINEERING CO  
1384 POMPTON AVE CEDAR GROVE NJ  
FEDERAL TOOL & MFG CO  
3600 ALABAMA AVE MINNAPOLIS 16 MINN  
AMERICAN SMELTING REFINING CO  
FEDERATED METALS DIV  
150 ST CHARLES ST NEWARK 5 NJ  
FEEBACK CONTROLS INC  
8 ERIE DRIVE NATICK MASS  
FEILER ENGG & MFG CO  
8026 N MONTICELLO AVE SKOKIE ILL  
FEINER & SONS P  
522 W 45 ST NEW YORK N Y  
FELT PRODUCTS MFG CO  
7450 MCCORMICK BLVD SKOKIE ILL  
FEN-TONE CORP  
106 5TH AVE NEW YORK 11 N Y  
FENWAL ELECTRONIC INC  
63 FOUNTAIN ST FRAMINGHAM MASS  
FENWAL INC  
PLEASANT ST ASHLAND MASS  
FERRANTI ELECT INC  
INDUSTRIAL PK PLAINVIEW L I N Y  
FERRIS INOUMENT CORP  
110 CORNELIA ST BOONTON N J  
FERRO DYNAMICS CORP  
GREGG ST & RTE 17 LODI N J  
FERROTHERM CO  
1861 E 65TH ST CLEVELAND OHIO  
FERROTRAN ELECTRONICS CO INC  
693 BROADWAY NEW YORK 12 N Y  
FERROXUBES CORP OF AMERICA  
35 E BRIDGE ST SAUGERTIES N Y  
F & F ENTERPRISES INC CHICAGO SWITCH DIV  
1733 MILWAUKEE AVE CHICAGO 47 ILL  
FFGM ELECTRONICS  
12820 PANAMA ST LOS ANG CALIF  
FIBRE GLASS EVERCOAT CO  
BLUE ASH KIGLER MILLS RDS CINN OHIO  
FIDELITONE MICROWAVE INC  
6415 RAVENSWOOD AVE CHICAGO ILL  
FIDELITY AMPLIFIER CO  
1633 HALSTEAD ST CHICAGO ILL  
FIDELITY CHEMICAL PRODUCTS CORP  
470 FRELINGHUYSEN AVE NEWARK 12 N J  
FIDELITY ELECTRIC CO  
332 N ARCH ST LANCASTER PA  
FIDELITY INSTRUMENT CORP  
100 E BOUNDARY AVE YORK PA  
FIELD EMISSION CORP  
611 3RD ST MCMINNVILLE ORE  
FIFTH DIMENSION INC  
P O BOX 483 PRINCETON N J  
FILM CAPACITORS INC  
3400 PARK AVE NEW YORK 56 NY  
FILMOHM CORP  
48 W 25 ST NEW YORK 10 N Y  
FILTERS INC  
30 SAGMORE HILL PORT WASH N Y  
FILTRON CO  
131-15 FOWLER AVE FLUSHING 55 N Y  
FILTRON CO INC WESTERN DIV  
10023 JEFFERSON BLVD CULVER CITY CALIF  
FINNELL SYSTEM INC  
ELKHART INO  
FINNEY CO  
34 INTERSTATE ST BEDFORD OHIO

FIRE CONTROL CO INC  
703 THORNTON ST WILMINGTON 1 DEL  
FIRST ELECTRONICS CORP  
13 ST ANNE ST JAMAICA PLAIN MASS  
FISCHER & CO R A  
517 COMMERCIAL ST GLENDALE 3 CALIF  
FISCHER & PORTER CO  
WARMINSTER PA  
FISCHER ELECTRONICS INC  
2238 BAILEY AVE BUFFALO 11 N Y  
FISH-SCHURMAN CORP  
70 PORTMAN RO NEW ROCHELLE N Y  
FISHER AKIN CO  
1005 SEPULVEOA BLVD MANHATTAN BEACH CALIF  
FISHER & CROME  
109 N CAMAC ST PHILA 7 PA  
FISHER BERKELEY CORP  
1475 POWELL ST EMERYVILLE CALIF  
FISHER CO INC OSCAR  
P O BOX 426 NEWBURGH N Y  
FISHER ENGG INC  
P O BOX 327 HUNTINGTON INO  
FISHER GOVERNOR CO  
BOX 307 MARSHALLTOWN IOWA  
FISHER PIERCE CO  
170 PEARLS ST BRAINTREE MASS  
FISHER RADIO CORP  
2121 44 DR LONG ISLAND CITY N Y  
FISHER RESEARCH LAB  
1975 UNIVER AVE PALO ALTO CALIF  
FISHER SCIENTIFIC CO  
1 REAGENT LANE FAIR LAWN NJ  
FISHER SCIENTIFIC CO INSTRUMENT DIV  
INDIANA PENNA  
FISHER SPECIAL MFG CO  
446 MORGAN ST CINN OHIO  
FITZBURGH ENGINEERING CORP  
CLEGHORN ST FITZBURGH MASS  
FLAME RESEARCH INC  
BOX 10502 PITTSBURGH 35 PA  
FLEXONICS DIV OF CALUMET & HECLA  
300 E DEVAN AVE BARTLETT ILL  
FLEETWOOD LABS INC  
35 ROCKWOOD PL N ROCHELLE N Y  
FLEXAUST CO  
100 PARK AVE NEW YORK 7 N Y  
FLEXO INTERNATIONAL CORP  
3720 MILWAUKEE AVE CHICAGO ILL  
FLEXO WIRE DIV COPPERWELD STEEL CO  
OSWEGO N Y  
FLEXROCK CO  
3609 FILBERT ST PHILA PENNA  
FLOOUIL PRODUCTS INC  
COBLESKILL N Y  
FLORIDA GEARS & SYSTEMS INC  
16550 N W 10TH AVE MIAMI FLA  
FLORIDA TRANSFORMER DIV YORK RES CORP  
DE LEON SPRINGS FLA  
FLO-TRONICS INC ELECT CONTROLS DIV  
1330 QUINCY ST NE MINNEAPOLIS 13 MINN  
FLOW CORP  
11 CARLETON ST CAMBRIDGE MASS  
FLUIDYNE ENG CORP  
5740 MAYZATA BLVD MINN MINN  
FLUKE MFG CO INC JOHN  
BOX 7161 SEATTLE WASH  
THE FLUOROCARBON CO  
1754 S CLEMENTINE ANAHEIM CALIF  
FLUORULON LABS INC  
BOX 305 CALOWELL N J  
FLUSH WALL RADIO CO  
1012 CLEVELAND ST CLEARWATER FLA  
F & M SCIENTIFIC CORP  
RT 41 & STARR RD AVONOLE PA  
FONOA GAGE CO INC  
STAMFORD CONN  
FORBER & WAGNER INC  
SILVER CREEK N Y  
FORBES & WAGNER INC  
345 CENTRAL AVE SILVER CREEK N Y  
WM A FORCE & CO INC  
216 NICHOLS AVE BROOKLYN 8 NY  
FORD ELECTRONICS CORP  
11747 VOSE ST N HOLLYWOOD CALIF  
FORD INSTRUMENT CO DIV SPERRY RANO CORP  
31-10 THOMSON AVE LONG ISLAND CITY 1 N Y  
FORO RADIO MICA CORP  
536 63 ST BROOKLYN N Y  
FORDHAM MFG CO  
2220 PEARSALL AVE NEW YORK 69 N Y  
FOREDOM ELECTRIC CO INC  
BETHFL CONN  
THE FOREST ELECT CO  
1001 N 25TH AVE MELROSE PARK ILL  
FORK STANDARDS INC  
WEST CHICAGO ILL  
FORM-IT PRODUCTS INC  
16-19 W WALNUT ST CHICAGO 12 ILL  
FORMCRAFT TOOL CO  
2465 ARCHER AVE CHICAGO ILL  
FORMEO PLASTICS INC  
207 STONEHINGE LANE CARLE PL N Y  
FORMICA CORP  
4614 SPRING GROVE AVE CINCINNATI 11 OHIO  
FORMICA METAL PROD CO  
CORPORATION WAY MEDFORD MASS  
FORMSPRAG INC  
23601 HOOVER RO WARREN MICH  
FORSBERG MFG CO  
125 SEAVIEW AVE BRIDGEPORT CONN  
FORT WAYNE METALS INC  
3211 MACARTHUR DR FT WAYNE INO  
FORWAY INDUSTRIES INC  
122 GREEN AVE WOODBYRY N J  
FOSTER TRANSFORMER CO  
3820 COLERAIN AVE CINNATI OHIO  
FOSTORIA CORP DEPT D2  
TITUS AVE WARRINGTON INO PK WARRINGTON PA

FOSTORIA CORP  
1200 MAIN ST FOSTORIA OHIO  
FOTO VIDEO LABS  
36 COMMERCE RD CEDAR GROVE N J  
FOURDEE INC  
5440 E COLONIAL DR ORLANDO FLA  
FOURJAY INDUSTRIES  
2801 ONTARIO AVE DAYTON OHIO  
FOX CO THOMAS T  
304 MT PLEASANT AVE NEWARK 4 N J  
FOX PRODUCTS CO  
4720 N 18 ST PHILA PA  
FOXBORO CO  
NEPONSET AVE FOXBORO MASS  
F & R ENTERPRISES  
910 VALENCIA ST SAN FRAN CALIF  
FRANCE MFG CO  
10325 BEREA RO CLEVELANO 2 OHIO  
FRANKE GEAR WORKS INC  
4401 RAVENSWOOD AVE CHICAGO ILL  
FRANKLIN ELECTRONICS INC  
E 4TH ST BRIDGEPORT PA  
FRANKLIN MFG CO  
65 NE 22ND AVE MINN MINN  
FRANKLIN SYSTEMS INC  
WEST PALM BEACH FLORIDA  
FREBANK CO  
711 W BROADWAY GLENDALE CALIF  
FREDERICK ELECT CORP  
414 PINE AVE FREDERICK MO  
FREDERICKS CO  
PHILMONT ANNE ST BETHAYRES PENNA  
FREE TRANSFORMER CO  
1718-36 WEIRFIELD ST BROOKLYN 27 N Y  
FREELANO PRODUCTS CO  
706 OKEEFE ST NEW ORLEANS LA  
FREEMAN CO  
8TH & WALNUT YANKTON S O  
FREEWAY WASHER & STAMPING CO  
4911 GRANT AVE CLEVELANO OHIO  
FRENCHTOWN PORCELAIN CO  
FRENCHTOWN N J  
FRENCH RADIO MFG CO  
164 W PARKER ST SCRANTON PA  
FREQUENCY ENGG LABS  
BOX 504 ASBURY PARK NJ  
FRICK GALLAGHER MFG CO  
200 S MICHIGAN WELLSTON OHIO  
FRIDEN CALCULATING MACHINE CO  
2350 WASHINGTON AVE SAN LEANDRO CALIF  
FRIDEN COMMERCIAL CONTROLS CORP  
1 LEIGHTON AVE ROCHESTER N Y  
FRONTIER ELECT CO  
4608 MEMPHIS AVE CLEVE OHIO  
FRYLING ELECT PROD INC  
HOLLY SPRINGS MISS  
FRYLING MFG CO  
531 W 11TH ST ERIE 6 PA  
FUEL WATCHMAN INC  
77 29 138 ST FLUSHING N Y  
FUGLE MILLER LABS INC  
301 CENTRAL AVE CLARK N J  
FULLER CO H B  
1201 FULLER RO LINDEN N J  
FULLER CO H B  
904 W BLACKHAWK ST CHICAGO ILL  
FURANE PLASTICS INC  
4516 BRAZIL ST LOS ANGELES 39 CALIF  
FURANE PLASTICS INC  
42 CHASNER ST HEMPSTEAD L I N Y  
FURNAS ELECTRIC CO  
1000 MCKEE ST BATAVIA ILL  
FURZEHILL LABS LTO  
THEOBALD ST BOREHAMWOOD HERTS ENG  
FUSITE CORP  
6000 FERNVIEW AVE CINCINNATI 12 OHIO  
F X R INC  
26-12 BOROUGH PLACE WOODSIDE 77 N Y  
FYR-FYTER ELECTRONIC & ALARM CORP  
EDISON N J

G

GABRIEL ELECTRONICS DIV GABRIEL CO  
MILLIS MASS  
GAI-TRONICS CORP  
525 LANCASTER AVE READING PENNA  
GALLAND-HENNING NOPAK DIV  
2753 S 31ST ST MILWAUKEE WISC  
GAMMA SCIENTIFIC INC  
4455 TWAIN SAN DIEGO 20 CALIF  
GAP INSTRUMENT CORP  
116 E HERRICK RO FREEPORT N Y  
GAP INSTRUMENT CORP  
17 BROOKLYN AVE WESTBURY L I N Y  
GAR PRECISION PARTS  
190 HENRY ST STAMFORD CONN  
GAROE MFG CO  
53 JOHN ST CUMBERLAND R I  
GARDINER ELECTRONIC CO  
2545 E INDIAN SCHOOL RO PHOENIX ARIZ  
GARONER LAB INC  
P O BOX 5728 BETHESDA MD  
GARDNER-DENVER CO  
FRONT ST QUINCY ILL  
GARLOCK ELECTRONIC PRODUCTS  
402 MAIN ST PALMYRA N Y  
GARLOCK ELECTRONIC PRODUCTS  
600 N 10TH ST CAMOEN 1 NJ

# ELECTRONIC MANUFACTURERS—A TO Z

GARNER T H CO  
177 S INDIAN HILL BLVD CLAREMONT CALIF  
GARRARD SALES CORP  
8D SHORE RD PORT WASHINGTON N Y  
GARY WELLS CO  
361 ROCKAWAY AVE VALLEY STREAM N Y  
GASSER METAL PRODUCTS  
69-15 50TH AVE WOODSIDE N Y  
GATES & CO GEO W  
HEMPSTEAD TPKE & LUCILLE AVE FRANK SQ N Y  
GATES ELECTRONIC CO  
2243 WHITE PLAINS RD BRONX N Y  
GATES RADIO CO  
123 HAMPSHIRE ST QUINCY ILL  
GAVIN INSTRUMENTS INC  
DEPOT SQUARE SOMERVILLE N J  
GAVITT WIRE & CABLE CO DIV OF AMERACE CORP  
455 N QUINCE ST ESCONOIDO CALIF  
GAVITT WIRE & CABLE CO PLANT & GEN OFFICE  
DIV AMERACE CORP  
BROOKFIELD MASS  
GAYLOR PRODUCTS CO  
1110 CUMPTON ST N HOLLYWOOD CALIF  
GAYLORD RIVES CO  
181 N HILL ST PASADENA CALIF  
GB COMPONENTS INC  
14621 ARMINA ST VAN NUYS CAL  
G C ELECTRONICS COMPANY CHEMICAL TOOL DIV  
400 50 WYMAN ST ROCKFORD ILL  
G-C ELECTRONICS CO KNOB & RESISTOR DIV  
400 S WYMAN ST ROCKFORD ILL  
G-C ELECTRONICS CO DIV TETRON ELECTRONICS  
400 S WYMAN ST ROCKFORD ILL  
GEARTRONICS CORPORATION  
114 CHELMSFORD RD BILLERICA MASS  
GEBE ELECTRONIC SERVICE  
4112 W JEFFERSON BLVD LOS ANG CAL  
GEE LAR MFG CO  
400 WYMAN ST ROCKFORD ILL  
GEER MACHINE WORKS INC  
200 NEVADA ST EL SEGUNDO CALIF  
GEFCO MFG CORP  
101 PINE ST BOX 436 GRAYSLAKE ILL  
GELMAN INSTRUMENT CO  
CHELSEA MICH  
GEMCO ELECTRIC CO  
25685 W EIGHT MILE RD DETROIT MICH  
GEMS CO  
SHEPPARD LANE BOX 255 FARMINGTON CONN  
GENALEX DIV BRITISH INDUSTRIES CORP  
80 SHORE RD PORT WASHINGTON N Y  
GENERAL APPLIED SCIENCE LAB  
MERRICK & STEWART AVE WESTBURY N Y  
GENERAL ATOMATICS INC  
331 ALMA ST PALO ALTO CALIF  
GENERAL ATRONICS CORP ATRONIC PROD DIV  
1200 E MERMAID LANE PHILA PA  
GENERAL ATRONICS CORP  
UNION HILL W CONSHOHOCKEN PENNA  
GENERAL ATRONICS CORP  
ELECTRONIC TUBE AND INSTRUMENT DIVISION  
1200 EAST MERMAID LANE PHILA 18 PA  
GENERAL AUTOMATIC CORP  
111 33RD ST UNION CITY N J  
GENERAL AUTOMATICS INC  
331 ALMA ST PALO ALTO CALIF  
GENERAL BOX CO  
1825 MINER ST DES PLAINES ILL  
GENERAL CABLE CORP  
QUINCY MICH  
GENERAL CABLE CORP  
730 3RD AVE NEW YORK N Y  
GENERAL CABLE CORP  
25 WASHINGTON ST PERTH AMBOY N J  
GENERAL CABLE CORP  
1278 ORGILL AVE MEMPHIS TENN  
GENERAL CABLE CORP  
600 RAILROAD ST ROME N Y  
GENERAL CAPACITOR CO  
755 LOMA VERDE AVE PALO ALTO CALIF  
GENERAL CERAMICS DIV IND GENERAL CORP  
CROWS HILL RD KEASBEY N J  
GENERAL COIL PRODUCTS CORP  
147 12 LIBERTY AVE JAMAICA N Y  
GENERAL COMMUNICATION CO  
677 BEACON ST BOSTON 15 MASS  
GENERAL COMPUTERS INC  
9000 W PICO BLVD LOS ANG CALIF  
GENERAL CONTROL CO  
1200 SOLDIERS FIELD RD BOSTON 34 MASS  
GENERAL CONTROLS CO  
801 ALLEN AVE GLENDALE 1 CALIF  
GENERAL CONTROLS CO AIRCRAFT/ELEC CONTROLS  
3320 S FLOWER ST BURBANK CALIF  
GENERAL CONTROLS CO IRON MOUNTAIN DIV  
IRON MOUNTAIN MICH  
GENERAL CONTROLS CO OF CANADA LTD  
171 SURREY ST GUELPH ONT CANADA  
GENERAL CONTROLS CO  
8080 MCCORMICK BLVD SKOKIE ILL  
GENERAL CRYSTAL CO INC  
P O BOX 9 BURLINGTON WISC  
GENERAL DEVICES INC  
P O BOX 253 PRINCETON N J  
GENERAL DYNAMICS TELECOMMUNICATION  
100 CARLSON RD ROCHESTER N Y  
GENERAL DYNAMICS ELECT  
3302 PACIFIC HWY SAN DIEGO CALIF  
GENERAL DYNAMICS POMONA  
P O BOX 1011 POMONA CALIF  
GENERAL DYNAMICS/ASTRONAUTICS  
DIV OF GENERAL DYNAMICS CORP  
PO BOX 1128 SAN DIEGO 12 CALIF  
GENERAL DYNAMICS/ELECTRONICS  
INFORMATION TECHNOLOGY DIV  
1895 HANCOCK ST SAN DIEGO 12 CALIF

GENERAL DYNAMICS ELECTRONICS  
1400 GOODMAN ST ROCHESTER N Y  
GENERAL ELECTRIC CO COMPUTER DEPT  
13430 N BLACK CANYON HWY PHOENIX ARIZ  
GENERAL ELECTRIC CO  
1034 66TH AVE OAKLAND 21 CALIF  
GENERAL ELECTRIC CO POWER TUBE DEPT  
PALO ALTO CALIF  
GENERAL ELECTRIC CO ATOM POWER EQUIP  
NUCLEAR ELECTRONIC PROOS SECT  
175 CURTNER AVE SAN JOSE CALIF  
GENERAL ELECTRIC CO  
1285 BOSTON AVE BRIDGEPORT 2 CONN  
GENERAL ELECTRIC CIRCUIT PROTECTIVE  
41 WOODFORD AVE PLAINVILLE CONN  
GENERAL ELECTRIC CO AUDIO PRODUCTS DEPT  
2200 N 22 ST DECATUR ILL  
GENERAL ELECTRIC HOTPOINT DIV  
E PLEASANT ST OAKLB ILL  
GENERAL ELECTRIC CO SPECIALTY MOTOR DEPT  
1635 BROADWAY FORT WAYNE 2 IND  
GENERAL ELECTRIC CO  
SHELBYVILLE IND  
GENERAL ELECTRIC CO RECEIVING TUBE DEPT  
316 E 9TH OWENSBORO KY  
GENERAL ELECTRIC CO INSULATOR DEPT  
5 CHARLES & CROMWELL ST BALTIMORE 30 MD  
GENERAL ELECTRIC DIST TRANSFORMER DEPT  
60 JACKSON ST HOLYOKE MASS  
GENERAL ELECTRIC COMPANY CHEM MATERIAL DEPT  
ONE PLASTICS AVENUE PITTSFIELD MASS  
GENERAL ELECTRIC CO ORDNANCE DEPT  
100 PLASTICS AVE PITTSFIELD MASS  
GENERAL ELECTRIC CO MAGNETIC MATERIALS SEC  
EDMORE MICH  
GENERAL ELECTRIC RECEIVING TUBE DEPT  
BOX 47 SPRINGFIELD N J  
GENERAL ELECTRIC RECTIFIER COMPONENTS DEPT  
COLUMBIA ST CLYDE N Y  
GENERAL ELECTRIC CO  
10 MANSTON ST PO BOX 278 COXSACKIE N Y  
GENERAL ELECTRIC CO CAPACITOR DEPT  
JOHN ST HUDSON FALLS N Y  
GENERAL ELECTRIC CO  
APPARATUS SALES DIV SCHENECTADY N Y  
1 RIVER RD SCHENECTADY 5 N Y  
GENERAL ELECTRIC CO POWER TUBE DEPT  
BLOG 267 SCHENECTADY 5 N Y  
GENERAL ELECTRIC CO  
SYRACUSE N Y  
GENERAL ELECTRIC CO CATHODE RAY TUBE DEPT  
ELECTRONICS PARK SYRACUSE N Y  
GENERAL ELECTRIC HEAVY MILITAR ELECT DEPT  
COURT ST SYRACUSE N Y  
GENERAL ELECTRIC CO SEMICONDUCTOR DEPT  
SYRACUSE N Y  
GENERAL ELECT CO SPECIALTY DEVICES OPER  
1811 LEMOYNE AVE SYRACUSE N Y  
GENERAL ELECTRIC CO  
TECHNICAL PRODS DEPT  
ELECTRONIC PARK SYRACUSE N Y  
GENERAL ELECTRIC CO TELEVISION RECEIVER DEPT  
ELECTRONICS PARK SYRACUSE N Y  
GENERAL ELECTRIC CO  
FRENCH RD UTICA N Y  
GENERAL ELECTRIC CO  
SILICONE PRODUCTS DEPT A WATERFORD N Y  
GENERAL ELECTRIC CO  
CAROLINA WELDS PLANT GOLDSBORO N C  
GENERAL ELECTRIC CO  
21800 TUNGSTEN RD CLEVELAND 17 OHIO  
GENERAL ELECTRIC CO MINIATURE LAMP DEPT  
NELA PARK CLEVELAND 12 OHIO  
GENERAL ELECTRIC LAMINATED PRODUCTS DEPT  
COSHOCTON OHIO  
GENERAL ELECTRIC CO DOVER WIRE PLT  
100 W BROADWAY DOVER OHIO  
GENERAL ELECT CO LOW VOLT SWITCHGEAR DIV  
6901 ELMWOOD AVE PHILA PA  
GENERAL ELEC CO MISSILE & SPACE VEH DEPT  
VALLEY FORGE SPACE TECH CTR  
P O BOX 8555 PHILA 1 PA  
GENERAL ELECT CO WIRING DEVICE DEPT  
95 HATHAWAY ST PROVIDENCE 7 R I  
GENERAL ELECTRIC CAPACITOR DEPT  
IRMO S C  
GENERAL ELECTRIC CO MISSILE AND ARMAMENT DEP  
LAKESIDE AVE BURLINGTON VT  
GENERAL ELECTRIC COMMUNICATION PROD DEPT  
MOUNTAIN VIEW RD LYNCHBURG VA  
GENERAL ELECTRIC CO INDUSTRY CONTRL DEPT  
1501 ROANOKE BLVD SALEM VA  
GENERAL ELECTRIC CO SPECIALTY CDNTROL DEPT  
P O BOX 812 WAYNESBORO VA  
GENERAL ELECT CONTROL INC  
8001 BLOOMINGTON FREETWAY MINN MINN  
GENERAL ELECTRODYNAMICS CORP  
4430 FOREST LANE GARLAND TEXAS  
GENERAL ELECTRONICS INC  
101 HAZEL ST PATERSON N J  
GENERAL ELECTRONIC LABS INC  
8440 SECOND AVE SILVER SPRING MD  
GENERAL ELECTRONIC LAB INC  
SIMON ST NASHUA NH  
GENERAL ELECTRO MECHANICAL CORP  
785 HERTEL AVE BUFFALO N Y  
GENERAL FINDINGS INC  
LEACH & GARNER BLDG ATTLEBORO MASS  
GENERAL FORMULATIONS INC  
320 S UNION SPARTA MICH  
GENERAL INDUSTRIES CO  
OLIVE & TAYLOR STS ELYRIA OHIO  
GENERAL INDUSTRIES CO  
RTE 97 BELLEVILLE OHIO  
GENERAL INST CORP MAGNE HD & SYSTMCS DIV  
3216 EL SEGUNDO BLVD HAWTHORNE CALIF

GENERAL INSTR CORP HARRIS A S W DIV  
WOODBURY CONN  
GENERAL INSTRUMENT CO  
DARLINGTON SC  
GENERAL INSTRUMENT CORP CAPACITOR DIV  
ORANGE ST DARLINGTON SC  
GENERAL INSTRUMENT CORP  
65 GOUVEURNER ST NEWARK N J  
GENERAL INSTRUMENT CORP RADIO RECEPTOR DIV  
DEF & ENGG PRODS GRP  
ANDREWS RD HICKSVILLE L I N Y  
GENERAL INSTRUMENT CORP SEMICONDUCTOR DIV  
600 W JOHN ST HICKSVILLE N Y  
GENERAL INSTRUMENT CORP F W SICKLES DIV  
165 FRONT ST CHICOPEE MASS  
GENERAL INSTRUMENT CORP CAPACITOR DIV  
TAZEWELL VA  
GENERAL INSULATED WIRE WORKS INC  
69 GORDON AVE PROVIDENCE 3 RI  
GENERAL KINETICS INC  
2611 SHIRLINGTON RD ARLINGTON VA  
GENERAL MAGNETICS INC  
135 BLOOMFIELD AVE BLOOMFIELD N J  
GENERAL MAGNETIC CORP  
10001 ERWIN AVE DETROIT MICH  
GENERAL MAGNETICS INC  
2641 LOUISIANA AVE MINN MINN  
GENERAL METAL PROD CO  
DIV OF PLANETRONICS INC  
CENTRE & GLENDALE STS EASTON PA  
GENERAL METAL PROD CO  
1010 CENTRE ST EASTON PA  
GENERAL METERS INC  
P O BOX 1701 GRAND JUNCTION COLO  
GENERAL MICROWAVE CORP  
155 MARINE ST FARMINGDALE N Y  
GENERAL MILLS INC  
1620 CENTRAL AVE MINNEAPOLIS 13 MINN  
GENERAL MILLS INC CHEMICAL DIV  
5 KENSINGTON RD KANKAKEE ILL  
GENERAL MOTORS CORP NEW DEPARTURE DIV  
HAYES AVE SANDUSKY OHIO  
GENERAL PLASTICS CORP  
53 LA FRANCE AVE BLOOMFIELD N J  
GENERAL PRECISION INC  
LIBRASCOPE DIV SAN MARCOS BRANCH  
1370 ENCINITAS RD SAN MARCOS CALIF  
GENERAL PRECISION EQUIP LIBRASCOPE DIV  
670 ARQUES AVE SUNNYVALE CALIF  
GENERAL PRODUCTS CORP  
SALEM ST UNION SPRINGS N Y  
GENERAL RADIO CO  
WEST CONCORD MASS  
GENERAL RAILWAY SIGNAL CO  
P O BOX 600 ROCHESTER N Y  
GENERAL RELAY CORP  
39 LEONARD ST DOVER N J  
GENERAL RESISTANCE INC  
430 SOUTHERN BLVD NEW YORK 55 N Y  
GENERAL RF FITTINGS INC  
702 BEACON ST BOSTON MASS  
GENERAL SCIENTIFIC EQUIP CO  
7516 LIMELKIN PIKE PHILA PA  
GENERAL SCIENTIFIC CORP  
1509 FIRST ST SAN FERNANDO CALIF  
GENERAL STENCILS INC  
827 E 92ND ST BROOKLYN 36 N Y  
GENERAL TECHNOLOGY CORP  
3510 TORRANCE BLVD TORRANCE CALIF  
GENERAL TEL & ELECT LEICH ELECT CO  
333 E FIRST ST GENOA ILL  
GENERAL TEL & ELECT ANNARBOR PLANT  
405 FOURTH ST ANN ARBOR MICH  
GENERAL TEL & ELECT WALTHAM PLANT  
63 SECOND AVE WALTHAM MASS  
GENERAL TEL & ELECT HILLSBORO PLANT  
HILLSBORO N H  
GENERAL THERMODYNAMICS INC  
7649 SAN FERNANDO RD BURBANK CALIF  
GENERAL TIME CDRP ELECTR SYS DIV  
201 SUMMER ST STAMFORD CONN  
GENERAL TRANSISTOR CORP  
600 W JOHN ST HICKSVILLE N Y  
GENERAL VACUUM CORP  
81 HICKS AVE MEDFORD MASS  
GENISCO INC  
2233 FEDERAL AVE LOS ANGELES CALIF  
GENISTROM INC  
6320 W ARIZONA CIRCLE LOS ANG CALIF  
GENISTRON INC  
111 GATEWAY RD BENSENVILLE ILL  
GENTAPE CORP  
51 LA FRANCE AVE BLOOMFIELD N J  
GEOPHYSICAL INST CO INC  
315 TUDOR RD MANASSAS VA  
GEOPHYSICAL SPECIALTIES CO  
3110 SHORES BLVD WAYZATA MINN  
GEOPHYSICAL SPEC CO  
BOX 301 ROUTE 3 HOPKINS MINN  
GEOPHYSICS CORP OF AMER  
BURLINGTON RD BEDFORD MASS  
GEORATOR CDRP  
TUDOR LANE MANASSAS VA  
GEORGE GORTON MACHINE CO  
1321 RACINE ST RACINE WISC  
GEOSCIENCE INSTRUMENTS CORP  
110 BECKMAN ST NEW YORK N Y  
GEOTECHNICAL CORP  
3401 SHILOH RD GARLAND TEXAS  
GEOTRONIC LABS INC  
1314 CEDAR HILL AVE DALLAS 8 TEXAS  
GERBER SCIENTIFIC INST CO  
1505 RTE 5 S WINDSOR CONN  
GERST & CO PAUL E  
4868 N CLARK ST CHICAGO 40 ILL  
GERTSCH PRODUCTS INC  
3211 LA CIENEGA BLVD LOS ANGELES 16 CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

GIANNINI CONTROLS CORP SERVD COMP DIV  
1133 FLOWER GLENDALE CALIF  
GIANNINI CONTROLS CORP GYRO DIV  
1600 S MOUNTAIN AVE DUARTE CALIF  
GIANNINI CONTROLS CORP SYSTEMS DIV  
1600 S MOUNTAIN AVE DUARTE CALIF  
GIANNINI CONTROLS CORP CONRAC DIV  
GLENDDRA CALIF  
GIANNINI CONTROLS CORP TRANSDUCER DIV  
55 N VERNON AVE PASADENA CALIF  
GIANNINI CONTROLS CORP CRAMER DIV  
OLD SAYBROOK CONN  
GIANNINI CONTROLS CORP NJ DIV  
SHERWOOD LANE CALDWELL TWP NJ  
GIBBS MFG RESEARCH CORP  
450 N MAIN ST JANESVILLE WISC  
GIBSON ELECTRIC CO  
OLD WM PENN HWY DELMONT PA  
GILBERT & BAKER MFG CO  
WEST SPRINGFIELD MASS  
GILFORD INSTRUMENT LABS INC  
OBERLIN OHIO  
GILLIES CO INC DUNCAN M  
66 CENTRAL ST WEST BOYLSTON MASS  
GILMORE INDUSTRIES INC  
335 RICHMOND RD CLEVELAND OHIO  
GIRARD-HOPKINS  
1000 40 AVE OAKLAND 1 CALIF  
GIRDLER PROCESS EQUIP DIV  
2820 BROADWAY BOX 43 LOUISVILLE KY  
GISHOLT MACHINE CO  
1245 WASHINGTON MADISON WISC  
GITS BROS MFG CO  
1846 S KILBOURN AVE CHICAGO ILL

GLADDING MCREAM & CO  
2901 LOS FELTZ BLVD LOS ANGELES CALIF  
GLADDING MCREAM & CO  
1551 PRIMROSE ST MONROVIA CALIF  
GLASER STEERS CORP  
155 ORATON ST NEWARK N J  
GLASPLY CORP  
S SIXTH ST VERPLANCK N Y  
GLASSCO INSTRUMENTS CO  
777 SO ARROYO PKWY PASADENA CALIF  
GLASS-SOLDER ENGG  
4232 TEMPLE CITY BLVD ROSEMEADE CALIF  
GLASS-TITE INDUSTRIES INC  
725 BRANCH AVE PROVIDENCE 4 R I  
GLASSEAL PRODUCTS CO INC  
725 COMMERCE RD LINDEN N J  
GLEASON AVERY INC  
AUBURN N Y  
G L ELECTRONICS CO INC  
300 HARVARD AVE WESTVILLE N J  
GLP ELECTRONICS INC  
350 RIVERSIDE AVE BRISTOL CONN  
GLENN PACIFIC CORP  
703 37TH AVE OAKLAND 1 CALIF  
GLENTRONICS INC  
748 E ALOSTA BLVD GLENDORA CALIF  
THE GLODDEN CO  
5662 BRIDGE ST JOHNSTOWN PENNA  
GLOBE ELECTRICAL MFG CO  
1729 W 134 ST GARDENA CALIF  
GLOBE ELECTRONICS CO  
400 S WYMAN ST ROCKFORD ILL  
GLOBE INDUSTRIES INC  
1784 STANLEY AVE DAYTON 4 OHIO  
GLYCO CHEMICALS DIV C L HUIKING CO INC  
417 5TH AVE NEW YORK 16 N Y  
G-M LABORATORIES INC  
4300 N KNOX AVE CHICAGO 41 ILL  
G M MFG CO  
12 E 125TH NEW YORK N Y  
GODFREY MFG CO  
1633 HALSTED ST CHICAGO ILL  
GOE ENGG CO  
P O BOX 22004 LOS ANGELES CALIF  
GOLDEN CO  
1054 38 ST BROOKLYN 19 N Y  
GOLDING MFG CO  
90 PORETE AVE N ARLINGTON N J  
GOLDSMAN CO  
1328 34 N 4TH ST PHILA PA  
GOMBOS INC CO JOHN  
WEBRO ROAD CLIFTON N J  
GOOD ALL ELECTRIC MFG CO  
112 W FIRST ST OGALLALA NEBR  
GOOD ELECTRONICS CORP  
P O BOX 2406 W PALM BEACH FLA  
GOOD-ALL ELECTRIC MFG CO  
ALLIANCE NEB

GOODRICH AVIATION PRODUCTS DIV B F GOODRICH  
500 S MAIN ST AKRON 18 OHIO  
GORDON CO CLAUD S  
RICHMOND ILL  
GORDON ENTERPRISES  
5362 N CAHUENGA BLVD N HOLLYWOOD CALIF  
GORDOS CORP  
250 GLENWOOD AVE BLOOMFIELD N J  
GORE & ASSOC INC W L  
555 PAPER MILL RD NEWARK DEL  
GORHAM ELECT DIV GORHAM MFG CO  
PROVIDENCE R I  
GORMAN MACHINE CORP  
480 S MAIN ST RANDOLPH MASS  
GORN ELECTRIC CO GORN ELECT DIV  
845 MAIN ST STAMFORD CONN  
GOTHAM AUDIO DEVELOPMENT CORP  
2 W 46 ST NEW YORK 36 N Y  
GOW MAC INSTRUMENT CO  
100 KINGS RD MADISON N J  
G P E CONTROLS INC  
240 E ONTARIO ST CHICAGO 11 ILL  
GPL DIV GENERAL PRECISION INC  
63 BEDFORD RD PLEASANTVILLE N Y

GPS INSTRUMENT CO  
180 NEEDHAM ST NEWTON 64 MASS  
W R GRACE & CO DAVIDSON CHEMICAL DIV  
ERWIN TENN  
GRAFLEX INC  
3750 MONROE AVE ROCHESTER N Y  
GRAFO COLLOIDS CORP  
310 WILKES PL SHARON PA  
GRAHAM MFG CO  
147 BRIDGE ST EAST GREENWICH 1 RI  
GRAHAM RESEARCH INC  
666 22ND AVE N E MINNEAPOLIS 18 MINN  
GRAHAM TRANSMISSION INC  
HENONONEE FALLS WIS  
GRANCO PRODUCTS INC  
83 30 KEW GARDENS RD KEW GARDENS N Y  
GRAND COIL WINDERS  
14306 LAKESHORE AVE GRAND HAVEN MICH  
GRAND TRANSFORMERS INC  
BEECHTREE & MARION STS GRAND HAVEN MICH  
GRAND TRANSFORMERS INC  
PAW PAW AVE BENTON HARBOR MICH  
GRANER T H CO  
177 S INDIAN HILL BLVD CLAREMONT CALIF  
GRANGER ASSOC  
974 COMMERCIAL ST PALO ALTO CALIF  
GRANITE STATE MACH CO INC  
124 JOLIETTE ST MANCHESTER N H  
GRANT GEAR WORKS  
154 W 2 ST S BOSTON MASS  
GRANT PULLEY & HARDWARE CORP INDUSTRIAL DIV  
HIGH ST W NYACK N Y  
GRANT PULLEY & HDWE CORP  
944 LONG BEACH AVE LOS ANGELES CALIF

GRAPHIC SYSTEMS  
925 DANVILLE ROAD YANCEYVILLE NC  
GRAPHICS INC  
590 BELLEVILLE TURNPIKE KEARNY N J  
GRAPHICS INC  
PO BOX 72 STATE 59 POTEAU OKLA  
GRAPHIK CIRCUITS DIV CINCH MFG CORP  
200 TURNBULL CANYON RD CITY OF INDUST CAL  
GRAPHITE METALLIZING CORP  
1050 NEPPERMAN AVE YONKERS NY  
GRASON-STRADLER CO INC  
WEST CONCORD MASS  
GRAY GAINER ELECTRONICS  
BOX 3736 AKRON 14 OHIO  
GRAY & KUHN  
10 PELHAM PKWAY PELHAM N Y  
GRAY INSTRUMENT CO  
448 MILL RD ANDALUSIA PA  
GRAY MFG CO  
16 ARBOR ST HARTFORD CONN  
GRAY RADIO CO  
501 FOREST HILL BLVD W PALM BEACH FLA  
GRAYHILL INC  
561 HILLGROVE AVE LA GRANGE ILL  
GRAYHILL MOLDTRONICS INC  
229 BURLINGTON AVE CLARENDON HILLS ILL  
GREAT EASTERN MFG CO  
163-165 REMSEN AVE BROOKLYN 12 N Y  
GREAT FALLS PRODUCTS CO INC  
GREAT FALLS AVE ROCHESTER N H  
GREAT LAKES ELECTRIC MFG CO  
17 S DESPLAINES ST CHICAGO 6 ILL  
GREEN INSTRUMENTS INC H J  
2500 SHAMES DR WESTBURY N Y  
GREEN INSTRUMENT CO  
295 VASSAR ST CAMBRIDGE MASS  
GREEN RECTIFIER CO  
1-10 30 ST FAIRLAWN N J  
GREENBRIER INSTRUMENTS INC  
RONCEVERTE WEST VA  
GREENE CO L CHARLTON  
MILLSTREAM CHELMSFORD MASS  
GREENE CORP G G  
WARREN PA  
GREENE TWEED & CO  
NORTH WALES PA

GREENLEAF DIV OF SYSTRON DONNER CORP  
7814 MAPLEWOOD INDUSTRY ST LOUIS MO  
GREENTREE ELECTRONICS CORP  
2020 PLACENTIA AVE COSTA MESA CALIF  
GREGORY MAGNETIC INDUSTRY INC  
2133 N E 19TH AVE FT LAUDERDALE FLA  
GRETBACH INSTRUMENT SCORP  
315 NORTH AVE NEW ROCHELLE N Y  
GREINER CO EMIL  
22 N MOORE ST NEW YORK 13 N Y  
GREM ENGG CO  
923 LONGVIEW RD KING OF PRUSSIA PA

GREMAR MFG CO  
7 NORTH AVE WAKEFIELD MASS  
GRIES REPRODUCER CORP  
5 2ND ST NEW ROCHELLE N Y  
GRINNELL ELECTRONICS INC  
742 E ALOSTA BLVD GLENDORA CALIF  
GROOV-PIN CORP  
1125 HENDRICKS CAUSEWAY RIDGEFIELD N J  
GROVER PHOTO PROD  
341 ARDEN GLENDALE CALIF  
GRUENBERG ELECTRIC CO INC  
9 COMMERCIAL AVE GARDEN CUTY N Y  
GUARDIAN ELECTRIC MFG CO  
1550 W CARROLL ST CHICAGO 12 ILL  
GUARDIAN ELECTRIC MFG CO  
333 W CARROLL CHICAGO ILL  
GUARDIAN ELECTRIC MFG CO OF CALIF INC  
5755 CAMILLE AVE CULVER CITY CALIF  
THE GUEDEMAN CO  
W HURON ST CHICAGO 10 ILL  
GUEDEMAN CO OF CALIF  
7473 AVE 304 VISALIA CALIF  
GUIDANCE CONTROLS CORP  
SUB WARNER ELEC BRAKE & CLUTCH CO

GUIDANCE TECHNOLOGY INC  
2500 BROADWAY SANTA MONICA CALIF  
GUIOE LAMP DIV  
2915 PENDELTON AVE ANDERSON IND  
GUIDE MFG CO  
8218 LANKERSHIM BLVD N HOLLYWOOD CALIF  
GUILD ELECTRONICS INC  
388 BROADWAY NEW YORK N Y  
GUILLEMIN NETWORKS INC  
391 ELIOT ST NEWTON 64 MASS  
GULTON INDUSTRIES INC  
212 DURHAM AVE METUCHEN N J  
GULTON INDUSTRIES INC ENG MAGNETICS DIV  
13031 CERISE AVE HAWTHORNE CALIF  
GULTON INDUSTRIES INC WEST INSTRUMENT CORP  
4363 MONTROSE AVE CHICAGO ILL  
GULTON INDUSTRIES INC ORTHOLOG DIV  
4054 QUAKER BRIDGE RD TRENTON N J  
GULTON INDUSTRIES INC  
CG ELECTRONICS DIV  
15000 CENTRAL EAST ALBUQUERQUE N M  
GUNNAR LABS  
3333 26TH ST BOX 546 RT 1 BRADENTON FLA  
GURLEY W & L E  
514 FULTON ST TROY N Y  
G-V CONTROLS INC  
OKNER PARKWAY LIVINGSTON N J  
GWILLIAM CO  
342 FURMAN ST BROOKLYN 1 N Y  
GYRA ELECTRONICS CORP  
WASHINGTON & ELM STS LA GRANGE ILL  
GYREX CORP  
3003 PENNA AVE SANTA MONICA CALIF

## H

HACKENSACK CABLE CORP  
110 ORCHARD ST HACKENSACK N J  
HACKER INSTRUMENTS INC  
SHERWOOD LANE PASSAIC AVE CALDWELL TW N J  
MAGAN CHEMICALS & CONTROLS INC  
BOX 1346 PITTSBURGH PA  
HAIRSPRING VIBRATING CO  
406 32ND ST UNION CITY N J  
HAL MEN CO  
36 14 11 ST LONG ISLAND CITY N Y  
HALEDY ELECT CO  
1949 51 MCDONALD AVE BROOKLYN N Y  
HALEX INC  
P O BOX 546 EL SEGUNDO CAL  
HALEX CORP  
27302 W 7 MILE RD DETROIT MICH  
HALL MFG CO  
3901 WESLEY TERRACE SCHILLER PK ILL  
HALLAMORE ELECTRONICS CO  
714 N BROOKHURST ST ANAHEIM CALIF  
HALLETT MFG CO  
5910 BOWCRAFT ST LOS ANGELES CALIF  
HALLIBURTON ENTERPRISES INC MFG DIV  
4724 S BOYLE AVE LOS ANGELES 58 CAL  
HALLICRAFTERS PACIFIC DIV  
300 W WARNER AVE SANTA ANA CALIF  
HALLICRAFTERS CO  
4401 W 5TH AVE CHICAGO 26 ILL  
HALLIKAINEN INSTRUMENTS  
1341 7 ST BERKELEY CALIF  
HALLMARK INST CORP  
2215 COMMERCE ST DALLAS TEXAS  
HALMAR ELECTRONICS INC  
1544 WEST MOUND ST COLUMBUS 23 OHIO  
HALOGEN INSULATOR & SEAL CORP  
9960 PACIFIC AVE FRANKLIN PARK ILL  
HAMILTON ELECTRONICS CORP  
2726 W PRATT AVE CHICAGO ILL  
HAMILTON HALL INC  
227 N WATER MILWAUKEE WISC  
HAMILTON KENT MFG CO  
427 GRANT ST KENT OHIO  
HAMILTON MFG CO  
TWO RIVERS WISC  
HAMILTON STANDARD ELECTRONICS DEPT  
MAIN ST BROAD BROOK CONN  
HAMILTON STANDARD DIV OF UNITED AIRCRAFT  
WINDSOR LOCKS CONN  
HAMILTON WATCH CO INDUSTRIAL PRODS DIV  
COLUMBIA AVE LANCASTER PA  
HAMLIN INC  
LAKE & GROVE STS LAKE MILLS WISC  
HAMMARLUND MFG CO INC  
MARS HILL N CAROLINA  
HAMNER ELECTRONICS CO INC  
P O BOX 531 PRINCETON N J  
HANCOCK TELECONTROL CORP  
143 SOUND BEACH AVE OLD GREENWICH CONN  
HANDEE HOUSEHOLD PRODUCTS  
408 12 ST BROOKLYN NY  
HANDY & HARMAN  
850 THIRD AVE NEW YORK N Y  
HANDY & HARMAN  
BRIDGEPORT CONN  
HANDY & HARMAN  
330 N GIBSON RD EL MONTE CALIF  
HANOVIA LAMP DIV/ENGLEHARD INDUSTRIES INC  
100 CHESTNUT ST NEWARK 5 N J  
HANSEN MFG CO  
R R 1 PRINCETON IND  
HARDER CO DONALD C  
2580 K ST SAN DIEGO 2 CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

HARDMAN CO H V  
583 CORTLANDT ST BELLEVILLE 9 N J  
HARKINS RADIO INC  
4444 E WASHINGTON ST PHOENIX ARIZ  
HARMAN KARDON INC  
AMES CT PLAINVIEW L I N Y  
HARMON LICHTENSTEIN & CO  
26 BROADWAY NEW YORK 4 N Y  
HAROWE SERVO CONTROLS INC  
W CHESTER PK AT WESTTOWN RD W CHESTER PA  
HARPER LEADER INC  
1046 S MAIN ST WATERBURY CONN  
HARREL INC  
16 FITCH ST E NORWALK CONN  
HARRIS MFG CO INC  
8031 35 LITZINGER RD ST LOUIS 17 MO  
HARRISON LABS  
45 INDUSTRIAL RD BERKELEY HGTS N J  
HARRISON PAINT & VARNISH CO  
1329 HARRISON AVE S W CANTON 1 OHIO  
HARRITON SHARPE CORP  
8060 SALT LAKE AVE HUNTINGTON PK CALIF  
HARRIS REFRIGERATION CO  
308 RIVER ST CAMBRIDGE 39 MASS  
HARRISTAHL LABORATORIES  
474 E 2ND ST BROOKLYN 26 N Y  
HARSHAW CHEMICAL CO  
1945 E 97 ST CLEVELAND 6 OHIO  
HART MFG CO  
128 BARTHOLOMEW AVE HARTFORD CONN  
HART MFG CO  
ANN ARBOR MICH  
HARTLEY PROD RESCH LAB  
397 W 21 ST HOLLAND MICH  
HARTLEY PRODUCTIONS CO  
517 519 E 162 ST NEW YORK N Y  
HARTMAN ELECTRICAL MFG CO  
175 N DIAMOND ST MANSFIELD OHIO  
HARTWELL CORP  
9035 VENICE BLVD LOS ANGELES 34 CALIF  
HARVEY ALUMINUM  
19200 S WESTERN AVE TORRANCE CALIF  
HARVEY HUBBELL INC  
STATE ST & BOSTWICK AVE BRIDGEPORT 2 CONN  
HARVEY WELLS ELECTRONICS INC  
14 HURON DRIVE NATICK MASS  
HARVICK MFG CORP  
SOUTH GATE CALIF  
HARWALD CO INC  
1245 CHICAGO AVE EVANSTON ILL  
HARDWIC HANDLE INC  
40 HERMON ST NEWARK N J  
HARWORTH MFG CO  
409 EL CAMINO REAL MENLO PARK CALIF  
HASSALL INC JOHN  
CANTAGUE RD WESTBURY LI N Y  
HASTINGS-RAYOIST INC  
NEWCOMB AVE HAMPTON VA  
HATHAWAY INSTRUMENTS DIV LIONEL  
5800 E JEWELL AVE DENVER 22 COLO  
HAVEG INDUSTRIES INC  
900 GREENBANK RD WILMINGTON 8 DELA  
HAVIR MFG CO  
436 CLEVELAND AVE ST PAUL MINN  
HAWLEY PRODUCTS CO  
333 N 6TH ST ST CHARLES ILL  
HAYDON CO A W  
232 N ELM ST WATERBURY 20 CONN  
THE A W HAYDON CO  
4060 INCE BLVD CULVER CITY CALIF  
HAYDON OIV GENERAL TIME CORP  
245 E ELM ST TORRINGTON CONN  
HAYDON INSTRUMENT CO  
17 BROWN ST WATERBURY CONN  
HAYDON SWITCH INC  
536 S LEONARD ST WATERBURY CONN  
HAYES INC C I  
875 WELLINGTON AVE CRANSTON R I  
HAYNES LABS INC C W  
61 CHANDLER ST SPRINGFIELD 9 MASS  
HAYNES STELLITE CO  
1020 PARK AVE KOKOMO IND  
HAYS CORP  
742 E 8TH ST MICHIGAN CITY IND  
HAZELTINE ELECTRONICS DIV/HAZELTINE CORP  
59-25 LITTLE NECK PKWY LITTLE NECK 62 N Y  
H B INSTRUMENT CO  
AMERICAN BRISTOL STS PHILA PA  
HEALY-RUFF CO  
2255 UNIVERSITY AVE ST PAUL 14 MINN  
HEAREVER CO INC  
2644 CASTRO VALLEY BLVD CASTRO VALLEY CAL  
HEATH CO SUB OF DAYSTROM INC  
BENTON HARBOR MICH  
HEATH CO DIV OF DAYSTROM INC  
HILLTOP RD ST JOSEPH MICH  
HEATRON CO  
333 EBERTS ST YORK PA  
HEHN LESTER C  
30 MANORHAVEN BLVD PRT WASH N Y  
HEINEMANN ELECTRIC CO  
BRUNSWICK PIKE TRENTON N J  
HEINRICH CO CARL  
711 CONCORD AVE CAMBRIDGE 38 MASS  
HEINZ MUELLER ENGG CO  
4725 IOWA ST CHICAGO 51 ILL  
HEINZE ELECT CO DIV CONSOLIDATED ELEC LAMP  
685 LAWRENCE S T LOWELL MASS  
HELCO PRODUCTS CORP  
7832 BALBOA BLVD VAN NUYS CALIF  
HELDOR MFG CORP  
238 LEWIS ST PATERSON N J  
HELICAL PROD CO INC  
622 THIRD ST HERMOSA BCH CALIF  
HELFI-COIL CORP  
SHELTER ROCK LANE DANBURY CONN

HELIOTEK DIVISION OF TEXTRON ELECTRONICS INC  
12500 GLADSTONE AVE SYLMAR CALIF  
HELIPOT DIV BECKMAN INSTRUMENTS INC  
2500 FULLERTON RD FULLERTON CALIF  
HELLER CO GERALD K  
2673 S WESTERN ST LAS VEGAS NEV  
HELLIGE INC  
877 STEWART AVE GARDEN CITY NY  
HELWIG CO  
2550 N 30TH ST MILWAUKEE 10 WISC  
HENES MFG CO  
4301 E MADISON ST PHOENIX ARIZ  
HENNEKE ENG CO  
STONE RIDGE N Y  
HENRY ENGINEERING CO  
3625 W PACIFIC AVE BURBANK CALIF  
HENRY & MILLER INDUSTRIES INC  
675 GARFIELD AVE JERSEY CITY 5 N J  
HENSCHEL CORP  
14 CEDAR ST AMESBURY MASS  
HEPPNER MFG CO  
BOX 608 ROUND LAKE ILL  
HERCULES CHEMICAL CO INC  
416 BROADWAY NEW YORK 13 N Y  
HERMASEAL CO  
1010 N MAIN ST ELKHART IND  
HERMES PLASTICS INC  
154 W 14TH ST NEW YORK 11 N Y  
HERMES-SONIC CORP  
13-19 UNIVERSITY PL NEW YORK N Y  
HERMETIC PACIFIC CORP  
4232 TEMPLE CITY ROSEMEAD CALIF  
HERMETIC SEAL CORP  
4232 TEMPLE CITY BLVD PASADENA CALIF  
HERMETIC SEAL CORP  
NORTH ARLINGTON N J  
HERMETTE CORP  
100 LADGE DRIVE AVON MASS  
HERZOG MINIATURE LAMP WORKS  
50 17 5 ST LONG ISLAND CITY N Y  
HETCO INC  
110-114 TREMONT ST EVERETT MASS  
HEVI-DUTY ELECTRIC CO DIV BASIC PROD CORP  
3002 W BURLEIGH ST POBX 563 MILWAUKEE WIS  
HEWLETT PACKARD CO  
1501 PAGE HILL RD PALO ALTO CALIF  
HEXACON ELECTRIC CO  
161 W CLAY AVE ROSELLE PARK N J  
HEXCEL PRODUCTS INC EASTERN DIV  
HAVRE DE GRACE MO  
HEYER INDUSTRIES INCORPORATED  
LAB OF MARQUETTE CORP  
500 CORTLANDT ST BELLEVILLE N J  
HEYMAN MFG CO  
147 MICHIGAN AVE KENILWORTH N J  
H & H MACHINE CO INC  
NOBLE & JACKSON STS NORRISTOWN PA  
H & H PRODUCTS CO  
766 RAMSEY AVE HILLSIDE N J  
HICKOK ELECTRICAL INSTRUMENT CO  
10514 DU PONT AVE CLEVELAND 8 OHIO  
HICO CORP  
76 COOLIDGE HILL RD WATERTOWN MASS  
HIDYNE INSTRUMENT & ENGRG CO  
309 ANDERSON ST TULLAHOMA TENN  
HIEATT ENGG CO  
2228 N HOLLYWOOD WAY BURBANK CALIF  
HI G INC  
BRAOLY FIELO WINDSOR LOCKS CONN  
HIGH RELIABILITY CIRCUIT SYSTEMS  
1853 N RAYMOND AVE ANAHEIM CALIF  
HIGH SPEED HAMMER CO  
313 NORTON ST ROCHESTER N Y  
HIGH VACUUM EQUIPMENT CORP KINETICS DIV  
2 CHURCHILL RD HINGHAM MASS  
HIGH VACUUM EQUIP CORP  
HINGHAM MASS  
HIGH VACUUM FURNACE & ELECT DV  
90 AIRPORT RD CONCORD N H  
HIGH VOLTAGE ENG CORP  
BURLINGTON MASS  
HIGHLAND OESIGN INC  
90 MAGNOLIA AVE WESTBURY N Y  
HIGHSIDE CHEMICALS INC  
11 COLFAX AVE CLIFTON N J  
HILDEBRAND JOHN CO  
45 BRIGHTON ST BELMONT MASS  
HILL & CO E VERNON  
PO BOX 189 LAKE GENEVA WISC  
HILL ELECTRONICS INC  
300 N CHESTNUT ST MECHANICSBURG PA  
HILLBURN ELECTRONIC PRODUCTS CO  
55 GREENPOINT AVE BROOKLYN 22 N Y  
HI LO MFG CORP  
1122 NEWPORT AVE CHICAGO ILL  
HINCHMAN MFG CO INC  
259 E FIRST AVE ROSELLE N J  
HINDLE TRANSFORMER CO  
WOODS CHURCH RD RD 3 FLEMINGTON NJ  
HI-PAR PRODUCTS CO  
347 LUNENBURG ST FITCHBURG MASS  
HI PURITY METALS INC  
340 HUDSON ST HACKENSACK N J  
HI Q DIV  
AEROVOX CORP OLEAN N Y  
HI-Q DIV AEROVOX CORP  
BOX 68 MYRTLE BEACH S C  
HI-SHEAR RIVET TOOL CO  
2600 W 247TH ST TORRANCE CALIF  
HISONIC INC  
P O BOX 534 SHAWNEE KANS  
HI SPEC ELECTRONICS CORP  
7328 ETHEL AVE HOLLYWOOD CALIF  
HI SPEC ELECTRONICS CORP  
14713 KESWICK ST VAN NUYS CALIF  
HI-SPEED EQUIPMENT CO  
73 POND ST WALTHAM 54 MASS

HITCHINER MFG CO INC  
PO BOX 330 MILFORD NH  
HITEMP INC  
1532 CALIFORNIA AVE MONROVIA CALIF  
HITEMP WIRES INC  
1200 SHAMES DRIVE WESTBURY NY  
HI TEST CHEMICAL CORP  
722 64TH ST BROOKLYN 20 N Y  
HOBBS CORP JOHN W DIV STEWART-WARNER CORP  
SPRINGFIELD ILL  
HOBBS MFG CO  
24 SALTSBURY ST WORCHESTER MASS  
HOBSON BROS  
4940 LAWRENCE AVE CHICAGO ILL  
HOFFMAN CO P R  
321 CHERRY ST CARLISLE PA  
HOFFMAN ELECT CORP SEMICONDUCTORS DIV  
1001 N ARDEN DR EL MONTE CALIF  
HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV  
3761 S HILL ST LOS ANGELES T CALIF  
HOFFMAN ELECTRONICS CORP  
2205 LEE ST EVANSTON ILL  
HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV  
2621 S HILL ST LOS ANGELES 7 CALIF  
HOFFMAN ELECTRONICS CORP MLTRY PROD DIV  
3740 GRAND AVE LOS ANG CALIF  
HOFFMAN ENG CORP  
9TH & TYLER ANOKA MINN  
HOGAN FAXIMILE CORP  
635 GREENWICH ST NEW YORK N Y  
HOKE INC  
1 TENAKILL PARK CRL SKILL N J  
HOLBROOK MERRILL CO  
1150 KIFER RD SUNNYVALE CALIF  
HOLEX INC  
P O BOX 148 HOLLISTER CALIF  
HOLLAND ELECTRONICS  
772 E 53 ST BROOKLYN N Y  
HOLLINGSWORTH CO  
FDRT LAUDERDALE FLA  
HOLLIS ENGINEERING INC  
PINE ST EXT NASHUA N H  
HOLLO-KROME SCREW CORP  
HARTFORD 10 CONN  
HOLT INSTRUMENT LABS  
DIV HOLT HARDWOOD CO INC OCONTO WISC  
HOLTZER CABOT DIV NATL PNEUMATIC CO  
125 AMORY ST BOSTON 19 MASS  
HOLUB INDUSTRIES INC  
413 OE KALB AVE SYCAMORE ILL  
HOMALITE CORP  
11-13 BROOKSIDE OR WILMINGTON OEL  
HOME ELECT MFG CO  
2825 E SPRING ST LONG BEACH 6 CALIF  
HOMMEL CO  
HOPE & MAPLE STS CARNEGIE PENNA  
HONEYWELL CONTROLS LTO  
VANDERHOOF AVE TORONTO ONTARIO CANADA  
HOOKER CHEMICAL CORPORATION  
28 IROQUOIS ST NIAGARA FALLS N Y  
HOOVER ELECTRIC CO  
2100 STONER AVE LOS ANGELES CALIF  
HOOVER ELECTRONICS CO  
110 W TIMONIUM RD TIMONIUM MO  
HOPAK ELECTRIC INC  
680 DAVISVILLE RD WILLOW GROVE PA  
HORLICK CO INC WM I  
266 SUMMER ST BOSTON 10 MASS  
HOSKINS MFG CO  
4445 LANTON AVE DETROIT MICH  
HOTPACK CORP  
5074A COTTMAN AVE PHILA PA  
HOTWATT INC  
OANVERS MASS  
HOUDAILLE IND INC BUFFALO HYDRAULICS DIV  
539 E DELAVAN AVE BUFFALO 11 N Y  
HOULIHAN CO T J  
2510 W LAWRENCE CHICAGO 25 ILL  
HOUSTON FEARLESS CORP WESTWOOD DIV  
11801 W OLYMPIC BLVD LOS ANGELES 64 CAL  
HOUSTON INSTRUMENT CORP  
4950 TERMINAL AVE BELLAIRE 101 TEXAS  
HOUSTON INSTRUMENT CORP  
BOX 22234 HOUSTON TEXAS  
HOWARD CRYSTAL HOLDERS INC  
2600 GRAND AVE KANSAS CITY 8 MO  
HOWARD FOUNDRY CO  
1700 N KOSTNER AVE CHICAGO 39 ILL  
HOWARD INDUSTRIES INC LOYD SCRUGGS DIV  
P O DRAWER 232 FESTUS MO  
HOWARD INDUSTRIES INC  
1760 STATE ST RACINE WISC  
HOWARD INSTRUMENT CO  
RED BANK N J  
HOWELL INSTRUMENTS INC  
3479 VICKERY BLVD FT WORTH TEXAS  
HOYT ELECTRICAL INSTRUMENT WORKS  
42 CARLETON ST CAMBRIDGE 42 MASS  
HP ASSOCIATES AFF HEWLETT PACKARD  
2900 PARK AVE PALO ALTO CALIF  
HRB SINGER INC  
SCIENCE PARK STATE COLLEGE PA  
HUBBARD - SPOOL DIV  
GARRETT IND  
HUBER INDUSTRIES INC  
4974 HILLSIDE AVE CINN OHIO  
HUDSON LAMP CO  
528 ELM ST KEARNY N J  
HUDSON TOOL & DIE CO  
18 MALVERN ST NEWARK 5 N J  
HUDSON WIRE CO WINSTED DIV  
981 MAIN ST WINSTED CONN  
HUDSON WIRE CO  
OSSINING NEW YORK  
HUFCO INDUSTRIES  
2815 OLIVE AVE BURBANK CALIF

# ELECTRONIC MANUFACTURERS—A TO Z

HUGGINS LABS INC  
999 E ARQUES SUNNYVALE CALIF  
HUGHES AIRCRAFT CO-GROUND SYSTEMS OIV  
PO BOX 2097 FULLERTON CALIF  
HUGHES AIRCRAFT CO IND SYSTEMS DIV  
5261 W IMPERIAL LOS ANG CALIF  
HUGHES AIRCRAFT CO ELECT PROD OIV  
PO BOX 278 NEWPORT BEACH CALIF  
HUGHES AIRCRAFT CO  
BOX 45426 AIRPORT STA LOS ANG CALIF  
HUGHES AIRCRAFT CO VACUUM TUBE PROD DIV  
2020 SHORT ST OCEANSIDE CALIF  
HUGHES AIRCRAFT CO MICROWAVE TUBE DIV  
11105 S LA CIENEGA BLVD LOS ANGELES 9 CAL  
HUGHES PRODUCTS GROUP HUGHES AIRCRAFT CO  
BOX 90427 LOS ANGELES 45 CALIF  
HUGHES SEMICONDUCTORS DIV  
500 SUPERIOR AVE NEWPORT BEACH CALIF  
HUGHES TREITLER MFG CORP  
1045 39TH ST BROOKLYN N Y  
HUGHES & PHILLIPS  
3200 SAN FERNANDO BLVD BURBANK CALIF  
HUGHSON CHEM CO OIV LORD MFG CO  
GREEN GARDEN 12TH ERIE PA  
HULL CORP  
DAVISVILLE RD AT PA TWPK HATBDRO PA  
HUMPHREY INC  
2805 CANON ST SAN DIEGO CALIF  
HUNT CO PHILIP A  
5150 GRANT AVE CLEVELAND OHIO  
HUNT CORP  
453 LINCOLN ST CARLISLE PA  
HUNT ELECTRONICS  
2617 ANTON DR DALLAS TEXAS  
HUNTER SPRING CO  
1 SPRING AVE LANSDALE PA  
HUNTER TOOLS  
9851 ALBURTIS AVE SANTA FE SPRINGS CALIF  
HUPPERT CO K H  
6830 COTTAGE GROVE AVE CHICAGO 37 ILL  
HURLETRON INC EMS DIV  
528 WEST LAMBERT ROAD WHITTIER CALIFORNIA  
HURLETRON INCORPORATED ELECTRIC EYE EOP DIV  
1938 E FAIRCHILD ST DANVILLE ILL  
HURLETRON INC WHEATON ENG DIV  
920 MANCHESTER RD WHEATON ILL  
HURON INDUSTRIES  
PO BOX 557 PORT HURON MICH  
HURST TOOL & MFG CO  
RD 46 PRINCETON IND  
HUSE-LIBERTY MICA CO  
PEABODY INDUSTRIAL CENTER PEABODY MASS  
HUYCK SYSTEMS CO DV OF HUYCK CORP  
360 WOLF HILL RD HUNTINGTON STA L I N Y  
H W ELECTRONICS INC  
NATICK MASS  
HY GAIN ANTENNA PRODUCTS CO  
1135 N 22 ST LINCOLN NEBR  
HYCON MFG CO  
700 ROYAL OAKS OR MONROVIA CALIF  
HYORA POWER CO  
10 PINE COURT NEW ROCHELLE N Y  
HYDRAULIC RES ELECT OIV  
1675 SHELDON AVE SUNVALLEY CALIF  
HYDRO MOLOING CO  
100 SHARRON AVE PLATTSBURGH N Y  
HYROMATICS INC  
5 LAWRENCE ST BLOOMFIELD N J  
HYDROPOISE INC SUB BROOKS INST CO  
SCOTTSDALE ARIZ  
HYGRODYNAMICS INC  
949 SELIM RD SILVER SPRING MO  
HYLETRONICS CORP  
165 CAMBRIDGE ST BURLINGTON MASS  
HYPERION INC  
127 COOLIDGE HILL RD WATERTOWN MASS  
HYSER ELECT MFG CO  
556 SEVENTH AVE MINN MINN  
HYSOL CANADA LTD  
PO BOX 53 POSTAL STA R TORONTO ONT CANADA  
HYSOL CORP  
OLEAN N Y  
HYSOL OF CALIF OIV  
1706 POTRERO S EL MONTE CALIF  
HYSON MFG CO  
PO BOX N PASADENA CALIF  
HYTECH OIV OF BISSETT BERMAN CORP  
G STREET PIER SAN DIEGO 1 CALIF

IDEAS INC  
214 IVINSON AVE LARAMIE WYD  
IDENTIFICATION SERVICE CORP  
144 W 46 ST NEW YORK 36 N Y  
IE MFG  
3039 CARROLL AVE CHICAGO 12 ILL  
IERC DIV INTERNL ELECT RESCH CORP  
135 W MAGNOLIA BLVD BURBANK CALIF  
I H MFG CO  
121 GREENE ST NEW YORK N Y  
ILEX OPTICAL COMPANY  
ILG ELECTRIC VENTILATING CO  
2850 PULASKI RD CHICAGO ILL  
ILG ELECTRIC VENTILATING CO  
1709 W 8TH ST LDS ANG CALIF  
ILIKON CORP  
NATICK IND CENTRE NATICK MASS  
ILLINOIS CONDENSER CO  
1616 N THROOP ST CHICAGO 22 ILL  
ILLUMINATED CONTROLS INC  
RIVERTON N J  
ILLUMITRONIC ENGG CO  
680 E TAYLOR AVE SUNNYVALE CALIF  
IMAGE INSTRUMENTS INC  
2300 WASHINGTON ST NEWTON 62 MASS  
IMC MAGNETICS CORP  
570 MAIN ST WESTBURY LI NY  
IMC MAGNETICS CORP WESTERN DIV  
6058 WALKER AVE MAYWOOD CALIF  
IMC MAGNETICS CORP  
917 W MADISON ST PHOENIX ARIZ  
IMPACT-O-GRAPH CORP  
1508 BF KEITH BLDG CLEVELAND 15 OHIO  
IMPERIAL ELECT INC  
8530 ROLAND ST BUENA PARK CALIF  
IMPROVED SEAMLESS WIRE CO  
775 EDDY ST PROVIDENCE R I  
INCELOID CO INC  
8127 33 OLEANDER ST NEW ORLEANS LA  
IND ELEC RUBBER CO  
31945 AURORA RD SOLON OHIO  
IND HARWARE MFG CO INC  
109 PRINCE ST NEW YORK NY  
INDAMER ELECTRONICS  
1038 W EVELYN SUNNYVALE CALIF  
INDAR CORP SUB PR MALLORY CO  
3448 SHELBY ST INDIANAPOLIS IND  
INDIANA GENERAL CORP  
EICOR DIV OGLESBY ILL  
INDIANA GENERAL CORP MAGNET DIV  
VALPARAISO IND  
INDIANA GENERAL CORPORATION  
KEASBEY N J  
INDIANA STEEL & WIRE CO  
2200 E JACKSON ST MUNICE IND  
INDIANA STEEL PRODUCTS DIV IND GEN CORP  
405 ELM ST VALPARAISO IND  
INOIKON CO  
76 COOLIDGE HILL RD WATERTOWN MASS  
INDIUM CORP OF AMERICA  
1676 LINCOLN AVE UTICA 4 N Y  
INDUCTION HEATING CORP  
181 WYTHE AVE BROOKLYN 11 N Y  
INDUCTOR ENGG INC  
117 SCHLEY AVE LEWES DELA  
INDUSTRIAL ACOUSTICS CO  
341 JACKSON AVE N Y N Y  
INDUSTRIAL CONDENSER CORP  
3243 N CALIFORNIA AVE CHICAGO 18 ILL  
INDUSTRIAL CONTROL CO  
CENTRAL AVE AT PINELAWN FARMINGDALE LI NY  
INDUSTRIAL DEVICES INC  
EDGEWATER N J  
INDUSTRIAL DEVELOPMENT LABS INC  
982 RIVER RD EDGEWATER NJ  
INDUSTRIAL ELECTRONIC ENGINEERS INC  
5528 VINELAND AVE N HOLLYWOOD CALIF  
INDUSTRIAL ELECTRONIC HARWARE CORP  
109 PRINCE ST NEW YORK NEW YORK  
INDUSTRIAL ELECTRONICS INC  
8060 WHEELER ST DETROIT 10 MICH  
INDUSTRIAL ELECTRONICS OF OMAHA INC  
6614 BLONOD ST OMAHA NEBR  
INDUSTRIAL ELECTRICAL WORKS  
1509 CHICAGO ST OMAHA 2 NEBR  
INDUSTRIAL ENGRAVERS INC  
130 25 180 ST SPRINGFIELD GARDENS N Y  
INDUSTRIAL INSTRUMENTS INC  
89 COMMERCE RD CEQAR GROVE N J  
INDUSTRIAL MATERIALS CO  
383 BRANNAN ST SAN FRANCISCO CALIF  
INDUSTRIAL METALS ALLOY CO INC  
20 E ACADIA AVE WINSTON-SALEM NO CAR  
INDUSTRIAL NUCLEONICS CORP  
650 ACKERMAN RD COLUMBUS 21 OHIO  
INDUSTRIAL RADIO CORP  
462 N PARKSIDE AVE CHICAGO 44 ILL  
INDUSTRIAL RETAINING RING CO  
57 COROIER ST IRVINGTON 11 NJ  
INDUSTRIAL TEST EQUIPMENT CO  
55 E 11TH ST NEW YORK 3 NY  
INDUSTRIAL TECTONICS INC  
3686 JACKSON AVE ANN ARBOR MICH  
INDUSTRIAL TIMER CORP  
1407 MCCARTER HWY NEWARK 4 N J  
INDUSTRIAL TRANSFORMER CORP  
GOULDSBORO PA  
INDUSTRIAL WINDING MACHINERY CORP  
BX 744 CHURCH ST STA NEW YORK 8 NY  
INDUSTRIAL WIRE & CABLE CO INC  
110-114 TREMONT ST EVERETT MASS  
INDUSTRO TRANSISTOR CORP  
35-10 36TH AVE LONG ISLAND CITY 6 NY  
INDUSTRIONICS CONTROLS INC  
20 VANDAM ST NEW YORK N Y  
INERTIA SWITCH INC  
311 W 43 ST NEW YORK 36 NY

INFINETICS INC  
1601 JESSUP ST WILMINGTON 2 DEL  
INFORMATION PRODUCTS CORP  
1566TH ST CAMBRIDGE MASS  
INFORMATION SYSTEMS INC  
10131 NATIONAL BLVD LOS ANG CALIF  
INFOTRONICS CORPORATION  
1401 S POST OAK ROAD HOUSTON TEXAS  
INFRARED INDUSTRIES INC  
62 4TH AVE WALTHAM 54 MASS  
INFRARED INDUSTRIES INC WESTERN DIV  
PO BOX 989 SANTA BARBARA CALIF  
INGERSOLL-RAND CO  
PHILLIPSBURG N J  
INGERSOLL PRODUCTS DIV BORG-WARNER CORP  
1000 W 120TH ST CHICAGO 43 ILL  
INJECTORAL CO  
6 BAY ST BROOKLYN 14 N Y  
INLAND MOTOR CORP  
RAOFORD VA  
INMANCO INCORPORATED  
712 SOUTH FEDERAL STREET CHICAGO 5 ILL  
INSCO INC  
BOX 422 QUAKERTOWN PA  
INSCO COMPANY  
MAIN STREET GROTON MASS  
INSL X PRODUCTS CORP  
115 117 WOODWORTH AVE YONKERS N Y  
INSO ELECT PROD INC  
103 PARK AVE NUTLEY NJ  
INSTRON ENGG CORP  
2500 WASHINGTON ST CANTON MASS  
INSTRU LAB INC  
1207 LAMAR ST DAYTON OHIO  
INSTRU-LEC CORP  
520 HOMESTEAD AVE MOUNT VERNON NY  
INSTRUMENT CASE DIV TA MFG CORP  
4607 ALGER ST LOS ANGELES 39 CALIF  
INSTRUMENT CORP OF FLA  
PO BOX 1226 MELBOURNE FLA  
INSTRUMENT CORP OF AMER  
516 GLENWOOD AVE BALTIMORE MD  
INSTRUMENT DEVELOPMENT LABS INC  
67 MECHANIC ST ATTLEBORO MASS  
INSTRUMENT ELECTRONICS CORP  
PD BOX 830 PORT WASHINGTON NY  
INSTRUMENT LABS CORPORATION  
315 W WALTON PL CHICAGO 10 ILL  
INSTRUMENT MASTERS INC  
11 HAMBURG TURNPIKE RIVERDALE N J  
INSTRUMENT RESISTORS CO  
1036 COMMERCE AVE UNION N J  
INSTRUMENTATION ASSOCIATES  
17 W 60 ST NEW YORK 23 NY  
INSTRUMENTS FOR INDUSTRY INC  
101 NEW SOUTH RD HICKSVILLE LI NY  
INSTRUMENTS INC  
3102 CHARLES PAGE BLVO BX 556 TULSA OKLA  
INSTRUMENTS OF N E  
108 GREENWOOD LANE WALTHAM MASS  
INSULATING FABRICATORS OF NE INC  
69 GROVE ST WATERTOWN 72 MASS  
INSULATING FABRICATORS INC  
150 UNION AVE E RUTHERFORD NJ  
INSULEX CO  
1506 10TH ST NORTH BERGEN N J  
INSUL VICON CORP  
1369 INDUSTRIAL RD SAN CARLOS CALIF  
INT EASTERN CO  
801 6TH AVE NEW YORK NY  
INTEGRATED MICA CORP  
202 FRANKLIN PLACE WOODMERE NY  
INTELLEX INC  
30 S SALSIPUEDES ST SANTA BARBARA CALIF  
INTERCONTINENTAL ELECTRONICS CORP  
300 SHAMES DRIVE WESTBURY NEW YORK  
INTERCONTINENTAL INSTRUMENTS INC  
123 GAZZA BLVD FARMINGDALE L I N Y  
INTERELECTRONICS CORP  
2432 GRD CONCOURSE NEW YORK 58 NY  
INTERFERENCE MEASUREMENT LAB INC  
850 SHEPHERD AVE BROOKLYN 8 N Y  
INTERLAKE STAMPING CORP  
12415 EUCLIO AVE CLEVELAND 6 OHIO  
INTERLECTRIC DIV EL TRONICS  
1401 LEXINGTON AVE WARREN PA  
INTERNATION AUDIO STYLUS CORP  
107 LAKE AVE TUCKAHOE N Y  
INTERNATIONAL BUSINESS MACH  
NEW CIRCLE RD LEXINGTON KY  
INTL BUSINESS MACH FEDERAL SYS DIV  
NEIGHBORHOOD RD KINGSTON N Y  
INTL BUSINESS MACHINES DATA SYSTEMS DIV  
PO BOX 390 POUGHKEEPSIE N Y  
INTL CRYSTAL MFG CO INC  
18 N LEE OKLAHOMA CITY OKLA  
INTERNATIONAL DATA SYSTEMS INC  
2925 MERRILL RD DALLAS 29 TEXAS  
INTERNATIONAL DIODE CORP  
88 90 FORREST ST JERSEY CITY N J  
INTERNATIONAL ELECTRIC INDUSTRIES INC  
468 GRAND AVE BROOKLYN 38 NY  
INTL ELECTRIC INDUSTRIES INC  
14 SUFFOLK ST FREEPORT LI NY  
INTERNATIONAL ELECT INDOUST  
PO BOX 9036 NASHVILLE TENN  
INTL ELECTRONIC INDUSTRIES  
9036 MELROSE NASHVILLE TENN  
INTERNATIONAL ELECT MAGNETICS INC  
1901 MARGUETTE ST N CHICAGO ILL  
INTL ELECTRONIC RESEARCH CORP  
135 W MAGNOLIA BLVO BURBANK CALIF  
INTL ELECT RESCH CORP  
177 W MAGNOLIA BLVO BURBANK CALIF  
INTERNATIONAL ELECTRONICS CORP  
81 SPRING ST NEW YORK 12 N Y



# ELECTRONIC MANUFACTURERS—A TO Z

INTL ELECTRONICS MFG CO  
2ND ST EXT GREENWOOD ACRES ANNAPOLIS MD  
INTERNATIONAL ENGG INC  
PO BOX 536 FAR HILLS BRANCH DAYTON 19 OHIO  
INTERNATIONAL INSTRUMENTS INC  
BOX 2954 NEW HAVEN 15 CONN  
INTL INSTRUMENT INC  
88 MARSH HILL RD ORANGE CONN  
INTERNATIONAL NICKEL CO  
67 WALL ST NEW YORK 5 N Y  
INTL POWDER METALLURGY CO  
439 W MAIN ST RIDGEWAY PENNA  
INTL PUMP & MACHINE WORKS  
81 DORSIA AVE LIVINGSTON N J  
INTERNATIONAL RADIANT CORP  
577 EAST 156TH ST NEW YORK 55 N Y  
INTERNATIONAL RADIO ELECTRONICS CORP  
R 4 BOX 261 ELKHART IND  
INTL RADIO & ELECTRON  
17TH & MISHAWAKA ELKHART IND  
INTERNATIONAL RECTIFIER CORP  
233 KANSAS ST EL SEGUNDO CALIF  
INTERNATIONAL RESEARCH & DEVELOPMENT CORP  
PO BOX 55 WORTHINGTON OHIO  
INTERNATIONAL RESISTANCE CO ST PETERSBG DIV  
2801 72ND STREET N ST PETERSBURG FLA  
INTERNATIONAL RESISTANCE CO  
BURLINGTON IOWA  
INTERNATIONAL RESISTANCE CO  
401 N BROAD ST PHILADELPHIA 8 PA  
INTL RESISTANCE CO  
BOONE NC  
INTERSTATE ELECTRONICS CORP  
707 E VERMONT AVE ANAHEIM CALIF  
INTERTECH INC  
333 STATE ST NORTH HAVEN CONN  
INVAC CORP  
26 FOX RD WALTHAM 54 MASS  
INVENGEERING INC  
PO BOX 360 BELMAR N J  
INVESTMENT CASTING CO  
60 BROWN AVE SPRINGFIELD N J  
INTEX INC  
DIV OF CONTINENTAL OVERSFIELD INDUST INC  
1100 N E 125 ST N MIAMI FLA  
IONIC ELECTROSTATIC CORP  
111 MONROE ST GARFIELD N J  
IONIC MIDWEST CORP  
450 N SOMERSET AVE INDIANAPOLIS 22 IND  
IONICS INC ELECTRON ARC DIV  
244 BROAD ST LYNN MASS  
IPPOLITO & CO INC JAMES  
1624 STILLWELL AVE BRONX N Y  
IRCO CORP  
16 HUDSON ST NEW YORK 13 NY  
IRCON INFRARED CONTROLS INC  
4431 W DIVISION ST CHICAGO 51 ILL  
IRON FIREARM MFG CO ELECTRONICS DIV  
2838 S E 9 AVE PORTLAND 2 ORE  
IRVAN FERROMAGNETICS CORP  
13856 SATICOY ST VAN NUYS CALIF  
IRWIN LABS INC  
1238 S GERHART AVE LOS ANGELES 22 CALIF  
ISOCHEM RESINS CO  
221 OAK ST PROVIDENCE 9 R I  
ISOCYANATE PRODUCTS INC  
900 WILMINGTON RD NEW CASTLE DELA  
ISOLANTITE MFG CORP  
337 WARREN AVE STIRLING N J  
ISOMET CORP  
430 COMMERCIAL AVE PALISADES PARK NJ  
ISOTOPE ACCESSORIES CO INC  
5312 WESTMINSTER AVE PHILA 31 PA  
ISOTOPIES INC  
123 WOODLAND AVE WESTWOOD NJ  
ISTOPES SPEC CO  
P O BOX 688 BURBANK CALIF  
ITA ELECTRONICS CORP  
LANSDOWNE PENNA  
ITEK ELECTRO - PRODUCTS  
75 CAMBRIDGE PKWY CAMBRIDGE 42 MASS  
I TEL INC  
P O BOX 641 ROCKVILLE MD  
I-T-E CIRCUIT BREAKER CO  
601 E ERIE AVE PHILA 34 PENNA  
I T I BEARING DIVN  
18301 SANTE FE AVE COMPTON CALIF  
ITI ELECTRONICS INC  
369 LEXINGTON AVE CLIFTON N J  
ITT COMPONENTS DIV  
100 KINGSLAND RD CLIFTON N J  
ITT COMPONENTS DIV  
P O BOX 7065 ROANOKE VA  
ITT FEDERAL LABS DIV INT TEL & TEL CORP  
3301 WAYNE TRACE FORT WAYNE IND  
ITT FEDERAL LABORATORIES DIV INTL TEL & TEL  
500 WASHINGTON AVE NUTLEY NJ  
IT & T INDUSTRIAL PRODUCTS DIV  
15191 BLEDSOE ST SAN FERNANDO CAL  
ITT KELLOGG  
6650 S CICERO AVE CHICAGO 38 ILL  
ITT KELLOGG COMM SYSTEMS DEPT  
500 N PULASKI RD CHICAGO 24 ILL  
ITT KELLOGG  
951 COMMERCIAL ST PALO ALTO CALIF  
ITT SURPRENANT MFG CO  
172 STERLING ST CLINTON MASS

FOR INFORMATION ON PRODUCTS

SEE THE

"PRODUCT AND MANUFACTURERS" SECTION

## J

JACK & HEINTZ DIV SIEGLER CORP  
BOX 6719 CLEVELAND 1 OHIO  
JACK INDUSTRIES BILL  
143 S CEDROS AVE SOLANA BEACH CALIF  
JACKES-EVANS MFG CO  
4427 GERALDINE ST LOUIS 15 MO  
JACKSON BROS LONDON LTD  
KINGSWAY WADDON SURREY ENGLAND  
JACKSON ELECTRICAL INSTRUMENT CO  
124 MCOONOUGH ST DAYTON 2 OHIO  
JACOBS INSTRUMENT CO  
BETHESDA 14 MO  
JACOBSON NUT MFG CORP  
MARK RD KENILWORTH N J  
JADARO MACHINE PRODUCTS  
325 S SHILOH RD GARLAND TEXAS  
JAIDINGER MFG CO  
1921 W HUBBARD ST CHICAGO 22 ILL  
JAMESRURY CORP  
45 NEW ST WORCESTER MASS  
JAMES ELECTRONIC INC  
4050 ROCKWELL ST CHICAGO ILL  
JAMES PLATING WORKS INC  
1609 N ELSTON AVE CHICAGO 22 ILL  
JAMISON PLASTIC CORP  
1225 NEW BRIDGE RD N BELLMORE LI NY  
JAMPRO ANTENNA CO  
7500 14TH AVE SACRAMENTO CALIF  
JAN ENG  
2018 PICO BLVD SANTA MONICA CALIF  
JAN HARDWARE MFG CO  
38-01 QUEENS BLVD LONG ISLAND CITY 1 N Y  
JANCO CORP  
3111 WINONA AVE BURBANK CALIF  
JANDOR INC  
948 IRVING AVE DAYTON OHIO  
JANSA WOODWORKING CORP  
350 MESEROLE ST BROOKLYN 6 N Y  
JANSEN ELECT MFG CO INC  
2285 UNIVERSITY AVE ST PAUL MINN  
JARRELL ASH CO  
26 FARWELL ST NEWTONVILLE MASS  
JARVIS ELECTRONICS CORP  
1140 CHERRY ST WINNETKA ILL  
JAVEX ELECTRONICS  
PO BOX 646 REDLANDS CALIF  
JAY-EL PRODUCTS INC  
1859 W 169TH ST P O BOX 25 GARDENA CAL  
J B L INSTRUMENT CO  
SYCAMORE MILL RD CLIFTON HGTS PA  
JEFFERS ELECTRONICS DIV SPEER CARBON CO  
HOOVER AVE DUBOIS PA  
JEFFERSON ELECTRONIC PRODUCTS CORP  
322 STATE ST SANTA BARBARA CALIF  
JEFFERSON WIRE & CABLE CORP  
181 GREENWOOD ST WORCESTER MASS  
JEFFREY MFG CO  
803 N 4 ST COLUMBUS 16 OHIO  
JELLIFF MFG CORP C O  
PEQUOT RD SOUTHPORT CONN  
JENNINGS RADIO MFG CORP  
970 MCLAUGHLIN AVE SAN JOSE 8 CALIF  
JENSEN INDUSTRIES INC  
7333 HARRISON ST FOREST PARK ILL  
JENSEN MFG DIV MUTER CORP  
6601 S LARAMIE AVE CHICAGO 38 ILL  
JERROLO ELECTRONICS CORP  
15TH & LEHIGH AVE PHILA PENNA  
JERSEY SPECIALTY CO INC  
PO BOX 235 WAYNE N J  
JETA INC  
957 SAW MILL RIVER RD YONKERS 2 NY  
JET-O-MATIC ENGINEERING INC  
2126 RIVERSIDE AVE MINNEAPOLIS 4 MINN  
JETRONIC INDUSTRIES  
MAIN & COTTON ST PHILA 27 PA  
JETTTRON PRODUCTS  
56 ROUTE 10 HANOVER N J  
JFD ELECTRONIC CORP  
6101 16 AVE BROOKLYN 4 N Y  
JFD ELECTRONICS SOUTHERN INC  
INDUSTRY DRIVE OXFORD DRIVE OXFORD NO CAR  
J & G MACHINE CO INC  
42 LA GRANGE ST WORCESTER MASS  
JO-BELL PRODUCTS INC  
5456 W 111 ST OAK LAWN ILL  
JOCLIN MFG CO  
LUFBERG AVE WALLINGFORD CONN  
JODEE PLASTIC INC  
9903 FOSTER AVE BROOKLYN N Y  
JOHANSON MFG CO  
PO BOX 329 BOONTON NJ  
JOHNS-MANVILLE  
200 N MAIN ST MANVILLE N J  
JOHNS-MANVILLE  
TILTON N H  
JOHNSON & CO INC K W  
1825 WEBSTER ST DAYTON 4 OHIO  
JOHNSON & HOFFMAN MFG CORP  
31 E 2ND ST MINEOLA LI N Y  
JOHNSON AIRCRAFT ENGG CO M J  
BOX 10 MORRISTOWN AIRPORT MORRISTOWN N J  
JOHNSON CO E F  
299 10 AVE S W WASECA MINN  
JOHNSON CO E F  
2210 SECOND AVE S W WASECA MINN  
JOHNSON ELECTRONICS INC  
P O BOX 1675 HWY 17-92 CASSELBERRY FLA  
JOHNSON MFG CO INC  
MOUNT VERNON IOWA

JOHNSON SERVICE CO  
507 E MICHIGAN ST MILWAUKEE 2 WISC  
JOHNSON WILLIAMS INC  
2300 LEGHORN ST MT VIEW CALIF  
JOHNSTON FOIL MFG CO  
6106 S BROADWAY ST LOUIS 11 MO  
JOHNSTON HEARING AID MFG CO  
708 WEST 40 TH ST MINNEAPOLIS 9 MINN  
JO-LINE TOOLS INC  
8442 OTIS ST SOUTH GATE CALIF  
JONATHAN MFG CO  
720 E WALNUT FULLERTON CALIF  
JONES ELECTRONICS HIRAM  
2313 W OLIVE AVE BURBANK CALIF  
JONES ELECTRONIC CO INC M C  
185 N MAIN ST BRISTOL CONN  
JONES & LAMSON MACH CO  
160 CLINTON ST SPRINGFIELD VT  
JONES & LAUGHLIN STEEL CORP  
WIRE ROPE DIV MUNCY PA  
JONES OPTICAL WORKS A D  
2400 MASSACHUSETTS AVE CAMBRIDGE 4 MASS  
JONTZ MFG CO INC  
1101 E MCKINLEY AVE MISHAWAKA IND  
JORDAN CONTROLS INC  
3235 W HAMPTON AVE MILWAUKEE 9 WISC  
JORDAN ELECTRONICS DIV VICTOREEN  
3025 W MISSION RD ALHAMBRA CALIF  
JOR MAC CO  
704 10TH AVE GRAFTON WISC  
JOSLYN MFG & SUPPLY CENTRAL MFG DIV  
3700 S MORGAN ST CHICAGO ILL  
JOVAL PRODUCTS  
250 MCWHORTER ST NEWARK N J  
JOY MFG CO  
338 S BROADWAY NEW PHILA OHIO  
JSC ENGINEERING & DEVELOPMENT CORP  
P O BOX 295 HIALEAH FLA  
JUALL GEAR CO INC  
1108 GOFFLE RD HAWTHORNE NJ  
JUDD WIRE MFG CORP  
TURNPIKE RD TURNERS FALLS MASS  
JULIE RESEARCH LABS  
603 W 130 ST NEW YORK 27 NY  
J-V-M DIVISION FIDELITONE MICROWAVE INC  
9300 W 47TH BROOKFIELD ILL

## K

KAAR ENGG CORP  
2995 MIDDLEFIELD RD PALO ALTO CALIF  
GEORGE & KAERCHER CO  
4911 36TH AVE S MINNEAPOLIS 17 MINNESOTA  
KAHLE ENGG CO  
3300 HUDSON AVE UNION CITY N J  
KAHLENBERG BROS CO  
TWO RIVERS WISC  
KAHN & CO  
885 WELLS ROAD WETHERSFIELD HARTFORD CONN  
KAHN RESEARCH LABS  
81 S BERGEN PL FREEPORT N Y  
KAISER AIRCRAFT & ELECTRONICS  
2222 W PEORIA AVE PHOENIX ARIZ  
KAISER ELECTRONICS INC  
13 MONROE ST UNION N J  
KALPA SCIENTIFIC LABORATORIES INC  
P O BOX 172 FLEMINGTON N J  
KAMAN AIRCRAFT CORP  
OLD WINDSOR RD BLOOMFIELD CONN  
KANE ENGINEERING LABORATORIES  
845 COMMERCIAL ST PALO ALTO CALIF  
KANE MFG CORP  
P O BOX 641 N FRALEY ST KANE PA  
KANO LABS  
1000 S THOMPSON LANE NASHVILLE TENN  
KANTHAL CORP  
AMELIA PLACE STAMFORD CONN  
KAPITOL MAGNATIC CORP  
2241 N KNOX AVE CHICAGO 39 ILL  
KARG LAB INC  
30 MEADOW ST SOUTH NORWALK CONN  
KARG LABS INC  
162 ELY AVENUE SO NORWALK CONN  
KARLSON ASSOCIATES INC  
433 HEMPSTEAD AVE W HEMPSTEAD N Y  
KARTRON  
P O BOX 472 BEACH CALIF  
KAUKE & CO INC  
1632 EUCLID ST SANTA MONICA CALIF  
KAUPP & SON C B INC  
610 NEWARK WAY MAPLEWOOD N J  
KAWECKI CHEMICAL CO  
P O BOX 60 BOYERTOWN PENNA  
KAY ELECTRIC CO  
MAPLE AVE PINE BROOK N J  
KAY ELECTRIC CO PINLITE DIV  
OLD BLOOMFIELD AVE PINE BROOK NJ  
KAYE & CO INC JOSEPH  
737 CONCORD AVE CAMBRIDGE 38 MASS  
KAY-ESS CO  
8 NORTH ST DANBURY CONN  
KAYNAR CO  
7875 TELEGRAPH RD PICO RIVERO CALIF  
KAYNAR MFG CO INC  
BOX 2001 TERMINAL ANNEX LOS ANGELES CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

KAY-TOWNES ANTENNA CO  
BOX 593 ROME GA

KEARFOTT DIV GENERAL PRECISION INC  
LITTLE FALLS NJ

KEARFOTT CO INC  
253 N VINEDO AVE PASADENA CALIF

KEARFOTT SEMICONDUCTOR CORP  
437 CHERRY ST WEST NEWTON 65 MASS

KEARFOTT DIV GPI INC  
12690 ELMWOOD AVE CLEVELAND 11 OHIO

KEASBEY & MATTISON CO  
BURLER AVE AMBLER PA

KEIL ENGG PRODUCTS CORP  
6833 MANCHESTER AVE ST LOUIS 10 MO

KEISER IND INC  
LAUMAN ST P O BOX MT HOLLY SPRINGS PA

KEITHLEY INSTRUMENTS INC  
12415 EUCLID AVE CLEVELAND 6 OHIO

KELEKET X RAY DV LABS FO ELECT  
1601 TRAPELO RD WALTHAM MASS

KELL STROM TOOL CO INC ELECT DIV  
214 CHURCH ST WETHERSFIELD CONN

KELTRON CORP  
223 CRESCENT ST WALTHAM MASS

KELVIN ELECTRIC CO  
5919 NOBLE AVE VAN NUYS CALIF

KEMET CO DIV UNION CARBIDE CORP  
PO BOX 6087 CLEVELAND 1 OHIO

KEMET CO DIV OF UNION CARBIDE CORP  
11901 MADISON AVE CLEVELAND 1 OHIO

KEMLITE LABS INC  
1819 W GRAND AVE CHICAGO 22 ILL

KEMODE MFG CO  
161 W 18 ST NEW YORK 11 N Y

KEMTRON ELECTRON PRODUCTS INC  
14 PRINCE PL NEWBURYPORT MASS

KEN-DEL PRODUCTIONS INC  
515 SHIPLEY ST WILMINGTON 1 DEL

KENHOS CORP DV  
BOX 2 NORTON HGTS STA DARIEN CONN

KENWAMETAL INC  
LLOYD AVE LATROBE PA

KENNEDY INDUSTRIES  
1581 E CHARLES ST BANNING CALIF

KENRU CO  
PO BOX 121 PARSIPPANY N J

KENSICO TUBE CO DIV  
MT KISCO N Y

KENT CORP F C  
135 MANCHESTER PLACE NEWARK 6 N J

KENT LIGHTING CORP  
500 JOHNSON AVE BROOKLYN 37 N Y

KENT MFG CORP  
206 CENTER PRINCETON N J

KENTRON HAWAII LTD  
1140 WAIMANU ST HONOLULU 14 HAWAII

KEN TRON CORP  
395 LYNNWAY LYNN MASS

KENTUCKY ELECTRONICS INC  
2208 W SECOND ST OWENSBORO KY

KENWOOD ENGG CO  
265 COLFAX AVE KENILWORTH N J

KENYON TRANSFORMER CO  
1057 SUMMIT AVE JERSEY CITY 7 N J

KEPCO INC  
131 38 SANFORD AVE FLUSHING 55 N Y

KERN INSTRUMENTS INC  
120 GRAND ST WHITE PLAINS NY

KERCO PRODUCTS  
PO BOX 4178 LINCOLN 7 NEBR

KERSSILK PRODUCTS INC  
73 MURRAY ST NEW YORK N Y

KESSLER CHEMICAL CO INC  
STATE RD 6 COTTMAN AVE PHILA 35 PA

KESTER SOLDER CO  
4201 WRIGHTWOOD AVE CHICAGO 39 ILL

KESTER SOLDER CO  
88 FERGUSON ST NEWARK N J

KEUFFEL & ESSER CO  
DEPT EI 6 HOBOKEN N J

KEWAUNEE SCIENTIFIC EQUIP  
4012 LOGAN ST ADRAIN MICH

KEY RESISTOR CORP  
321 W REDONDO BEACH BLVD GARDENA CALIF

KEYSTONE BOLT & NUT CORP OF TENN  
422 FIFTH AVE S NASHVILLE TENN

KEYSTONE CARBON CO  
1935 STATE ST ST MARYS PA

KEYSTONE ELECTRONICS CO  
65 7 AVE NEWARK 4 N J

KEYSTONE ELECTRONICS CORP  
49 BLEECKER ST NEW YORK 12 N Y

KEYSTONE PRODUCTS CO  
904-6 23RD ST UNION CITY N J

K-F DEVELOPMENT CO  
2606 SPRING ST REDWOOD CITY CALIF

KFR CORP  
6006 W WASHINGTON BLVD CULVER CITY CALIF

KIBBY INSTRUMENT CO  
P O BOX 50 PERKINS CALIF

KIEKHAEFER MFG CO  
901 S 2ND ST MILWAUKEE 4 WISC

KIDO INC  
PO BOX 178 RT 7D MEAFORD NJ

KIDDE & CO WALTER  
1156 MAIN ST BELLEVILLE 9 NJ

KIDDE ULTRASONIC & DETECTION ALARMS INC  
1156 BRIGHTON RD CLIFTON N J

KILO ENG CO  
2011 3RD ST LAVERNE CALIF

KIMBALL ELECTRONICS CO INC  
3620 N W 48 TERRACE MIAMI FLA

KINELOGIC CORP  
29 S PASADENA AVE PASADENA CALIF

KINETICS CORP  
410 S CEDROS AVE SOLANA BEACH CALIF

KING LABS INC  
127 SOLAR ST SYRACUSE 3 N Y

KING RADIO CORP  
139 S BROCKWAY BOX 106 OLATHE KANS

KINGS ELECTRONICS CO INC  
40 MARBLEDALE RD TUCKAHOE NY

KINGSLEY MACHINE CO  
850 CAHUENGA BLVD HOLLYWOOD 38 CAL

KINNELECTRONICS CORP  
4125 HAYWARD AVE BALTIMORE 15 MD

KINNEY VACUUM DIV THE NEW YORK AIR BRAKE CO  
3529 WASHINGTON ST BOSTON 30 MASS

KINSMAN MFG CO INC  
54 MILL ST LACONIA N H

KIP ELECTRONICS CORP  
29 HOLLY PL BOX 562 STAMFORD CONN

KIRKLAND CO H R  
10 KING ST MORRISTOWN N J

KIRSCH MUSIC CORP  
15 58 127 ST FLUSHING N Y

KISTLER INSTRUMENT CORP  
15 WEBSTER ST N TONAWANDA NY

KLANN ORGAN SUPPLY CO  
PARK STATION WAYNESBORO VA

KLEER-TRONICS INC  
1933 OCEAN AVE SAN FRANCISCO CALIF

KLEER VUE MFG CO INC  
P O BOX 10326 PITTSBURGH 34 PA

KLEIN ELECT CO LEO  
8526 WASHINGTON BLVD CULVER CITY CALIF

KLEINSCHMIDT DIV SMITH-CORONA MARCHANT INC  
COUNTY LINE RD DEERFIELD ILL

KLEIN & SONS MATHIAS  
7200 MCCORMICK RD CHICAGO 45 ILL

KLIEGL BROS UNIV ELEC STAGE LIGHTING CO I  
321 W 50TH ST NEW YORK 19 NY

KLINCHER LOCKNUT CORP  
2153 HILLSIDE AVE INDIANAPOLIS 18 IND

KLINE IRON & STEEL CO  
P O BOX 1013 1225 35 HUGER ST COLUMBIA S C

KLING METAL SPINNING & STAMPING CO  
245 CENTRE ST NEW YORK 13 N Y

KLIPSCH & ASSOCIATES  
P O DRAWER 96 HOPE ARK

KNIGHT ELECTRONICS CORP  
2200 W MAYWOOD DRIVE MAYWOOD ILLINOIS

KNIGHTS CO JAMES  
CHURCH & WELLS STS SANDWICH ILL

KNOPP INC  
1307 66TH ST OAKLAND 8 CALIF

KNOWLES ELECTRONICS INC  
10545 ANDERSON PLACE FRANKLIN PARK ILL

KOBZY TOOL CO  
1535 N DAYTON CHICAGO ILL

KOILED KORDS DIV WHITNEY BLAKE CO  
106 PERSHING ST NEW HAVEN 14 CONN

KOLLMORGEN CORP  
347 KING ST NORTHAMPTON MASS

KOLLSMAN INST CORP STD KOLLSMAN IND INC  
80-08 45TH AVE ELMHURST 73 NY

KOLLSMAN INSTRUMENT CORP  
SUB STANDARD KOLLSMAN IND

KOLLSMAN MOTOR CORP  
5YOSSET L I N Y

KOLLSMAN PA  
DUBLIN PA

KOLLSTAN SEMICODT ELHMT DIV KOLLSMAN INST CORP  
111 NEW YORK AVE WESTBURY LI NY

KOLTON ELECTRIC MFG CO  
123 N J RAILROAD AVE NEWARK 5 N J

KOMAK INC  
2632 CUMBERLAND ST PHILA PA

KONIGSLOW STAMPING & TOOL CO E  
450 N 9TH ST ELWOOD IND

KOOLTRONIC FAN CO  
PO BOX 504 PRINCETON NJ

KOONTZ WAGNER ELECT CO INC  
516 N MICHIGAN ST SOUTH BEND IND

KOPP GLASS INC  
SWISSVALE PITTSBURGH 18 PENNA

KOPPERS CO INC  
KOPPERS BLDG PITTSBURGH 19 PA

KORFUND CO INC  
CANTIAGUE RD WESTBURY L I N Y

KORFUND DYNAMICS CORP  
CANTIAGUE RD WESTBURY L I N Y

KORRY MANUF CO  
223 8TH AVE SEATTLE WASH

KPT MFG CO  
ROSELAND N J

KRAEUTER & CO  
585 18TH AVE NEWARK N J

KRAUS ELECTRONICS INC  
543 CENTER DR PALO ALTO CALIF

KRAUTER ELECTRIC MACHINE CO  
360 GROVE ST NEWARK 3 N J

KRAUTER-WEBER TOOL CO  
69 12TH AVE NEWARK 2 NJ

KRECKMAN CO HERB  
CRESCO PA

KRENGEL MFG CO  
227 FULTON ST NEW YORK CITY N Y

KRESKY MFG CO INC  
2ND & H STS PETALUMA CALIF

KRESSILK PROD INC  
73 MURRAY ST NEW YORK 7 NY

KRISS ELECTRONICS INC  
191-195 ORATON ST NEWARK 4 NJ

KROKER ENGG & DEVEL CO  
9947 FRANKLIN AVE FRANKLIN PARK ILL

KROHN-HITE CORP  
580 MASSACHUSETTS AVE CAMBRIDGE 39 MASS

KRYLON INC  
FORD & WASHINGTON STS NORRISTOWN PA

KRYSTINEL CORP  
BOX 6 FOX ISLAND RD PORT CHESTER N Y

KTV TOWER COMMUNICATION EQUIP CO  
BOX 294-82D S HAMILTON ST SULLIVAN ILL

KUBAR INC  
21 ERIE ST CAMBRIDGE MASS

KUHN ELECTRONICS INC  
1801 MILLS AVE NORWOOD 12 OHIO

KULICKE & SOFFA MFG CO  
401 N BROAD ST PHILA 8 PA

KULITE BYTREC CORP  
50 HUNT ST NEWTON MASS

KULITE SEMICONDUCTOR PROD INC  
1030 HOYT AVE RIDGFIELD N J

KULITE TUNGSTEN CO  
1040 HOYT AVE RIDGFIELD NJ

KULKA ELEC CORP  
633 S FULTON ST MT VERNON NY

KUPFRIAN MFG DIV ROBINSON TECH PRODS INC  
1 HENRY ST BINGHAMTON NY

KURMAN ELECTRIC CO SUB CRESCENT PETROLEUM  
191 NEWEL ST BROOKLYN 22 N Y

KURSTON ELECTRONICS  
702 BAY ST STATEN ISLAND 4 NY

KURZ-KASCH INC  
1421 S BROADWAY DAYTON 1 OHIO

KUTHE LABS  
730 S 13 ST NEWARK 3 N J

K V TRANSFORMER CORP  
81 WATER ST OSSINING N Y

K W ENGINEERING WORKS  
PIN OAK COURT MEMPHONEE FALLS WISC

KWIKHEAT MFG CO  
3732 SAN FERNANDO RD GLENDALE CALIF

KYLE PRODUCTS  
9 & MARION S MILWAUKEE WISC

LAB CORP  
E ONONDAGA SKANEATELES N Y

LABELLE INDUSTRIES INC  
510 S WORTHINGTON ST OCONOMOWOC WISC

LABLINE INC  
3070 W GRAND AVE CHICAGO 22 ILL

LABORATORY EQUIPMENT CORP  
LAKEVIEW HILLTOP RD ST JOSEPH MICH

LABORATORY FOR ELECTRONICS INC  
1079 COMMONWEALTH AVE BOSTON 15 MASS

LAB-TRONICS INC  
3656 N LINCOLN AVE CHICAGO 13 ILL

LACESA ENGG CORP  
5614 W GRAND AVE CHICAGO 39 ILL

LACONIA MALLEABLE IRON CO INC  
71 WATER ST LACONIA N H

LAFAYETTE INSTRUMENT CO  
P O BOX 57 LAFAYETTE IND

LAI I & E DIV  
2133 ADAMS AVE SAN LEANDRO CALIF

THE LAKE CHEMICAL CO  
3052 W CARROLL AVE CHICAGO ILL

LAKE CITY INC SUB OF CONTROLS CO OF AMERICA  
110 WOODSTOCK ST CRYSTAL LAKE ILL

LAKE MFG CO  
2323 CHESTNUT ST OAKLAND 7 CALIF

LAKE SHORE ELECTRIC CORP  
205 WILLIS ST BEDFORD OHIO

LAMACO DF FLORIDA  
BOX 1386 HAINES CITY FLORIDA

LAMARCHE MFG CO  
3955 25TH AVE SCHILLER PARK ILL

LAMBDA ELECTRONICS CORP  
515 BROAD HOLLOW RD HUNTINGTON L I N Y

LAMINAIR INC  
18530 S BROADWAY GARDENA CALIF

LAMINATED SHEET PRODUCTS CORP  
449 NEPONSET ST NORWOOD MASS

LAMINATED SHIM CO  
UNION STREET GLENBROOK CONN

LA MORE C D  
2433 BIRKDALE ST LOS ANGELES 31 CALIF

LAMOTTE CHEMICAL PRODUCTS CO  
CHESTERTOWN MD

LAMPKIN LAB INC FDC DIV  
BRADENTON FLA

LAMPKIN LABS INC  
TECHNICAL DIVISION BRADENTON FLA

LAMSON & SESSIONS CO  
5025 W 73 ST CHICAGO ILL

LANCASTER GLASS CORP  
LANCASTER OHIO

LANCE ANTENNA MFG CORP  
1730-1802 1ST ST SAN FERNANDO CALIF

LAND AIR INC CHEYENNE DIV  
PO BOX 2327 CHEYENNE WYO

LAND AIR INSTRUMENT & ELECT DIV  
440 HESTER SAN LEANDRO CALIF

LANDAU METAL PROD CORP  
2 62 51ST AVE LONG ISLAND CITY N Y

LANDSVERK ELECTROMETER CO  
641 SONORA AVE GLENDALE CALIF

LANES INDS CORP DIV CORNELL DEEP DRAWING CO  
612 COLORADO AVENUE SANTA MONICA CALIF

LANG ELECTRIC MFG CO  
EDINBORO PA

LANGVIN DIV OF SONOTEC INCORP  
503 S GRAND AVE SANTA ANA CALIF

LANGLEY CORP  
310 EUCLID AVE SAN DIEGO CALIF

LANSING SOUND INC JAMES B  
3249 CASITAS LOS ANGELES 39 CALIF

LAPHAM HICKEY STEEL CORP  
3333 W 47TH ST PL CHICAGO ILL

L

# ELECTRONIC MANUFACTURERS—A TO Z

LAPMASTER DIV CRANE PACKING CO  
6400 OAKTON ST MORTON GROVE ILL  
LAPP INSULATOR CO RADIO SPECIALTIES DIV  
318 GILBERT ST LE ROY NY  
LA POINTE INDUSTRIES INC  
155 W MAIN ST ROCKVILLE CONN  
LA ROSE & ASSOC INC W T  
BOX F LANS STA TROY NY  
LARSOM INSTRUMENT CO  
GREENBUSH RO ORANGEBURG N Y  
LASER SYSTEMS CENTER OF LEAR SEIGLER INC  
2320 WASHTENAW AVE ANN ARBOR MICH  
LAS LAB INC  
1113 N ROLLING RO BALTIMORE MD  
LAUREHK RADIO MFG CO  
3927 WAYNE RD WAYNE MICH  
LAVELLE AIRCRAFT CORP  
STERLING ST NEWTOWN PA  
LA VEZZI MACHINE WORKS  
4635 W LAKE ST CHICAGO 44 ILL  
LAVOIE LABS INC  
MATAWAN-FREEHOLD RD MORGANVILLE NJ  
LEACH CORP INET DIV  
18435 SUSANA RD COMPTON CALIF  
LEACH CORP LEACH RELAY DIV  
5915 AVALON BLVD LOS ANGELES 3 CALIF  
LEACH CORP SPECIAL PRODUCTS DIV  
717 NORTH CONEY AZUSA CALIF  
LEACH & GARNER CO INDUSTRIAL DIVISION  
LEACH & GARNER BLDG ATTLEBORO MASS  
LEAR INC ASTRONICS DIV  
3171 S BUNOY DR SANTA MONICA CALIF  
LEAR INC ELECTRO-MECHANICAL DIV  
110 IONIA AVE NW GRAND RAPIDS MICH  
LEAR INCORPORATED INSTRUMENT DIVISION  
110 IONIA AVENUE N W GRAND RAPIDS MICH  
LEAR ROMEC DIV LEAR INC  
ELYRIA OHIO  
714 N BROOKHURST ST ANAHEIM CALIF  
LEAR SIEGLER INC ELECT INST DIV  
LEAR SIEGLER INC POWER EQUIP DIV  
P O BOX 6719 CLEVELAND 1 OHIO  
LEBOW ASSOCIATES  
21820 WYOMING OAK PARK 37 MICH  
LECLANCHE S A  
48 AVE DEGRANDSON YVERDON SWITZERLAND  
LECTROHM INC  
5560 NORTHWEST HWY CHICAGO ILL  
LEDEX INC  
123 WEBSTER ST DAYTON 2 OHIO  
LEE ELECTRIC INC  
566 52ND ST WEST N Y N JERSEY  
LEECRAFT MFG CO INC  
2116 44TH RO LONG ISLAND CITY N Y  
LEEOAL INC  
2929 S HALSTED CHICAGO ILL  
LEED INSULATOR CORP  
781 E PICO BLVD LOS ANGELES 21 CALIF  
LEEDS & NORTHROP CO  
4901 STENTON AVE PHILA PA  
L E E INC  
625 N Y AVE N W WASHINGTON 1 D C  
LEESONA CORPORATION  
WARWICK RHODE ISLAND  
LEETRONICS INC  
30 MAIN ST BROOKLYN 1 N Y  
LEFFINGWELL CHEMICAL CO  
P O BOX 1187 PERRY ANNEX WHITTIER CALIF  
LEHIGH VALLEY ELECT ENGG & MFG CO  
RD 1 BREININGSVILLE PA  
LEICHTNER MFG CO  
1510 N NEIL ST CHAMPAIGN ILL  
LEIGHTON LABS H W  
YORK RD & SUNSET LANE HATBORO PA  
LEIHAN BROS  
146 CHRISTIE ST NEWARK 5 NJ  
LEITCH HUARD CORP  
STARK & COMMERCIAL ST MANCHESTER N H  
LEKTRA LABS INC  
154 11 AVE NEW YORK 11 N Y  
LELAND AIRBORNE PRODUCTS  
740 E NATIONAL RD VANDALIA OHIO  
LEL INC  
75 AKRON ST COPIAGUE NY  
LEMERT ENGG CO  
1313 WESTERN AVENUE PLYMOUTH IND  
LENK MFG CO  
FRANKLIN KY  
LENKURT ELECTRIC CO  
1105 COUNTY RD SAN CARLOS CALIF  
LENZ ELECTRIC MFG CO  
1751 N WESTERN AVE CHICAGO 47 ILL  
LEPEL HIGH FREQUENCY LABS  
54-18 37 AVE WOODSIDE 77 NY  
LERCO ELECTRONICS INC  
501 S VARNEY ST BURBANK CALIF  
LESA COSTRUZIONI ELETTROMECCANICHE SPA  
VIA BERGAMO 21 MILANO ITALY  
LESLIE CO  
LYNDHURST NJ  
LESLIE CREATIONS  
LAFAYETTE HILL PENNA  
LESSELLS & ASSOCIATES INC  
916 COMMONWEALTH AVE BOSTON 15 MASS  
LE SUEUR MFG CO INC  
PATTONS CHAPEL BIRMINGHAM ALA  
LEVEY LABS HAROLD A  
8127-33 OLEANDER ST NEW ORLEANS 18 LA  
LEVIN & SON LOUIS  
3610 S BROADWAY LOS ANGELES 7 CALIF  
LEVOLOR LORENTZEN INC H K LORENTZEN DIV  
391 W BROADWAY NEW YORK 12 N Y  
LEWIS CO E B  
11 BRASS ST E HARTFORD 8 CONN  
THE LEWIS ENGINEERING CO  
339 CHURCH ST NAUGATUCK CONN

LEWIS & KAUFMAN ELECTRONICS TUBE DIV  
17320 EL RANCHO AVE LOS GATOS CALIF  
LEYGHTON-PAIGE CORP  
76 INDIANA AVE W ST PAUL 7 MINN  
LEYMAN MAGNETICS DIV  
5178 CROOKSHANK RD CINCINNATI OHIO  
LEYSE ALUMINUM CO  
KEWAUNEE WISC  
LIBBEY OWENS FORD GLASS CO LIBERTY MIRROR DV  
BRACKENRIDGE PA  
LIBRASCOPE DIV GENERAL PRECISION INC  
808 WESTERN AVE GLENDALE 1 CALIF  
LIBRASCOPE DIV GENERAL PRECISION INC  
100 E TUJUNGA AVE BURBANK CALIF  
LICON DIV ILLINOIS TOOL WORKS  
6615 W IRVING PARK RD CHICAGO 34 ILL  
LICON SWITCH & CONTROL  
2501 N KEELER AVE CHICAGO 30 ILL  
LIEBEL-FLARSHEIM CO  
111 E AMITY RD CINCINNATI 15 OHIO  
LIECO INC  
130 EILEEN WAY SYOSSET L I NY  
LIFE INSTRUMENT CO  
BROOK ST FRANKLIN MASS  
LIGHT ELECTRIC CORP  
214 LACKAWANNA AVE NEWARK 3 N J  
LIGHT METALS INC  
1100 E 24TH ST INDIANAPOLIS 5 IND  
LIGNACRAFT  
66 TRAVIS AVE BINGHAMTON N Y  
LIGNACRAFT DESIGN & DRAFTING SERVICE  
66 TRAVIS AVE BINGHAMTON N Y  
LIND INSTRUMENTS INC  
2294 MORA ORIVE MOUNTAIN VIEW CALIF  
LINDBERG ENGG CO  
2450 W HUBBARD ST CHICAGO 12 ILL  
LINDGREN & ASSOC ERIK A  
4515 N RAVENSWOOD CHICAGO 40 ILL  
LINDLY & CO  
248 HERRICKS RD MINEOLA NY  
LINDSAY STRUCTURE INC DIV INTL STEEL CO  
EVANSVILLE IND  
LINEAR INC  
DALLAS PENNA  
LINE ELECTRIC CO DIV IND TIME CORP  
229 RIVER STREET ORANGE NJ  
LINELL ENGG CORP CHAS S  
3974 N AVONDALE AVE CHICAGO 41 ILL  
LINEMASTER SWITCH CORP  
WOODSTOCK CONN  
LINE MATERIAL INDUSTRIES  
CENTRAL PLANT S MILWAUKEE WISC  
LINEN THREAD CO  
BLUE MOUNTAIN ALABAMA  
LING-ELECTRONICS DIV LING-TEMCO VOUGHT  
1515 S MANCHESTER ANAHEIM CALIF  
LINGO & SON INC JOHN E  
2814 BUREN AVE CANON N J  
LING-TEMCO VOUGHT INC ELECT DIV  
BOX 6191 DALLAS TEXAS  
LINK AVIATION INC SUB GEN PREC EQUIP CORP  
HILLCREST BINGHAMTON NY  
LINK-BELT CO  
200 LYNDALE AVE MINNEAPOLIS MINN  
LINK-BELT COMPANY  
3405 SIXTH AVE SEATTLE 4 WASH  
LINK-BELT COMPANY  
300 W PERSHING RD CHICAGO ILL  
LINK-BELT COMPANY BEARING PLANT  
7601 ROCKVILLE ROAD INDIANAPOLIS 41 IND  
LINK-BELT COMPANY  
3203 S WAYSIDE HOUSTON 1 TEXAS  
LINK-BELT COMPANY  
2045 W HUNTING PARK AVE PHILADELPHIA 40 PA  
LINK-BELT COMPANY  
COLMAR PA  
LINK-BELT COMPANY EWART PLANT  
220 S BELMONT AVE INDIANAPOLIS 6 IND  
LINK-BELT COMPANY  
400 PAUL AVE SAN FRANCISCO 19 CALIF  
LINK-BELT COMPANY  
1200 SYCAMORE ST MNTBLO LOS ANGELES 22 CAL  
LINK DIV GENERAL PRECISION INC  
BINGHAMTON N Y  
LIN RESEARCH CORP  
2412 REEDIE DR WHEATON MD  
LIONEL - WADSWORTH ULTRASONICS INC  
1440 BROADWAY NEW YORK 18 NY  
LIONEL CORP  
HOFFMAN PLACE HILLSIDE N J  
LIONEL CORP LIONEL ELECTRONIC LABS DIV  
1226 FLUSHING AVE BROOKLYN 37 NY  
LION FASTENER CO INC  
HONEYE FALLS N Y  
LION FASTENER CO INC  
LESTER PA  
LIPPS CO EDWIN A  
1511 COLORADO AVE SANTA MONICA CALIF  
LIQUIDOMETER CORP  
41-03 36 ST LONG ISLAND CITY 1 N Y  
LIQUIDOMETER CORP  
ROCKINGHAM RD BELLOWS FALLS VERMONT  
LISK CO G W  
CLIFTON SPRINGS N Y  
LITTELFUSE INC  
1865 MINER ST DES PLAINES ILL  
LITTLE FALLS ALLOYS INC  
189 CALDWELL AVE PATERSON 1 NJ  
LITTLEFORD BROS INC  
451 E PEARL ST CINCINNATI 2 OHIO  
LITTON ENGG LABS  
PO BOX 949 GRASS VALLEY CALIF  
LITTON INDUSTRIES ELECTRON TUBE DIVISION  
960 INDUSTRIAL RD SAN CARLOS CAL  
LITTON INDUSTRIES MARYLAND DIV  
4900 CALVERT COLLEGE PARK MD

LITTON SYSTEMS INC APPLIED SCIENCE DIVISION  
8535 WARNER DRIVE CULVER CITY CALIFORNIA  
LITTON SYS INC GUIDANCE & CONTROL DIV  
5500 CANOGA AVE WOODLAND HILLS CALIF  
LITTON SYST INC GUIDANCE & CONTROL DIV  
2211 WEST NORTH TEMPLE SALT LAKE CITY UTAH  
LITTON SYSTEMS CANADA LIMITED  
123 REXDALE BLVD REXDALE TORONTO ONT CAN  
LIVINGSTON AUDIO PRODUCTS CORP  
BOX 202 CALOWELL N J  
LIVINGSTON ELECT CORP  
320 RUNNYMEDE RO ESSEX FALLS N J  
L & L MFG CO  
804 MULBERRY ST UPLAND CHESTER PA  
LMB  
2528 W 9TH ST LOS ANGELES CALIF  
LOCKHEED AIRCRAFT LOCKHEED AIRCRAFT SER  
ONTARIO AIRPORT ONTARIO CALIF  
LOCKHEED ELECT CO INFORMATION TECHNOLOGY DIV  
US HIGHWAY 1 METUCHEN NJ  
LOCKREY CO  
P O BOX J SOUTHAMPTON N Y  
LOENCO INC  
2092 N LINCOLN AVE ALTADENA CALIF  
LOGE ELECTRONICS INC  
2171 W WASHINGTON BLVD LOS ANGELES 18 CAL  
LOGEMAN CO C W  
633 BERGEN ST BROOKLYN 38 NY  
LOGETRONICS INC  
500 E MONROE AVE ALEXANDRIA VA  
LONDON CHEMICAL CO INC  
1535 N 31ST AVE MELROSE PARK ILL  
LONG INC THOMAS J  
215 STONEHEDGE LA CARLE PL LI NY  
LORAIN COUNTY RADIO CORP  
203 9TH ST LORAIN OHIO  
LORAL ELECTRONICS CORP  
825 BRONX RIVER AVE NEW YORK 72 N Y  
LORD MFG CO  
1635 W 12TH ST ERIE 6 PA  
LOUD MACHINE WORKS INC  
969 E 2ND ST POMONA CALIF  
LOUTHAN MFG CO DIV FERRO CORP  
2000 HARVY AVE E LIVERPOOL OHIO  
LOUTHAN PLANT REFRACTORIES DIV FERRO CORP  
BOX 781 E LIVERPOOL OHIO  
LOWELL MFG CO  
3030 LACLEDE STATION RD ST LOUIS 17 MO  
L & R MFG CO  
577 ELM ST ARLINGTON NJ  
LUCAS MILHAUT ENGG CO  
5051 S LAKE DR CUDAHY WISC  
LUCCI AIRCRAFT INC  
SAROSOTA BRAOENTON AIRPORT SARASOTA FLA  
LUCKENBACH & CO PAUL  
312 W 231ST ST NEW YORK 63 N Y  
LUDLOW-SAYLOR WIRE CLOTH CO  
634 S NEWSTEAD AVE ST LOUIS MO  
LUDWIG HONOLD MFG CO  
CHESTER PIKE & FOLCROFT AVE FOLCROFT PA  
LUFKIN RULE CO  
1730 HESS ST SAGINAW MICH  
LUHRS & CO C H  
297 HUDSON ST HACKENSACK N J  
LUMA ELECTRIC EQUIPMENT CO  
P O BOX 132 TOLEDO 1 OHIO  
LUMATRON ELECTRONICS INC  
116 COUNTY COURTHOUSE RO NEW HYOE PK LI NY  
LUMEN INC  
BOX 905 JOLIET ILLINOIS  
LUMINATOR INC  
630 TERMINAL WAY COSTA MESA CALIF  
LUMINOUS PROCESSES INC  
161 E 42 ST NEW YORK 17 NY  
LUMINOUS PROCESSES INC  
444 GREEN BAY RD KENILWORTH ILL  
LUNDEY ASSOCIATES INC  
694 MAIN ST WALTHAM 54 MASS  
LUNDY ELECTRONICS & SYSTEMS INC  
GLEN HEAD L I N Y  
LUPER & SUNBERG  
AVON ILL  
LUXO LAMP CANADA LTD  
370 STE CROIX BLVD MONTREAL 9 P Q CANADA  
LUXO LAMP CORP  
DOCK STREET PORT CHESTER N Y  
LUXO LAMP CORP  
1683 JERROLD AVE SAN FRAN CALIF  
LYMAN ELECTRONIC CORP  
P O BOX 1649 SPRINGFIELD 1 MASS  
LYN TRON INC  
5350 RIVERTON AVE N HOLLYWOOD CALIF  
LYNCH COMMUNICATION SYSTEMS INC  
695 BRYANT ST SAN FRANCISCO CALIF  
LYNCH CORPORATION  
2304 CRYSTAL ST ANDERSON IND  
LYNCH MFG CO R H  
7831 ARROYO DR SAN GABRIEL CALIF  
LYNCOACH & TRUCK CO INC  
ONEONTA N Y  
LYON AIRCRAFT SERVICE  
2701 N ONTARIO ST BURBANK CALIF  
LYON METAL PRODUCTS INC  
P O BOX 671 AURORA ILL

FOR INFORMATION

ON PRODUCTS

SEE THE

"PRODUCTS AND MANUFACTURERS"

SECTION



## M

MAAS & WALDSTEIN CO  
2121 MCCARTER HWY NEWARK N J

MACALLEN CO INC  
BAY RD NEWMARKET N H

MACDERMID INCORPORATED  
WATERBURY 20 CONN

MACDONALD AND COMPANY  
714 E CALIFORNIA AVE GLENDALE 6 CALIF

MACHINE O MATIC  
717 CHICAGO AVE EVANSTON ILL

MACHINERY ELECTRIFICATION INC  
35 HUDSON ST NORTHBORO MASS

MACHLETT LABS INC  
1063 HOPE ST SPRINGDALE CONN

MACK ELECTRIC DEVICES INC  
48 GLENSIDE AVE WYNCOTE PENNA

MACK ENGINEERING  
2626 31ST AVE SO MINNEAPOLIS 6 MINN

MACKAY INC A D  
198 BROADWAY NEW YORK 38 N Y

MACKAY RADIO & TELEGRAPH CO MARINE DIV  
133 TERMINAL AVE CLARK N J

MACKAY RESEARCH LABS  
P O BOX 148A BENSON ARIZ

MACKENZIE ELECTRONICS INC  
1025 N MCCADDEN PL HOLLYWOOD 38 CALIF

MACLEAN-FOGG LOCK NUT CO  
5535 N WOLCOTT AVE CHICAGO 40 ILL

MACLEOD & HANOPOL  
10 ROLAND ST CHARLESTOWN 29 MASS

MAC PANEL CO  
BRENTWOOD ST HIGH POINT NO CAR

MAOIGAN CORP  
2119 W CENTRAL AVE ORLANDO FLA

MADIGAN ELECTRONIC CORP  
200 STONEHINGE LANE CARLE PLACE NY

MAGNADYNE CORP  
PORT CHESTER NY

MAGNAFLUX CORP  
7328 W LAWRENCE AVE CHICAGO 31 ILL

MAGNASYNC MFG CO  
5546 SATSUMA AVE N HOLLYWOOD CALIF

MAGNATRAN INC  
PO BOX 211 KEARNY NJ

MAGNAVOX  
US HWY 11 E JEFFERSON CITY TENN

MAGNAVOX  
1505 E MAIN ST URBANA ILL

MAGNAVOX CO  
2255 S CARMELINA AVE LOS ANGELES CALIF

MAGNAVOX COMPANY THE  
2131 BUETER RD FT WAYNE 4 IND

MAGNE HEAD DIV GENERAL INST CORP  
2660 S LACIENEGA BLVD LOS ANG CALIF

MAGNE-TRONICS INC  
49 W 45 ST NEW YORK N Y

MAGNECESSORIES  
BOX 6960 WASHINGTON 20 DC

MAGNECORD DIV MIDWESTERN INSTRUMENTS INC  
P O BOX 7186 TULSA OKLA

MAGNECRAFT ELECTRIC CO  
5575 N LYNCH AVE CHICAGO 30 ILL

MAGNETIC ANALYSIS CORP  
42-44 12TH ST LONG ISLAND CITY NEW YORK

MAGNETIC CIRCUIT ELEMENTS INC  
3722 PARK PL MONTROSE CALIF

MAGNETIC CONTROLS CO  
6405 CAMBRIDGE ST MINN MINN

MAGNETIC CORE CORP  
JOHN & LAWRENCE STS BOX 368 NEWBURGH N Y

MAGNETIC CORP  
7332 ETON AVE CANOGA PARK CALIF

MAGNETIC DEVICES INC  
712 EAST ST FREDERICK MD

MAGNETIC INDUSTRIES INC SUB PREC INSTR CO  
3941 E BAYSHORE BLVD PALO ALTO CALIF

MAGNETIC INSTRUMENT CO INC  
546 COMMERCE ST THORNWOOD NY

MAGNETIC METALS CO  
HAYES AVE & 21 ST CAMDEN 1 N J

MAGNETIC RESEARCH CORP  
3160 W EL SEGUNDO BLVD HAWTHORNE CALIF

MAGNETIC SHIELD DIV PERFECTION MICA CO  
1322 N ELSTON AVE CHICAGO 22 ILL

MAGNETICO INC  
6 RICHTER CT E NORTHPORT LI NY

MAGNETICS INC  
BUTLER PA

MAGNETICS RESEARCH CO  
179 WESTMORELAND AVE WHITE PLAINS N Y

MAGNETIC SYSTEMS CORP  
1897 US 19 S CLEARWATER FLA

MAGTON INC SUB MORTON SALT CO  
110 N WACKER DR CHICAGO 6 ILL

MAGNION INC  
195 ALBANY ST CAMBRIDGE 39 MASS

MAGTROL INC  
240 SENECA ST BUFFALO 4 NY

MAHLER RESEARCH FOUNDATION  
PO BOX 1159 NEW YORK 1 NY

MAHONEY TELETRONIC LABS INC  
209 16 AVE NEWARK 3 N J

MAICO ELECTRONICS INC  
21 N 3RD ST MINNEAPOLIS 1 MINN

MAICO ELECTRONICS INC DYNAMU MAGNETRONICS DV  
21 N 3 ST MINNEAPOLIS 1 MINN

MAICO ELECTRONICS INC ENG DIV  
123 NORTH 3RD ST MINN MINN

MAIDA DEVELOPMENT CO  
214 ACADEMY ST HAMPTON VA

MAILINK STEEL SAFE CO GIANT VIEW NETWORK  
1672 OAKWOOD AVE TOLEDO 6 OHIO

MAJESTIC EXTRUDERS INC  
32-37 DOWNING ST FLUSHING 52 N Y

MAJOR ELECTRONICS CORP  
762 WYTHE AVE BROOKLYN 11 N Y

MAKEPEACE DIV D E ENGLEHARD INDUSTRIES INC  
PINE & DENHAM STS ATTLEBORO MASS

MALCO MFG CO  
4025 W LAKE ST CHICAGO 24 ILL

MALKIN-ILLION CO  
400 COIT ST IRVINGTON 11 N J

MALLINCKRODT CHEMICAL WORKS  
2 & MALLINCKRODT STS ST LOUIS 7 MO

MALLINCKRODT CHEMICAL WORKS  
223-243 W SIDE AVE JERSEY CITY N J

MALLINCKRODT CHEMICAL WORKS  
3600 N 2ND ST ST LOUIS MO

P R MALLORY & CO INC  
3029 E WASHINGTON ST INDIANAPOLIS 6 IND

MALLORY & CO INC P R  
42 S GRAY ST INDIANAPOLIS 6 IND

MALLORY CAPACITOR CO DIV P R MALLORY CO INC  
CRAWFORDSVILLE IND

MALLORY CAPACITOR CO DIV P R MALLORY CO INC  
HUNTSVILLE ALA

MALLORY CAPACITOR CO DIV PR MALLORY CO INC  
42 S GRAY ST INDIANAPOLIS IND

MALLORY CAPACITOR CO  
GREENCASTLE IND

MALLORY ELCTMGNTC CO DIV PR MALLORY & CO INC  
DUQUOIN ILL

MALLORY ELECTRONICS CO PR MALLORY CO INC  
3302 ENGLISH AVE INDIANAPOLIS 6 IND

MALLORY ELECT CO  
3625 INDUSTRY AVE LAKEWOOD CALIF

MALLORY METALLURGICAL CO  
3029 E WASHINGTON ST IND IND

MAWCO CORP  
532-542 4TH ST RACINE WISC

MANDEX MFG CO INC  
2614 W 48TH ST CHICAGO 32 ILL

MANDREL INDUSTRIES INC MEG PRODUCTS DIVISION  
BOX 3115 SEATTLE 14 WASHINGTON

MANNING PAPER CO JOHN A  
P O BOX DRAWER 328 TROY N Y

MANOSTAT CORP  
20-26 N MOORE ST NEW YORK 13 NY

MANSOL CERAMICS CO  
140 LITTLE ST BELLEVILLE NJ

MANSON LABORATORIES INC  
375 FAIRFIELD AVE STAMFORD CONN

MANUFACTURERS ENGG & EQUIP CORP  
YORK RD & SUNSET LANE HATBORO PA

MANUFACTURERS CHEMICAL CO INC  
1450 FERRY ST CAMDEN N J

MARANTZ CO  
25-14 BDWY LONG ISLAND CITY N Y

MARATHON BATTERY CO  
840 HENRIETTA ST WAUSAU WISC

MARATHON ELECTRIC MFG CO  
EARLVILLE ILL

MARBLETT CORP  
37-31 30 ST LONG ISLAND CITY 1 N Y

MARBON CHEMICAL DIV BORG-WARNER CORP  
P O BOX 68 WASHINGTON V VA

MARCH DYNAMICS INC  
920 SOUTH OYSTER BAY ROAD HICKSVILLE NY

MARCHANT MACHINING CORP  
4704 RHODE ISLAND AVE HYATTSVILLE MD

MARCO INDUSTRIES CO  
207 SOUTH HELENA ST ANAHEIM CALIF

MARCON ELECTRONICS CORP  
KEARNY NJ

MARCONI INSTRUMENTS  
111 CEDAR DRIVE ENGLEWOOD N J

ROBERT J MARCY ASSOCIATES  
80 8TH AVE NEW YORK 11 NY

MAROUTH PROD  
1387 LEDGE RD HINCKLEY OHIO

MARINE ELECTRIC CORP  
600 4TH AVE BROOKLYN 15 N Y

MARION INSTRUMENT DIV  
GRENIER FIELD MANCHESTER NH

MARK PRODUCTS CO  
5439 FARGO AVE SKOKIE ILL

MARKAL COMPANY  
3052 W CARROLL AVE CHICAGO ILL

MARKEL & SONS LFRANK  
SCHOOL LANE NORRISTOWN PA

MARKEM MACHINE CO  
150 CONGRESS ST KEENE N H

MARKITE CORP  
155 WAVERLY PL NEW YORK N Y

MARLIN-ROCKWELL CORP  
402 CHANDLER ST JAMESTOWN NY

MARLIN-ROCKWELL CORP  
FALCONER N Y

MARMA ELECTRONICS CO  
1633 N HALSTED ST CHICAGO 14 ILL

MARQUARDT CORP  
2771 N GAREY AVE POMONA CAL

MARQUETTE DIV CURTISS-WRIGHT CORP  
1145 GALEWOOD DR CLEVELAND 10 OHIO

MARS INDUSTRIES INC  
5209 W BROADWAY MINNEAPOLIS 22 MINN

MARSHALL ASSOCIATES INC JOHN  
BOX 2463 BRIDGEPORT 8 CONN

MARSHALLTOWN MFG CO  
810 E NEVADA ST MARSHALLTOWN IOWA

MARSLAND ENGG LTD  
350 WEBER ST N WATERLOO ONT CANADA

MARSTAN ELECTRONICS CORP  
204 BABYLON TURNPIKE ROOSEVELT LI NY

MARTIN MARIETTA CORP ORLANDO DIV  
BOX 5837 ORLANDO FLA

MARTIN MARIETTA CORP  
DENVER 1 COLO

MARTIN COMPANY ELECT SYS & PROD DIV  
BALTIMORE 1 MARYLAND

MARTIN PROD INC  
139 E CENTRAL BLVD PALISADES PARK N J

MARTRONICS INC  
82 SANFORD ST HAMDEN 14 CONN

MARYLAND CERAMIC & STEATITE CO INC  
BOX 127 BELAIR MD

MARYLAND TELECOMMUNICATIONS INC  
10 B WINTERS LANE BALTIMORE 28 MD

MASER OPTICS INC  
89 BRIGHTON AVE BOSTON 34 MASS

MASK O MATIC INC  
55 BELMONT AVE PATERSON 2 N J

MASON ELECTRIC CORP  
3839 VERDUGO RD LOS ANGELES 65 CALIF

MASON-NEILAND DIV WORTHINGTON CORP  
55 NAHATAN ST NORWOOD MASS

MASONITE CORP  
LAUREL MISSISSIPPI

MASONITE FABRICATORS  
1577 RIO VISTA AVE LOS ANGELES CALIF

MASONITE FABRICATORS  
10360 EVENDALE DR CINN OHIO

MAST DEVELOPMENT CO INC  
2212 E 12TH ST DAVENPORT IOWA

MASTER APPLIANCE INC  
1600 FACTORY AVE MARION IND

MASTER ENGRAVING STUDIOS  
135 LIBERTY ST NEW YORK 6 NY

MASTER MOBILE MOUNTS INC  
4125 W JEFFERSON BLVD LOS ANG CALIF

MASTER SPECIALTIES CO  
956 E 108TH ST LOS ANGELES 59 CALIF

MASTER TAPE PRINTERS INC  
3400 N HALSTED ST CHICAGO ILL

MASTERCRAFT INSTRUMENT CO  
DUBUQUE IOWA

MASTERITE INDUSTRIES INC  
835 W OLIVE ST INGLEWOOD CALIF

MASTRA CO  
2104 SUPERIOR AVE CLEVELAND 18 OHIO

MATERIALS FOR ELECTRONICS CO  
BLOG 17 INTL AIRPORT JAMAICA N Y

MATHIS CO G E  
6100 S OAK PARK AVE CHICAGO 38 ILL

MATRIX CORP  
839 NEW YORK AVE TOLEDO OHIO

MATRIX ELECTRONICS CORP  
6360 FEDERAL BLVD SAN DIEGO 14 CALIF

MATRIX RES & OEV CORP  
11 MULBERRY ST NASHUA N H

MATTERN CORPORATION  
7444 W WILSON AVENUE CHICAGO 31 ILL

MATTHEWS & CO JAS  
3823 FORBES ST PITTSBURGH 13 PA

MATTHEWS RESEARCH INC  
4306 WHEELER AVE ALEXANDRIA VA

MAURER INC J A  
3701 31 ST LONG ISLAND CITY 1 NY

MAUREY INSTRUMENT CORP  
4555 W 60TH ST CHICAGO 29 ILL

MAXSON ELECTRONICS CORP  
475 10TH AVE NEW YORK 18 N Y

MAXSON ELECTRONICS CORP  
MAXSON DR OLD FORGE PENNA

MAXSON INSTRUMENTS  
DIV MAXSON ELECTRONICS CORP  
460 W 34 ST NEW YORK 1 NY

MAXSON ELECTRONICS CORP ELECTRONIC OES DIV  
2311 FARRINGTON DALLAS 7 TEX

MAY RESEARCH INC  
1405 11 AVE SO BOX 1167 MPLS 40 MINN

MAYBERRY ELECTRONICS CO  
111 S OAK ST INGLEWOOD 1 CALIF

MAYFLOWER ELECTRONIC DEVICES INC  
20 INDUSTRIAL AVE LITTLE FERRY NJ

MAYSTEEL PRODUCT INC  
MAYVILLE WISC

MAYTAG ELECTRONICS INC  
730 S TEJON STREET COLORADO SPRINGS COLO

MB ELECT VIBRATION ENGG PLANT  
781 WHALLEY AVE NEW HAVEN CONN

MB ELECTRONICS DIV TETRON ELECT INC  
781 WHALLEY AVE NEW HAVEN CONN

MC CLURE PROJECTORS  
BX 1338 1012 CHURCH ST EVANSTON ILL

MCALISTER INC J G  
1117 N MCCADDEN PL HOLLYWOOD 38 CALIF

MCCARRON ELECTRIC CO  
721 MONTEREY PASS RD MONTEREY PK CALIF

MCCORMICK SELPH ASSOC  
HOLLISTER AIRPORT HOLLISTER CALIF

MCCOY ELECTRONICS CO  
CHESTNUT & WATTS STS MT HOLLY SPRINGS PA

MCCULLOUGH TOOL CO  
5820 S ALAMEDA ST LOS ANG CALIF

MCDONNELL & MILLER INC  
3500 N SPAULDING AVE CHICAGO 18 ILL

MCDONNELL AIRCRAFT CORP  
LAMBERT-ST LOU ARPT BX 516 ST LOUIS 66 MO

MCGILL MFG CO ELECTRICAL DIV  
1002 N CAMPBELL ST VALPARAISO IND

MCGOHAN INC DON  
3700 W ROOSEVELT RD CHICAGO 24 ILL

MCGRAW EDISON PRIMARY BATTERY DIV  
BLOOMFIELD N J

MCGREGOR ELECTRONIC INDUSTRIES INC  
132 FIRST ST MCGREGOR IOWA

MCINTOSH LABS INC  
2 CHAMBERS ST BINGHAMTON N Y

MCKENNA LABORATORIES  
2503 MAIN ST SANTA MONICA CALIF

MCLEAN ENGG LABS  
P O BOX 228 70 WASHINGTON RD PRINCETON N J



# ELECTRONIC MANUFACTURERS—A TO Z

MCLEAN SYNTORQUE CORP  
WEST HURLEY N Y

MC MARTIN INDUSTRIES INC  
OMAHA NEBRASKA

MC MILLAN COMPANIES  
BROWNVILLE AVE IPSWICH MASS

MEAGHER ELECTRONICS CO  
177 WEBSTER STREET MONTEREY CALIF

MEASUREMENT ENGG LTD  
232 JOHN ST ARNPRIOR ONTARIO CAN

MEASUREMENTS DIV MC GRAW-EDISON CO  
BOX 180 BOONTON NJ

MEASUREMENT SYSTEMS INC  
140 WATER ST S NORWALK CONN

M E C INC  
796 BERRY RD P D BOX 577 NASHVILLE TENN

MECA ELECTRONICS  
107 E 8TH ST GIBSON CITY ILL

MECA ELECTRONICS INC  
P O BOX 645 DOVER N J

MECH-TRONIC EQUIPMENT CO  
P O BOX 510 SILVER SPRING MD

MECHANICAL ENGRAVING CO INC  
10 VAN CORTLANDT AVE E NEW YORK 68 N Y

MECHANICAL INDUSTRIES PRODS CO  
217 ASH ST AKRON 8 OHIO

MECHANICAL INDUST SOUTHERN CORP  
1500 S W 40TH ST FORT LAUDERDAL FLA

MECHANICAL PRODUCTS INC  
1824 RIVER ST JACKSON MICH

MECHANICS FOR ELECTRONICS INC  
249 FIFTH ST CAMBRIDGE 42 MASS

MECHATROL DIV SERVOMECHANISMS INC  
1200 PROSPECT AVE WESTBURY NY

MECTRON CO  
166 RIDGE AVE NORTH PLAINFIELD NJ

MECTRON CO  
501 E 1ST AVE ROSELLE N J

MEDCRAFT ELECTRONIC CORP  
426 GREAT EAST NECK RD BABYLON NY

MEDISTOR INST CO  
1443 NORTHLAKE WAY SEATTLE 3 WASH

MEDTRONIC INC  
3055 HIWAY NO 8 MINNEAPOLIS 18 MINN

MEKTRON DIV CALIF GENERAL INC  
798 F BOX 937 CHULA VISTA CALIF

MELABS  
3300 HILLVIEW AVE PALO ALTO CALIF

MELCO PRODUCTS INC  
301 S AVE S MINNEAPOLIS 15 MINN

MELCOR ELECT CORP  
48 TOLEDO ST S FARMINGDALE N Y

MELETRON CORP  
950 N HIGHLAND AVE LOS ANGELES 38 CALIF

MELETRON CORP  
940 N ORANGE DR LOS ANG CALIF

MELODY MASTER MFG CO  
2149 W ROSCOE ST CHICAGO 18 ILL

MELPAR INC  
3000 ARLINGTON BLVD FALLS CHURCH VA

MEL-RAIN CORP  
2100 E FLETCHER AVE INDIANAPOLIS 3 IND

MELROY ELECTRONIC MFG CO  
1012 CLEVELAND ST CLEARWATER FLA

MEL SCHWARTZ CO  
48 PINE ST EAST PATERSON NJ

MEMOREX CORP  
1180 SHULMAN AVE SANTA CLARA CALIF

MENLO PARK ENGG  
711 HAMILTON AVE MENLO PARK CALIF

MEPCO INC  
35-37ABBETT AVE MORRISTOWN NJ

MERCAST MFG CORP  
2620 1 ST LA VERNE CALIF

MERCK & CO INC ELECTRONIC CHEM DIV  
LINCOLN AVE RAHWAY NJ

MERCOID CORP  
4201 BELMONT AVE CHICAGO 41 ILL

MERCURY AIR PARTS CO INC  
BX 135 9310 W JEFFERSON CULVER CITY CALIF

MERCURY CONTACTS INC  
1950 NEVA DRIVE DAYTON 14 OHIO

MERCURY ENGG CORP  
339 E COTTAGE PL YORK PA

MERCURY TRANSFORMER CORP  
12964 PANAMA ST LOS ANGELES 66 CALIF

MERIAM INSTRUMENT CO ELECTRONIC DIV  
10120 MADISON CLEVELAND 35 OHIO

MERIDIAN METALCRAFT INC  
8739 S MILLERGROVE DR WHITTIER CALIF

MERIT SHORT WAVE DIATHERMY CO  
2758 WHITTIER BLVD LOS ANGELES 23 CALIF

MERIX CHEMICAL CO  
2234 E 75TH ST CHICAGO 49 ILL

MERRIMAC RESEARCH & DEVELOPMENT INC  
517 LYONS AVE IRVINGTON N J

MESA PLASTICS CO  
12270 NEBRASKA AVE LOS ANGELES 25 CALIF

MESUR MATIC ELECTRONICS CORP  
BRADFORD NH

METACHEM RESINS CORP MEREKO PRODS DIV  
530 WELLINGTON AVE CRANSTON 10 R I

ELECTRONICS DIV METAL TEXTILE CORP  
647 E 1ST AVE ROSELLE N J

METAL CRAFT INC  
BURGESS PL WAYNE N J

METAL EDGE INDUSTRIES  
GLOUSTER PIKE BARRINGTON NJ

METAL FABRICATORS CORP  
73 POND ST WALTHAM 54 MASS

METAL HYDRIDES INCORP  
12 24 CONGRESS ST BEVERLY MASS

METAL SPECIALTY PRODUCTS CORP  
27-01 BROOKLYN QUEENS EXP W WOODSIDE 77 NY

METAL & THERMIT CORP  
CARTERET N J

METALECTRO LAB  
11423 VANOWEN ST HOLLYWOOD CALIF

METALLIZING CO OF LOS ANG INC  
1233 S BOYLE AVE LOS ANG CALIF

METALLO GASKET CO  
16 BETHANY ST NEW BRUNSWICK N J

METALPHOTO CORP  
18531 S MILES RD CLEVELAND OHIO

METALPHOTO OF CINCINNATI  
7 E 75TH ST CINCINNATI OHIO

METALS & CONTROLS INC COMMERCIAL CONTRLS DPT  
300 N MAIN VERSAILLES KY

METAVAC INC  
45-68 162 ST FLUSHING 58 N Y

METCOM INC  
76 LAFAYETTE ST SALEM MASS

METEOR PRODUCTION ENGRG INC  
1465 S VANDEVENTER AVE ST LOUIS MO

METER MAKERS INC  
1101 W ARMITAGE CHICAGO ILL

METERS INC  
5333 N KEYSTONE AVE INDIANAPOLIS 20 IND

METETELIC CORP  
83 ERNA AVE MILFORD CONN

METEX ELECTRONICS  
WALNUT AVE CLARK N J

METHODE MFG CORP  
7447 W WILSON AVE CHICAGO 31 ILL

METHODE MFG CO  
1700 HICKS RD ROLLING MEADOWS ILL

METHODS RESEARCH CORP  
105 W WILLOW AVENUE STATEN ISLAND 5 NY

MET-L-CHEK CO THE  
11919 S WESTERN AVE LOS ANGELES 47 CALIF

METOX  
68 RUE VILLIERS DE 1 PARIS 20EME FRANCE

METPRO INC R I  
230 TORONTO AVE PROVIDENCE 5 R I

METRIC SYSTEMS CORP  
736 N BEALE ST FT WALTON BEACH FLA

METRON INSTRUMENT CO  
432 LINCOLN ST DENVER 3 COLO

METRON INSTRUMENT CO  
5302 S DELAWARE ST LITTLETON COLO

METRONIX INC  
75 WILSON MILLS RD CHESTERLAND OHIO

METROPOLITAN TELECOMMUNICATIONS CORP  
COIL WINDERS DIV  
AMES CT PLAINVIEW NY

METROTEK ELECTRONICS INC  
205 W CABARRUS ST RALEIGH NC CAR

METZ REFINING CO  
369 MULBERRY ST NEWARK 2 NJ

MEYER MANUFACTURING  
410 NW 2ND ST PIPESTONE MINN

M F ELECTRONICS CORP  
118 E 25 ST NEW YORK NY

M-G METAL PRODS CO  
1217 WEBSTER AVE CHICAGO 14 ILL

M H STANDARD CORP  
400 HEATON ST HAMILTON OHIO

M-H STANDARD CORP  
510 COMMUNIPAW AVE JERSEY CITY 4 NJ

MICA CORP  
4031 ELENDA ST CULVER CITY CALIF

MICA INSULATOR DIV MINNESOTA MINING MFG CO  
797 BROADWAY SCHENECTADY 1 NY

MICACRAFT PRODUCTS INC  
49 LIBERTY STREET NEWARK NJ

MICA FAB CO  
53 CENTRAL AVE ROCHELLE PARK N J

MICAMOLD ELECTRONICS MFG CORP  
65 GOUVERNEUR ST NEWARK 4 NJ

MICAC PRODUCTS CO  
8506 ILL RD HWY 14 FORT WAYNE IND

MICARTA FABRICATORS INC  
5924 N RAVENSWOOD AVE CHICAGO 4 ILL

MICHIGAN MAGNETICS INC  
VERMONTVILLE MICH

MICHIGAN MAGNETICS INC  
656 GRAND ALLEGAN MICH

MICHIGAN PANELYTE MOLDED PLASTICS DIV  
ST REGIS PAPER CO  
DEXTER MICH

MICHIGAN WIRE CLOTH CO  
2100 HOWARD ST DETROIT MICH

MICO INSTRUMENT CO  
80 TROWBRIDGE ST CAMBRIDGE 38 MASS

MICON ELECTRONICS INC SUB METALCRAFT INC  
ROOSEVELT FIELD GARDEN CITY L I N Y

MICRO BALANCING INC  
191 HERRICKS RD GARDEN CITY N Y

MICRO-CIRCUITS CO  
NEW BUFFALO MICH

MICRODOT INC  
220 PASADENA AVE S PASADENA CALIF

MICRODOT INC MAGNETICS DIV  
5960 BOWCROFT ST LOS ANG CALIF

MICRO GEE PROD INC  
6319 SLAUS AVE CULVER CITY CALIF

MICROFLECT CO  
3450 S 25 ST SALEM DRE

MICRO INSTRUMENT CO  
2245 S FEDERAL AVE LOS ANGELES 64 CAL

MICROLAB  
570 W MT PLEASANT AVE LIVINGSTON N J

MICRO LECTRIC INC  
19 DEBOVOISE AVE ROOSEVELT N Y

MICROLECTRON INC  
1547 18TH ST SANTA MONICA CALIF

MICROMAG INSTRUMENT CO  
115 HALLECK ST ROXBURY 20 MASS

MICRO MAGNA ELECTRONICS CORP  
1101 POWER AVE CLEVELAND 14 OHIO

MICROMAT CO  
548 PIERMONT AVE HILLSIDE N J

MICRODMATIC MACHINE CORP  
45 MORGAN AVE BROOKLYN 37 N Y

MICRO MEASUREMENTS CORP  
2412 NORWOOD MELROSE PARK ILL

MICROMECH MFG CO  
695 RAHWAY AVE UNION N J

MICROMEGA CORPORATION  
4134 DEL REY AVE VENICE CALIF

MICROMETALS  
72 E MONTECITO AVE SIERRA MADRE CALIF

MICROMETRICAL MFG CO  
3621 S STATE ANN ARBOR MICH

MICRO METRICS INC  
165 PENNSYLVANIA AVE PATERSON 3 N J

MICROMODULAR COMPONENTS DIV  
BOX 5 1 ANAHEIM CALIF

MICROMOLD PRODUCTS CORP  
1 SCHOOL ST YONKERS N Y

MICRONETICS INC  
5221 UNIVERSITY AVE SAN DIEGO 5 CALIF

MICRON GEAR MFG CO  
73 RUSHMORE ST WESTBURY L I NY

MICRONICS CORP OF AMERICA  
8116 OLD YORK RD PHILA 17 PA

MICRO-NOW INSTRUMENT CO INC  
6340 N TRIPP AVE CHICAGO 46 ILL

MICROPHASE CORP  
BOX 1166 GREENWICH CONN

MICRO PUMP CORP  
BOX 392 DANVILLE CALIF

MICRO-RADIONICS INC  
14844 OXNARD ST VAN NUYS CALIF

MICROSECOND ELECT INC  
3213 E WASHINGTON PHOENIX ARIZONA

MICROSEMICONDUCTOR CORP  
11250 PLAYA CT CULVER CITY CALIF

MICRO SONIC INDUSTRIES INC  
5305 CHICAGO AVE MINNEAPOLIS MINN

MICROSONICS INC  
349 LINCOLN ST HINGHAM MASS

MICROSONICS INC  
60 WINTER ST WEYMOUTH 88 MASS

MICROSPACE INC  
170 S VAN BRUNT ST ENGLEWOOD N J

MICRO STATE ELECTRONICS CORP  
152 FLORAL AVE MURRAY HILL N J

MICRO SYSTEMS INC  
319 AGUSTINO RD SAN GABRIEL CALIF

MICROTECH INC  
MILLDALE RD CHESHIRE CONN

MICROTRAN CO  
145 E MINOELA AVE VALLEY STREAM NY

MICROWAVE ASSOCIATES INC  
BURLINGTON MASS

MICROWAVE DEVELOPMENT LABS  
15 STRATHMORE ROAD NATICK MASS

MICROWAVE ELECTRONIC TUBE CO INC  
76 LAFAYETTE ST SALEM MASS

MICROWAVE ELECT CORP  
4061 TRANSPORT ST PALO ALTO CALIF

MICROWAVE ENG LABS  
943 INDUSTRIAL AVE PALO ALTO CALIF

MICROWAVE PHYSICS CORP  
420 KIRBY ST GARLAND TEX

MICROWAVE PRODUCTS INC  
14821 AETA ST VAN NUYS CAL

MICROWAVE SERVICES INTL INC  
ROUTE 46 CISCO RD DENVER NJ

MID-CONTINENT ENGINEERING  
1712 NORTHEAST NARSHALL MINN MINN

MIDDLESEX PAPER TUBE CO  
345 CHELMSFORD ST LOWELL MASS

MID-EASTERN ELECTRONICS INC  
32 COMMERCE ST SPRINGFIELD NJ

MIDGET LOUVER CO  
6-8 WALL ST NORWALK CONN

MIDLAND INDUSTRIAL FINISHES CO  
E WATER ST WAUKEGAN ILL

MIDLAND MFG CO  
3155 FIBERGLAS RD KANSAS CITY 15 KANSAS

MIDWEST COIL & TRANSF CO  
1640 N HALSTED ST CHICAGO ILL

MIDWEST ELECTRIC PRODUCTS INC  
1515 N FRONT ST MANKATO MINN

MIDWEST METAL PRODUCTS INC  
450 E DONOVAN ROAD KANSAS CITY 15 KANS

MIDWEST HOLDING & MFG CO  
GURNEE ILL

MID-WEST SPRING CO  
ETNA ST MENTON IND

MIDWESTERN INSTRUMENTS  
PO BOX 7509 TULSA OKLA

MIKROS INC  
7620 S W MACADAM AVE PORTLAND ORE

MILAN ELECTRIC MFG CO  
1100 ELMWOOD AVE PROVIDENCE 7 RI

MILBURN CO  
3246 E WOODBRIDGE DETROIT 7 MICH

MILES REPRODUCER CO  
812 BROADWAY NEW YORK 3 N Y

MILFORD RIVET & MACHINE CO  
MILFORD CONN

MILFORD RIVET & MACH CO  
801 ILL AVE AURORA ILL

MILFORD RIVET & MCH CO  
FLYRIA OHIO

MILGO ELECT CORP  
7620 N W 36TH AVE MIAMI FLA

MILLEN MFG CO JAMES  
150 EXCHANGE ST MALDEN 48 MASS

MILLER ASSOCIATES  
P O BOX 369 LAKEVILLE CONN

MILLER CO J W  
5917 S MAIN ST LOS ANGELES 3 CALIF

MILLER CO M C  
288 SADDLE RIVER RD UPPER SADDLE RV N J

MILLER CORP HARRY  
4TH & BRISTOL STS PHILA PA  
MILLER DIAL & NAMEPLATE CO  
4400 N TEMPLE CITY BLVD EL MONTE CALIF  
MILLER ELECTRO RESEARCH LABS  
5529 S 5TH ST MILWAUKEE 7 WISC  
MILLER FRANKLIN P & SON INC  
36 MEADOW ST EAST ORANGE N J  
MILLER-HARRIS INSTRUMENT CO  
1134 S FIRST ST MILWAUKEE 4 WISC  
MILLER-TROJAN CO INC  
TROY OHIO  
MILLETRON INC  
IRWIN PA  
MILLI SWITCH CORP  
FRANKFORT INO  
MILLI-SWITCH CORP  
PO BOX 67 MILL CREEK RD GLADWYNE PA  
MILLIPORE FILTER CORP  
P O BOX 427 BEOFORO MASS  
MILLITEST CORP  
88 MADISON AVE HEMPSTEAD N Y  
MILLIVAC INSTRUMENTS INC  
BOX 997 SCHENECTADY N Y  
MILRO CONTROLS CO INC  
280 MIDLAND AVE SADDLE BROOK N J  
MILTON-ROY CO  
6301 49TH BOX 12169 ST PETERSBURG FLA  
MILWAUKEE ELECTRONICS CORP  
5219 N HOPKINS ST MILWAUKEE 9 WIS  
MILWAUKEE RELAYS INC  
606 E PIONEER RD CEARBURG WIS  
MILWAUKEE RESISTOR CO  
700 W VIRGINIA ST MILWAUKEE 4 WISC  
MILWAUKEE STAMPING CO  
800 S 72 ST MILWAUKEE 14 WISC  
MINARIK ELECTRIC CO  
224 E 3RD ST LOS ANG CALIF  
MINATRON CORP  
BELLE MEAD 9 N J  
MINATURE INSTRUMENTS INC  
PTONE ELECTRONICS DIVISION  
9440 SCIENCE CENTER DRIVE MINN 27 MINN  
MINCO PRODUCTS INC  
740 WASHINGTON AVE MINNEAPOLIS 1 MINN  
MINCOM DIV MINN MINING & MFG CO  
2049 S BARRINGTON AVE LOS ANGELES 25 CAL  
MINE SAFETY APPLIANCES CO  
201 N BRADDOCK AVE PITTSBURGH 8 PA  
MINELCO  
21 PLYMOUTH ST HOLBROOK MASS  
MINERALS & INSULATION CO  
ROCHELLE PARK NJ  
MINIATURE ELECTRONIC COMPONENTS CORP  
HOLBROOK MASS  
MINI-MOLD INC  
14759 BESSEMER ST VAN NUYS CALIF  
MINI-TOOL TECHNICAL INDUSTRY INC  
544 GRAND AVE ENGLEWOOD N J  
MINICORD CORP OF AMERICA  
1915 ATLANTIC AVE ATLANTIC CITY N J  
MINISINK RUBBER CO INC  
ORANGE COUNTY UNIONVILLE N Y  
MINITEC  
5423 DELAWARE AVE LOS ANGELES 4 CALIF  
MINNEAPOLIS ELECT  
2233 UNIVERSITY AVE ST PAUL MINN  
MINNEAPOLIS-HONEYWELL HEILANO DIV  
5200 E EVANS AVE DENVER COLO  
MINNEAPOLIS-HONEYWELL MICRO SWITCH DIV  
CHICAGO & SPRING STS FREEPORT ILL  
MINNEAPOLIS-HONEYWELL BOSTON DIV  
1400 SOLDIERS FIELD RD BOSTON MASS  
MINNEAPOLIS-HONEYWELL FALL RIVER DIV  
PENN & BAY STS FALL RIVER MASS  
MINNEAPOLIS-HONEYWELL ELECT PROC DIV  
60 WALNUT ST WELLESLEY HILLS MASS  
MINNEAPOLIS HONEYWELL APPARATUS CONTROLS DIV  
2753 4TH AVE MINNEAPOLIS MINN  
MINNEAPOLIS-HONEYWELL CERAMIC LAB  
1885 DOUGLAS DR N MINNEAPOLIS MINN  
MINNEAPOLIS-HONEYWELL ORDNANCE DIV  
600 2ND ST N HOPKINS MINN  
MINNEAPOLIS-HONEYWELL AERO DIV  
2600 RIDGWAY RD MINNEAPOLIS MINN  
MINNEAPOLIS-HONEYWELL SEMICONDUCTOR PROD DIV  
1015 S 6 ST MINNEAPOLIS MINN  
MINNEAPOLIS-HONEYWELL PRECISION METER DIV  
GRENIER FIELD MANCHESTER N H  
MINNEAPOLIS-HONEYWELL BROWN INST DIV  
WAYNE & WINORIM AVES PHILA PA  
MINNEAPOLIS-HONEYWELL RUBICON DIV  
RIOGE AVE 35 ST PHILA PA  
MINNEAPOLIS-HONEYWELL SPECIAL SYS DIV  
QUEEN & S BAILEY POTTSTOWN PA  
MINN MINING & MFG CO ELFT PRODS DIV  
900 BUSH ST ST PAUL & MINN  
MINN MINING & MFG CO IRVINGTON DIV  
BOX 108 FREEHOLD N J  
MINN MINING MFG CO CHEMICAL DIV  
900 BUSH ST ST PAUL & MINN  
MINNESOTA MINING & MFG CO  
900 BUSH AVE ST PAUL & MINN  
MINNESOTA MINING & MFG CO  
HUTCHINSON MINN  
MINNESOTA RUBBER CO  
3630 WOODALE AVE MINN MINN  
MINOR RUBBER CO  
ACKERMAN ST BLOOMFIELD N J  
MINSHALL ORGAN INC  
28 BIRGE ST BRATTLEBORO VT  
MINSTER MACHINE CO  
1500 S 5TH ST MINSTER OHIO  
MIRATEL INC  
1 ST SE & RICHARDSON NEW BRIGHTON MINN  
MIRATEL INC  
1060 DIONNF ST ST PAUL 13 MINN

MISCO  
3806 GRAND AVE MINNEAPOLIS MINN  
MISKELLA INFRA-RED CO  
E 73 & GRAND AVE CLEVELAND 4 OHIO  
MISSILE SYSTEMS CORP CALIFORNIA DIVISION  
11949 VOSE ST N HOLLYWOOD CALIF  
MISSILE TRONICS CORP  
245 4TH ST PASSAIC N J  
MISSINERS INC  
3737 SAN FERNANDO RD GLENDALE CALIF  
MISSOURI RESEARCH LABORATORIES INC  
2109 LOCUST ST ST LOUIS 3 MO  
MITCHELL CAMERA CORP ASTROMICS DIV  
666 W HARVARO ST GLENDALE CALIF  
MITCHELL INDUSTRIES INC  
MUNICIPAL A P PO BOX 17 MINERAL WELLS TEX  
MITE CORP  
580 WINTERS AVE PARAMUS N J  
MITRONICS INC  
132 FLORAL AVE MURRAY HILL NJ  
MKS INSTRUMENTS INC  
45 MIDDLESEX TPKE BURLINGTON MASS  
M & O PLASTICS PRODUCTS  
BOX 402 BANNARD ST FREEHOLD NJ  
MNEMOTRON CORP  
441 WASHINGTON AVE NO HAVEN CONN  
MOBIL ELECTRONICS MFG CO  
1111 STATE RO 67 & ANDERSON INO  
MODEL ENGG & MFG INC  
50 FREDERICK ST HUNTINGTON INO  
MODEL RECTIFIER CORP  
1675 UTICA AVENUE BROOKLYN 34 N Y  
MODELECTRIC PRODUCTS CORP  
ASBURY PARK N J  
MODERN DESIGN DIV H C SCHLOER INC  
VESTAL PARKWAY EAST VESTAL N Y  
MODERN INDUSTRIES INC  
5755 CAMILLE AVE CULVER CITY CALIF

## FOR INFORMATION

## ON PRODUCTS

## SEE THE

## "PRODUCTS AND MANUFACTURERS"

## SECTION

MODERN LABORATORY EQUIP CO  
1811 I AVE NEW YORK 28 N Y  
MODULAR INST CORP DIV ASTROSONICS INC  
190 MICHAEL DR SYOSSET N Y  
MOHAWK COMMUNICATIONS INC  
CHADWICKS 1 NY  
MODULAR ELECTRONICS INC  
521 CENTRAL AVE OSSEA MINN  
MOHAWK ELECTRONICS CORPORATION  
944 HALSEY ST BROOKLYN 33 NY  
MOHAWK MFG CO  
P O BOX 1110 MIDDLETOWN CONN  
MOHAWK WIRE & CABLE CORP  
45 SUMMER ST LEOMINSTER MASS  
MOISTURE REGISTER CO  
1510 W CHESTNUT ST ALHAMBRA CALIF  
MOLDED FIBRE GLASS BODY CO  
4601 BENEFIT AVE ASHTABULA OHIO  
MOLOED FIBER GLASS CO  
4401 BENEFIT AVE ASHTABULA OHIO  
MOLDED INSULATION CO  
335 E PRICE ST PHILADELPHIA 44 PA  
MOLDED INSULATION CO  
123 E 8TH AVE CONSMOHOCKEN PENNA  
HOLDING ENGINEERS INC  
102 INTERSTATE RD ADDISON ILL  
MOLDOMATIC CORP  
17301 RIDGELAND AVE TINLEY PARK ILL  
MOLE-RICHARDSON CO  
937 N SYCAMORE AVE HOLLYWOOD 38 CALIF  
MOLECULAR DIELECTRICS INC  
101 CLIFTON BLVD CLIFTON NJ  
MOLECU-WIRE CORP  
SCOBENVILLE N J  
MOLEX PRODUCTS CO  
9515 SOUTHVIEW AVE BROOKFIELD ILL  
MOLLY CORP  
230 N 5 ST READING PA  
MOLON MOTOR & COIL CORP  
3737 INDUSTRIAL AVE ROLLING MEADOWS ILL  
MOLONEY ELECTRIC CO  
5390 BIRCHER BLVD ST LOUIS 20 MO  
MONA INDUSTRIES INC  
PO BOX 1786 PATERSON 17 NJ  
MONADNOCK MILLS  
1977 FIRST AVE SAN LEANDRO CALIF  
MONAGHAM CO J J  
500 ALCOTT ST DENVER 4 COLO  
MONITOR CONTROLLER  
99 GROVE ST ROCKLAND MASS  
MONITOR PRODUCTS CO INC  
815 FREMONT AVE S PASADENA CALIF  
MONITOR SYSTEMS INC  
FORT WASHINGTON PA  
MONODE INC  
3791 PROSPECT AVE CLEVE OHIO  
MONOSILICON INC  
139 E 157ST GAROENA CALIF  
MONROE CALCULATING MACHINE COMPANY  
555 MITCHELL ST ORANGE N J  
MONROE CALCULATING MACHINE CO  
VALLEY DRIVE BRISTOL VA  
MONROE ELECTRONICS INC  
MIDDLEPORT N Y

MONROE INDUSTRIES INC  
934 36TH ST SE GRAND RAPIDS 8 MICH  
MONTEK ASSOCIATES INC  
4675 S STATE ST SALT LAKE CITY 7 UTAH  
MONTFERY ENGINEERING  
PO BOX 3083 GRANADA HILLS CALIF  
MONTGOMERY MFG CO  
206 S MAIN ST OWENSVILLE IND  
MONTRONICS INC  
1212 W MAIN ST BOX 135 BOZEMAN MONT  
MONTROSE PRODUCTS CO INC  
AUBURN INDUSTRIAL PARK AUBURN MASS  
MOODY MACHINE PRODUCTS CO INC  
40 DUDLEY ST PROVIOENCE 5 RI  
MOORE ASSOCIATES INC  
893 AMERICAN ST SAN CARLOS CALIF  
MOORE CO HOWARD J  
105 E 165TH NEW YORK N Y  
MOORE CORP JOHN B  
BOX O DEPT EI PEERLESS BLDG NUTLEY 1 N J  
MOORE & CO SAMUEL  
MANTUA OHIO  
T R MORAN CO INC  
P O BOX 185 EL SEGUNO CAL  
MORAN INSTRUMENT CORP  
170 E ORANGE GROVE BLVD PASAENA CALIF  
MORAN PRODUCTS CO  
7199 WENTWORTH AVE CLEVELAND 2 OHIO  
MOREY CORP  
2014 N MAJOR AVE CHICAGO 39 ILL  
MORGAN ADHESIVES CO  
4650 DARROW RD STOW OHIO  
MORNINGSTAR PAISLEY FACTORIES  
1111 CHESTNUT ST REDWOOD CITY CALIF  
MORRIS CO J I  
390 ELM ST SOUTHBRIDGE MASS  
MORSE CO FRANK W  
354 CONGRESS ST BOSTON 10 MASS  
MORSE INSTRUMENT CO  
20 CLINTON ST HUDSON OHIO  
MOSAIC FABRICATION INC  
205 CHAPIN ST SOUTHBRIDGE MASS  
MOSELEY CO F L  
409 FAIR OAKS AVE PASADENA CALIF  
MOSER JEWEL CO  
544 FAYETTE ST PERTH AMBOY NJ  
MOSINEE PAPER MILLS CO  
MOSINEE WISC  
MOSLER RESEARCH PROD INC  
9 SOUTH ST DANBURY CONN  
MOSLEY ELECTRONICS INC  
4610 N LINDBERGH BRIDGETON MO  
MOSSMAN INC DONALD P  
PO BOX 265 BREWSTER NY  
MOSSMAN-ELLIOTT CORP  
204 SO LARKIN AVE JOLIET ILL  
MOTIOPHGRAPH INC  
4441 W LAKE ST CHICAGO 24 ILL  
MOTORDYNE INC  
2221 BARRY AVE LOS ANG CALIF  
MOTOROLA AVIATION ELECTRONICS INC  
10916 W WASHINGTON BLVD CULVER CITY CALIF  
MOTOROLA COMMUNICATIONS & ELECT INC  
4501 W AUGUSTA BLVD CHICAGO ILL  
MOTOROLA DAHLBERG CO  
BOX 549 MINNEAPOLIS MINN  
MOTOROLA INC  
1400 W 30TH ST QUINCY ILL  
MOTOROLA INC SEMICONDUCTOR PRODUCTS DIV  
5005 MCDOWELL RD PHOENIX ARIZ  
MOTOROLA INC SOLID STATE SYSTEMS DIV  
3102 N 56TH ST BOX 5409 PHOENIX 10 ARIZ  
MOTOROLA INC  
9401 GRAND AVE FRANKLIN PARK ILL  
MOTORESEARCH CO  
1600 JUNCTION AVE RACINE WISC  
MOTOR GENERATOR CORP HOBART BRO AFF  
W WATER ST TROY OHIO  
MOTSON CO J FRANK  
1717 BETHLEHEM PIKE FLOURTOWN PA  
MOULIC SPECIALITES CO  
1007 W WASHINGTON ST BLOOMINGTON ILL  
MOVIOLEA MFG CO  
1451 N GORDON ST HOLLYWOOD 28 CALIF  
MOXNESS PRODUCTS INC  
1914 INDIANA ST RACINE WISC  
MOYEN CO C P  
8157 MONTICELLO AVE SKOKIE ILL  
MP ENGINEERING CO  
FAIRFIELD 1 CONN  
MRC MFG CO SUB MATERIALS RES CORP  
RT 303 ORANGEBURG NY  
M & T MOULDING CO  
BLACK MOUNTAIN AVE BLACK MOUNTAIN NO CAR  
MUCKLE MFG CO  
U S HWY 14 OWATONNA MINN  
MUCON CORP  
9 ST FRANCIS ST NEWARK 9 N J  
MUELLER BRASS CO  
1925 LAPEER AVE PORT HURON MICH  
MUELLER ELECTRIC CO  
1583 E 31 ST CLEVELAND 14 OHIO  
MUIRHEAD & CO LTO  
BECKENHAM KENT ENGLAND  
MUIRHEAD INSTRUMENTS LTD  
STRATFORD ONTARIO CANADA  
MUIRHEAD INSTRUMENTS INC  
441 LEXINGTON AVE NEW YORK 17 NY  
MULLARD EQUIPMENT LTD  
MANOR ROYAL CRAWLEY SUSSEX ENG  
MULTI AMP ELECT CORP  
61F MYRTLE ST CRAWFORD N J  
MULTICORE SOLDER LTD  
HAYLANDS AVE HEMEL HEMP HERTFORDSHIRE ENG  
MULTI FLEX SEALS INC  
1811 FIRST AVE NEW YORK 28 N Y



# ELECTRONIC MANUFACTURERS—A TO Z

MULTI-PRODUCTS CO  
21470 CODDLEGE HWY DAK PARK 37 MICH  
MULTRONICS INC  
BX 227 1747 E MONTGOMERY AV ROCKVILLE MO  
MUNDT & SONS CHARLES  
53 FAIRMOUNT AVE JERSEY CITY 4 N J  
MUNSTON ELECTRONIC MFG CORP  
#1 BEECH ST ISLIP N Y  
MUNTZ INDUSTRIES INC  
1000 GREY AVE EVANSTON ILL  
MURRAY MFG CORP  
1250 ATLANTIC AVE BROOKLYN 16 NY  
MURA CORP THE  
777 NORTHERN BLVD GREAT NECK NY  
MUTER CO  
1255 S MICHIGAN AVE CHICAGO 5 ILL  
MUTRON INC  
MORRIS MINNESOTA  
M-W LABS INC  
1824 N MILWAUKEE AVE CHICAGO ILL  
MY-T-GRIP CO INC  
623 GLIDE ST ROCHESTER N Y  
MY-T-GRIP MFG CO INC  
176 BROADWAY NEW YORK 38 N Y  
MYCALEX CORP OF AMERICA  
125 CLIFTON BLVD CLIFTON NJ  
MYERS & SONS INC E A  
375 VALLEY BROOK RD CANONSBURG PA  
MYKROY INC  
645 WHEELING ROAD WHEELING ILL  
MYTRON MFG CO  
4522 BRAZIL ST LOS ANGELES 39 CALIF  
MYTRON PRODUCTS INC  
656 ATKINS AVE BROOKLYN 8 NY

## N

NAGEL-CHASE MFG CO  
2811 N ASHLAND AVE CHICAGO 13 ILL  
NAMEPLATES INC  
421 E 101 ST BROOKLYN N Y  
NANILOA CORP  
P O BOX 2791 STATION TOLEDO OHIO  
NAPOLEON PRODUCTS CO  
410 FILMORE ST NAPOLEON OHIO  
NARDA MICROWAVE CORP  
COMMERCIAL ST PLAINVIEW NY  
NARROW FABRIC CO  
P O BOX 742 READING PA  
NASCO SERVICE CORP  
6405 N W 36TH ST MIAMI FLA  
NASH-HAMMOND CO  
10141 E RUSH ST EL MONTE CALIF  
NASHVILLE ELECTRONICS INC  
2950 FOSTER CRIEIGHTON DR NASHVILLE TENN  
NATIONAL AERONAUTICAL CORP  
COMMERCE DR FT WASHINGTON PENNA  
NATIONAL BERYLLIA CORP  
1ST & HASKELL AVE HASKELL N J  
NATIONAL CARBON CO DIV UNION CARBIDE CORP  
270 PARK AVENUE NEW YORK 17 N Y  
NATL CASH REGISTER CO ELECT DIV  
1401 E EL SEGUNDO BLVD HAWTHORNE CALIF  
NATIONAL CASH REGISTER CO  
MAIN & K STS DAYTON 9 OHIO  
NATIONAL CERAMIC CO  
500 SOUTHWARD ST TRENTON N J  
NATIONAL CINE EQUIPMENT INC  
209 W 48 ST NEW YORK 36 N Y  
NATIONAL COIL CO  
P O BOX 1237 SHERIDAN WYP  
NATIONAL COMPANY INC  
61 SHERMAN ST MALDEN 48 MASS  
NATIONAL CONNECTOR CORP  
SCIENCE INDUSTRY CENTER MINN 27 MINN  
NATIONAL ELECTRONICS LABS INC  
1713 KALARAMA RD N W WASHINGTON 9 D C  
NATIONAL ELECT COIL DIV MCGRAW EDISON CO  
800 KING AVE COLUMBUS OHIO  
NATIONAL ELECTRONICS INC  
628 NORTH ST GENEVA ILL  
NATIONAL ELECTRONICS LAB  
304 BURNT MILLE AVE SILVER SPRING MD  
NATIONAL ENGG PRODUCTS INC  
435 WASHINGTON BLDG WASHINGTON D C  
NATIONAL GASKET & WASHER MFG CO  
124 E 25 ST NEW YORK 10 N Y  
NATIONAL INSTRUMENT LABS INC  
828 EVARTS ST N E WASHINGTON D C  
NATIONAL METALLIZING CORP  
825 NEW YORK AVE TRENTON 8 N J  
NATIONAL MOLDATE CO  
250 SOUTH AVE NEWARK N J  
NATL RADIAC INC  
475 WASHINGTON ST NEWARK N J  
NATL RADIO CO INC  
37 WASHINGTON ST MELROSE MASS  
NATIONAL RESISTRONICS INC  
58 WALTER ST PEARL RIVER N Y  
NATIONAL SCIENTIFIC LABS INC  
2010 MASSACHUSETTS AVE WASHINGTON D C  
NATIONAL SCREW & MANUFACTURING CO  
2440 E 75 ST CLEVELAND 4 OHIO  
NATL SEMICONDUCTORS LTD  
230 AUTHIER SR MONTREAL QUE CANADA  
NATL SEMICONDUCTOR CORP  
DANBURY CONN

NATIONAL SPECTROGRAPHIC LABS INC  
6300 EUCLID AVE CLEVELAND 3 OHIO  
NATIONAL STANDARD CO  
8TH & HOWARD STS NILES MICH  
NATL TELEVISION TUBE INC  
ROUTE 46 SADDLE BROOK N J  
NATIONAL TELEVISION TUBE INC  
PO BOX 133 ROCHELLE PARK NJ  
NATIONAL TEL TRONICS CORP  
52 ST CASIMIR AVE YONKERS N Y  
NATL TRANSISTOR DIV INT TEL & TEL CORP  
500 BROADWAY LAWRENCE MASS  
NATL ULTRASONIC CORP  
95 PARK AVE NUTLEY N J  
NATIONAL ULTRASONIC CORP  
JAMES ST SOMERVILLE N J  
NATIONAL UNION ELECT CORP ELECT DIV  
1201 BELL ST BLOOMINGTON ILL  
NATL UTILITIES CORP  
826 S ARROYO PARKWAY PASADENA CALIF  
NATIONAL VACUUM PLATERS INC  
2633 E HAGERT ST PHILA PA  
NATIONAL VIDEO CORP  
4300 W 47TH ST CHICAGO 32 ILL  
NATIONAL VULCANIZED FIBRE CO  
BOX 311 WILMINGTON DELA  
NATIONAL VULCANIZED FIBRE CO  
YORKLYN DEL  
NATL VULCANIZED FIBRE CO  
MULBERRY LAFAYETTE KENNETT SQ PA  
NATL WATER LIFT CO DIV PNEUM DYNAMICS CORP  
2220 PALMER AVE KALAMAZOO MICH  
NATURAL LIGHTING CORP  
630 S FLOWER BURBANK CAL  
NATVAR CORP  
211 RANDOLPH AVE WOODRIDGE N J  
NAUGLER ENGG INC  
19 MADISON AVE BEVERLY MASS  
NAVCOR  
960 RITTENHOUSE RD VALLEY FORGE IND PK  
NORRISTOWN PENNA  
NAVIGATION COMPUTER CORP  
VALLEY FORGE INDUSTRIAL PARK NORRISTOWN PA  
NAYBOR LAB INC E V  
26 MANORHAVEN BLVD PORT WASH N Y  
NAZ-DAR CO  
461 MILWAUKEE AVE CHICAGO 10 ILL  
NEDMAC INC  
708-42ND AVE NO MINNEAPOLIS 12 MINN  
NEFF INSTRUMENT CORP  
1088 HAMILTON RD DUARTE CALIF  
NEICO MICROWAVE CO  
19 JONES RD WALTHAM 54 MASS  
NELSON VACUUM PUMP CO GEO F  
2133 4 ST BERKELEY 10 CALIF  
NEMS-CLARKE CO DIV VITRO CORP OF AMERICA  
919 JESUP-BLAIR DR SILVER SPRING MD  
NEPTUNE ELECTRONICS CO  
30 W 15TH ST NEW YORK 11 NY  
NESHAMINY ELECT CORP  
EASTON RD NESHAMINY PA  
NESOR ALLOY PRODUCTS CO  
666 PASSAIC AVE W CALDWELL N J  
NETWORK INDUSTRIES INC  
P D BOX 397 BAYONNE N J  
NETWORKS ELECT CORP  
9750 DESOTS CHATSWORTH CALIF  
NEUSES INC P K  
511 DWYER ST ARLINGTON HGTS ILL  
NEUTRONIC ASSOCIATES INC  
32 TENNESSEE AVE HEMPSTEAD N Y  
NEVADA AIR PRODUCTS CO  
O BOX 1090 N VALLEY RD RENO NEV  
NEVEDA ANTENNA CO  
P O BOX 530 COLUSA CALIF  
NEWARK CONTROLS CO  
15 WARD ST BLOOMFIELD N J  
NEWARK SPINNING & STAMPING  
472 BLOY ST HILLSIDE N J  
NEWARK WIRE CLOTH CO  
351 VERONA AVE NEWARK N J  
NEWCASTLE FARRIS CORP  
75 N 11TH ST BROOKLYN 11 N Y  
NEWCOMB AUDIO PROD CO  
6824 LEXINGTON AVE HOLLYWOOD CALIF  
NEWCOMB SPRING CORP  
77 E HAWTHORNE AVE VALLEY STREAM N Y  
NEWCOMB SPRING OF ATLANTA INC  
1200 SPRING ST NW ATLANTA GA  
NEWCOMB SPRING OF CONN  
510 QUEEN ST SOUTHWINGTOM CONN  
NEW DEPARTURE DIV GMC  
269 N MAIN ST BRISTOL CONN  
NEW DEPARTURE DIV GMC  
HAYES AVE SANDUSKY OHIO  
NEW ENG ELECT WORKS INC  
365 MAIN ST LISBON N H  
NEW ENGLAND INSTRUMENT CO  
39 GREEN ST WALTHAM MASS  
NEW ENGLAND LAMINATES CO  
481 CANAL ST STAMFORD CONN  
NEW ENGLAND NUCLEAR CORP  
575 ALBANY ST BOSTON MASS  
NEW ENGLAND TAPE CO  
3D TOWER ST HUDSON MASS  
NEW ENGLAND TRANSFORMER CO  
47 MCGRATH HWY SOMERVILLE 43 MASS  
NEW HAMPSHIRE BALL BEARINGS INC  
ROUTE 202 PETERBOROUGH N H  
NEW HERMES ENGRAVING MACHINE CORP  
154 W 14TH ST NEW YORK 11 NY  
NEW JERSEY WOOD FINISHING CO  
AMBOY AVE WOODBRIDGE N J  
NEW LONDON INST CO INC  
82 UNION ST NEW LONDON CONN  
NEWMAN CORP M H  
79 CLIFTON AVE MARBLEHEAD MASS

NEW PRODUCTS INC  
CAMERON VILLAGE STA RALEIGH N C  
NEWTON CO  
53 ELM ST MANCHESTER CONN  
NEWTDN INSERT CO  
6500 AVALON BLVD LOS ANG CALIF  
NEWTON INSTRUMENT CO INC  
2410 GUESS RD DURHAM NO CAR  
NEW-TRONICS CORP  
3455 VEGA AVE CLEVELAND 13 OHIO  
N Y MFG & GENERAL SUPPLY CO  
144 46 70TH AVE FLUSHING N Y  
NEW YORK COIL CO  
40 2 AVE PHOENIXVILLE PA  
NEW YORK SOLDER CO  
684 E 133 ST NEW YORK 54 N Y  
NEW YORK TRANSFORMER CO  
3 AVE ALPHA N J  
NEW YORK TWIST DRILL CO INC  
30 N CLIFTON ST CHICAGO ILL  
N Y TWIST DRILL MFG CORP  
99 MAGNOLIA AVE WESTBURY N Y  
NEY CO J M  
P O BOX 990 HARTFORD 1 CONN  
NIAGARA ELECTRON LABS  
BOX 128 MAIN ST ANDOVER N Y  
NIAGARA ELECTRON LABS  
MAIN & GREENWOOD ST ANDOVER N Y  
NIAGARA MACH & TOOL WKS  
683 NORTHLAND AVE BUFFALO N Y  
NICAD DIV GOULD NATL BATTERIES INC  
EASTHAMPTON MASS  
NICAD DIV GOULD NATL BATTERIES INC  
931 N VANDALIA ST ST PAUL MINN  
NICHOLS & CLARK INC  
921 NEWBURY PORT TURNPIKE HATHORNE MASS  
NICHOLS ELECTRONICS  
85 SO 13TH ST MINNEAPOLIS 3 MINN  
NICHOLS PRODUCTS CO  
325 W MAIN ST MOORESTOWN NJ  
NIELSEN HARDWARE CORP  
770 WETHERSFIELD AVE HARTFORD CONN  
NILSEN MFG CO  
PO BOX 127 HAINES CITY FLA  
NILSSON ELECTRICAL LABORATORY INC  
103 LAFAYETTE ST NEW YORK 13 N Y  
NIPPERT ELECTRIC PRODUCTS CO  
1759 W MOUND ST COLUMBUS 23 OHIO  
NITINE INC  
45 S JEFFERSON RD WHIPPANY N J  
NJE CORP  
20 BORIGHT AVE KENILWORTH NJ  
NOBLE & WESTBROOK MFG CO  
EAST HARTFORD 8 CONN  
NOEL MFG CO  
3 W 18 ST NEW YORK 11 N Y  
NON LINEAR SYSTEMS INC  
DEL MAR AIRPORT DEL MAR CALIF  
NON-METALLICS INC  
58 FELTON ST WALTHAM MASS  
NONOTUCK MFG CO  
CANAL ST S HADLEY FALLS MASS  
NOPCO CHEMICAL CO  
60 PARK PLACE NEWARK N J  
NOPCO CHEMICAL CANADA LTD  
PO BOX 68 LONDON ONT CANADA  
NOPCO CHEMICAL CO PLASTICS DIV  
175 SCHUYLER AVE NORTH ARLINGTON NJ  
NORBATROL ELECTRONICS CORP  
356 COLLINS AVE PITTSBURGH PA  
NORDEN DIV UNITED AIRCRAFT CORP  
HELEN ST NORWALK CONN  
NORDEN DIV UNITED AIRCRAFT CORP DATA SYS DPT  
3501 HARBOR BLVD COSTA MESA CALIF  
NORMAN JONES INC  
50 MERRIMACK N H  
NORPLEX FABRICATORS INC  
BLACK RIVER FALLS WISC  
NORRICH PLASTICS CORP  
107 W 18TH ST NEW YORK N Y  
NORRMAN LABORATORIES ERNST  
WILLIAMS BAY WISC  
NORTH AMERICAN AVIATION AUTONETICS DIV  
9150 E IMPERIAL HWY DOWNEY CALIF  
NORTH AMERICA ELECTRONICS  
723 3RD AVE W BIRMINGHAM ALA  
NORTH AMERICAN ELECT INC  
71 LINDEN ST WEST LYNN MASSACHUSETTS  
NORTH ATLANTIC INDUSTRIES INC  
TERMINAL DR PLAINVIEW NY  
NORTH ATLANTIC INDUST INC  
603 MAIN ST WESTBURY N Y  
NORTHEAST ELECT CORP  
AIRPORT RD CONCORD N H  
NORTHEASTERN ENG INC  
25 S BEDFORD RD ST MANCHESTER N H  
NORTHEAST SCIENTIFIC CORP  
30 WETHERBEE ST ACTON MASS  
NORTH ELECTRIC CO  
GALION OHIO  
NORTHERN ELECT INC  
8440 PILLSBURY AVE S MINN MINN  
NDRTHERN ENGG LABS  
845 BELOIT ST BURLINGTON WISC  
NORTHERN ORDNANCE INC  
48TH & MARSHALL ST NE ST PAUL 21 MINN  
NORTHERN PLASTICS CORP  
2ND MARKET ST LACROSSE WISC  
NORTHERN PRECISION LABORATORIES  
541 COMMERCE ST FRANKLIN LAKES N J  
NORTHERN RADIO CO  
143 W 22 ST NEW YORK 11 N Y  
NORTHERN RADIO MFG CO LTD  
1950 BANK ST OTTAWA ONT CANADA  
NORTH HILLS ELECTRONICS INC  
ALEXANDER PL GLEN COVE L I N Y



P

NORTHMOOR RECORDING  
BDX 691 ST LDUIS 88 MO  
NORTHROP CORP  
9744 WILSHIRE BLVD BEVERLY HILLS 941  
NORTH SHORE NAMEPLATE DIV ANODYNE INC  
214-27 NORTHERN BLVD BAYSIDE 61 N Y  
NORTDN ASSOC INC  
240 DLD COUNTRY RD HICKSVILLE NY  
NORTDN CO NEW PRODS DEPT  
WORCESTER MASS  
NORTRONICS CO INC  
8101 W 10TH AVE N MINNEAPOLIS MINN  
NORTRONICS DIV NORTHROP CORP  
222 N PRAIRIE AVE HAWTHORNE CALIF  
NORWALK CUTTER SHARPENING CO  
69 CDNN AVE BOX 588 S NORWALK CONN  
NORWOOD CONTRDLS UNIT DETROIT CONTRDLS DIV  
5900 TRUMBULL AVE DETROIT MICH  
NOTHELFER WINDING LABS INC  
P O BOX 455 TRENTON 3 N J  
NP KFR CORP  
6006 WASHINGTON BLVD CULVER CITY CALIF  
NRC EQUIPMENT CORP  
160 CHARLEMONT ST NEWTON 61 MASS  
NRK MICROWAVE DIV COOK ELECT CO  
4601 W ADDISON ST CHICAGO 41 ILL  
NUCLEAR-CHICAGO CORP  
333 E HOWARD AVE DES PLAINES ILL  
NUCLEAR CORP OF AMER  
2 RICHWOOD PL DENVER NJ  
NUCLEAR CORP OF AMER  
3540W OSBORN RD PHOENIX ARIZ  
NUCLEAR DEVELOPMENT LAB INC  
P O BOX 7034 KANSAS CITY 13 MO  
NUCLEAR-ELECTRONICS CORP  
2925 N BROAD ST PHILADELPHIA 32 PA  
NUCLEAR ENTERPRISES G B LTD  
BANKHEAD MEDWY SIGHTHL EDINBURGH 11 SCTLND  
NUCLEAR MEASUREMENTS CORP  
2460 N ARLINGTON AVE INDIANAPOLIS 18 IND  
NUCLEAR PROD INC  
10173 RUSH ST EL MONTE CALIF  
NUCLEONIC CORP OF AMERICA  
196 DEGRAW ST BROOKLYN 31 N Y  
NUCLEONIC PROD CO  
3133 E 12TH ST LOS ANGELES 23 CALIF  
NUCLIDE ANALYSIS ASSOC  
P O BOX 752 STATE COLLEGE PA  
NUGENT ELECT CO INC  
802 E 8TH ST NEW ALBANY IND  
NU-LINE INDUSTRIES  
1015 SO SIXTH ST MINNEAPOLIS 4 MINN  
NU STEEL CO  
1714 S ASHLAND AVE CHICAGO 8 ILL  
NUTMEG SCREW MACH PROD CO  
P O BOX 147 WATERBURY CONN  
NUTONE INC  
MADISON & RED BANK RDS CINCINNATI OHIO  
NUTRON DIV WESTMORE INC  
137 SOUTH AVE FANWOOD NJ  
NYGLASS INC  
7314 E MADISON PARAMOUNT CALIF  
NYLOGRIP PROD  
570 PLEASANT ST WATERTOWN MASS  
NYLOK CORP  
8046 CENTRAL PARK AVE SKOKIE ILL  
NYTRONICS INC  
550 SPRINGFIELD AVE BERKELEY HEIGHTS N J  
NYTRONICS INC  
480 FAIRMAR RD PO BOX 259 LEXINGTON KENTY

OAK MFG CO  
CRYSTAL LAKE ILLINOIS  
O DELL BROS  
2950 GRANT RD MOUNTAIN VIEW CALIF  
OGDEN COIL TRANSFORMER CO  
3323 W CERMAK RD CHICAGO 23 ILL  
OHIO BRASS CO  
380 N MAIN ST MANSFIELD OHIO  
OHIO CARBON CO  
12508 BERE RD CLEVELAND 11 OHIO  
OHIO CHEMICAL & SURGICAL EQUIPMENT CO  
1177 MARQUETTE ST CLEVELAND 14 OHIO  
OHIO CHEMICAL & SURGICAL EQUIPMENT CO  
1130 GRAND ST HOBOKEN NJ  
OHIO CRANKSHAFT CO TOCCO DIV  
3800 HARVARD AVE CLEVELAND 5 OHIO  
OHIO SEAMLESS TUBE DIV COPPERWELD STEEL CO  
SHELBY OHIO  
OHIO SEMICONDUCTORS  
OIV TECUMSEN PRODS CO  
1205 CHESAPEAKE AVE COLUMBUS OHIO  
OHMART CORP  
4241 ALLENDORF DR CINN OHIO  
OHMITE MFG CO  
3601 HOWARD ST SKOKIE ILL  
OHMWEVE CO INC  
43 DARCY ST WEST HARTFORD CONN  
OIL RITE CORP  
2318 WALOO BLVD MANITOWOC WISC  
OK ELECTRONICS CORP  
7 HUNT PL NUTLEY 1 NJ  
OLSEN TINIUS TESTING MACH CO  
EASTON ROAD WILLOW GROVE PA  
OLYMPIC INSTRUMENTS INC  
VASHON WASH

OLYMPIC PLASTICS CO INC  
3471 S LACIENEGA BLVD LOS ANGELES 16 CALIF  
OLYMPIC PRODUCTS CO INC  
3 AVE ALPHA NJ  
OLYMPIC RADIO & TV DIV SIEGLER CORP  
34-01 38 AVE LONG ISLAND CITY 1 NY  
OMCO  
BOX 1110 US 93 & LAS PALMS ST KINGMAN ARIZ  
OMEGA LABS INC  
HAVERHILL ST ROWLEY MASS  
OMNI SPECTRA INC  
8844 PURITAN AVE DETROIT 38 MICH  
OMNITRONICS INC SUB BORG WARNER CORP  
511 N BROAD ST PHILA PA  
OMNITRONICS MFG INC  
PD BOX 1419 PEDNY PARK ST DMAHA NEBR  
ONAN DV OF STUDEBAKER PACKARD CORP  
2515 UNIVERSITY AVE S E MINN MINN  
ONEIDA ELECTRONICS INC  
YORKVILLE NY  
ONIC DEVICES INC  
P O BOX 144 10 E BROAD ST PALMYRA N J  
ON MARK COUPLINGS INC  
4440 YORK BLVD LOS ANGELES 41 CALIF  
ONONDAGA ELECTRONICS DIV SPEER CARBON CO  
1810 W FAYETTE ST SYRACUSE 1 N Y  
ONSRUD MACHINE WORKS INC  
7720 N LEHIGH AVE MILES 48 ILL  
OPAD ELECTRIC CO  
43 WALKER ST NEW YORK 13 N Y  
OPTECH INC  
102 GRANO ST WESTBURY N Y  
OPTICAL COATING LAB INC  
977 SEBASTOPOL RD SANTA ROSA CALIF  
OPTICAL GAGING PRODUCTS INC  
26 FORBES ST ROCHESTER 11 N Y  
OPTIC ELECTRONIC CORP  
2605 MANNA DR DALLAS 20 TEX  
OPTICS FOR INDUSTRY  
3727 N PALMER ST MILWAUKEE 12 WIS  
OPTIMIZED DEVICES INC  
864 FRANKLIN AVE THORNWOOD NY  
OPTO ELECTRONIC DEVICES INC  
660 NATIDNAL AVE MOUNTAIN VIEW CALIF

OPTOMECHANISMS INC  
216 E 2ND ST MINEOLA N Y  
OPTRON CORP  
335 S SALINAS ST SANTA BARBARA CALIF  
ORANGE ROLLER BEARINGS CO INC  
557 MAIN ST ORANGE NJ  
ORBITT ELECTRONICS INC  
306 N ALBANY AVE N MASSAPEQUA LI N Y  
ORBIT INDUSTRIES  
BOX 666 RESEDA CALIF  
ORBITRAN CO INC  
11487 WOODSIDE AVE LAKESIDE CALIF  
ORBITRONICS INC  
3660 E 40TH AVE DENVER 5 COLO  
ORDANCE OPERATION ELECT DIV AVCO CORP  
RICHMOND IND  
OREGON ELECTRONICS MFG CO  
2105 SE 6 AVE PORTLAND 14 ORE  
ORGAN CO ROBERT R  
297 PASSAIC AVE CALDWELL TWP N J  
ORIGINAL ENDERES CO  
GUTTENBERG IOWA  
ORION ELECTRONICS CORP  
108 COLUMBUS AVE TUCKAHD N Y  
ORTHO FILTER CORP  
7 PATERSON ST PATERSDN 1 N J  
ORTHOLOG DIV  
P O BOX 37 PRINCETON JUNCTION N J  
ORTHOLOG DIV GULTON INDUST  
4054 QUAKER BRIDGE RD TRENTON NJ  
ORTHO MAGNETICS INC  
BOX 240 KUTZTOWN PENNA  
ORTHO PRECISION RESISTORS INC  
7 PATTERSON ST PATERSON N J  
ORTMAN-MILLER MACHINE CO INC  
19 143RD ST HAMMOND IND  
ORTRONIX INC  
FORSYTH RD DR 8217 ORLANDO FLA  
OSBORNE ELECTRONIC CORP  
712 SE HAWTHORNE BLVD PORTLAND 14 ORE  
OSBORNE TRANSFORMER CORP  
3834 MITCHELL AVE DETROIT 7 MICH  
OSCAR A SCHOTT CO  
500-11TH AVE SO MINNEAPOLIS 4 MINN  
O 6 S RESEARCH INC  
1811 BANNARD ST RIVERTON N J  
OSTER MFG CO JOHN AVIONIC DIV  
1 MAIN ST RACINE WISC  
OTARTON LISTENER CORP  
SCARBOROUGH PK OSSINING N Y  
OTIS ELEVATOR CO DEFENSE & INDUSTRIAL DIV  
35 RYERSON ST BROOKLYN 5 N Y  
OTTO CONTROLS  
8611 LINCOLN AVE MORTON GROVE ILL  
OYNAIRE INC  
706 FOREST ST CHARLOTTESVILLE VA  
OVERHEAD OODR CORP  
PO BOX 188 HARTFORD CITY IND  
OVERLOAD CONTROL CO  
151 PENNA AVE N LONG BEACH ISLAND PARK N Y  
OWEN LABS INC  
55 BEACON PL PASADENA CALIF  
OXFORD COMPONENTS DIV OXFORD ELECT CORP  
3911 S MICHIGAN CHICAGO 15 ILL  
OXFORD ELECTRIC CORP  
3911 S MICHIGAN AVE CHICAGO 53 ILL  
DXYGEN EQUIPMENT & SERVICE CO  
8335 S HALSTED ST CHICAGO 20 ILL  
OZONE METAL PRODUCTS CORP  
101-32 101ST OZONE PARK L I N Y  
OZONE RESEARCH & EQUIP CORP  
3840 N 40TH AVE PHOENIX ARIZ

PACE ELECTRICAL INSTRUMENTS CO  
70-31 84 ST GLENDALE 27 L I N Y  
PACE ENGINEERING CO  
13035 SATICOY ST N HOLLYWOOD CALIF  
PACIFIC AUTOMATION PRODUCTS  
1200 AIR WAY GLENDALE 1 CALIF  
PACIFIC COMMUNICATIONS & ELECTRONICS CO  
3102 ROLISON RD REDWOOD CITY CALIF  
PACIFIC ELECTRODEVICES  
9820 EVEREST ST DDWNEY CALIF  
PACIFIC ELECTRO MAGNETICS CO INC  
942 COMMERCIAL ST PALO ALTO CALIF  
PACIFIC MERCURY ELECT INC  
8345 HAYVENHURST AVE SEPULVEDA CALIF  
PACIFIC MERCURY TV MFG CORP  
8345 HAYVENHURST AVE SEPULVEDA CALIF  
PACIFIC OPTICAL CORP DIV CHICAGO AERIAL IND  
120 GLASGOW AVE INGLEWOOD 1 CALIF  
PACIFIC PHOTOMETRIC INSTRUMENTS  
BOX 996 BERKELEY 4 CALIF  
PACIFIC RELAYS INC  
13915 SATICOY ST VAN NUYS CALIF  
PACIFIC SCIENTIFIC CO  
P O BOX 22019 LOS ANGELES 22 CALIF  
PACIFIC SEMICONDUCTORS INC  
12955 CHADRON AVE HAWTHORNE CALIF  
PACIFIC SEMICONDUCTORS INC  
14520 S AVIATION BLVD LAWNDALE CALIF  
PACIFIC TRANSDUCER CORP  
11836 W PICD BLVD LOS ANGELES CAL  
PACIFIC UNIVERSAL PROD CORP  
168 VISTA AVE PASADENA 8 CALIF  
PACKARD BELL COMPUTER CORP  
1905 ARMACOST AVE LOS ANGELES 25 CALIF  
PACKARD BELL ELECTRONICS CORP  
12333 W OLYMPIC BLVD LOS ANGELES 64 CALIF  
PACKARD BELL ELECTRONICS  
2341 MICHIGAN AVE SANTA MONICA CALIF  
PACKARD INSTRUMENT CO  
P O BOX 428 LAGRANGE ILL  
PACO ELECTRONICS CO INC  
70-31 84TH ST GLENDALE 27 LI NY  
PACO PRECISION  
70-31 84TH ST GLENDALE 27 LI N Y  
PAECO DIV HEWLETT PACKARD CO  
620 PAGE MILL RD PALO ALTO CALIF  
PAGE FOGWELL CORP  
3014 N COOLIDGE AVE LOS ANGELES CALIF  
PAKTRON DIV ILL TOOL WORKS  
1321 LESLIE AVE ALEXANDRIA VA  
PALCO ENG CO  
355 COLUMBIA ST P O BOX 291 FRANKFORT IND  
PALNUT CO  
25 GLEN RD MOUNTAINSIDE NY  
PALO ALTO ENGG CO  
620 PAGE MILL RD PALO ALTO CALIF  
PALOMAR EQUIP CO  
4254 NIAGARA AVE SAN DIEGO 7 CALIF  
PAMPA ELECT CORP  
221 ROCK HILL RD BALA-CYNWYD PA  
PANDUIT CORP  
17301 RIDGELAND AVE TINLEY PARK ILL  
PAN-ELECTRONICS CORP  
PO BOX 404 GRIFFIN GA  
PANEL ENG CORP  
222 W HURON ST CHICAGO ILL  
PANELLIT INC DIV INFORMATION SYS INC  
7401 HAMLIN AVE SKOKIE ILL  
PANELYTE DIV ST REGIS PAPER CO  
ENTERPRISE AVE TRENTON 4 NEW JERSEY  
PANELLIT LTD  
MEMBER OF ELLIOTT AUTOMATION GROUP  
ELSTREE WAY BOREHAMWOOD HERTS ENGLAND

PAN FAX INC  
401 OLD COAST HWY SANTA BARBARA CALIF  
PANOB CORP  
49 BEECH PORT CHESTER N Y  
PANTHER ELECTRONICS INC  
901 S MAIN ST BURBANK CALIF  
PAPER PRODUCTS MINNESOTA MINING & MFGING CO  
HARTFORD CITY INDIANA  
PAPESCH & KOLSTAD INC  
BOX 3726 10703 CAPITAL AV OAK PARK 37 MICH  
PARABAM INC  
12822 YUKON HAWTHORNE CALIF  
PARADYNAMICS INC  
10 STEPAR PLACE HUNTINGTON STA L I N Y  
PARAGON ELECTRIC CO  
1600 12 ST TWO RIVERS WISC  
PARAGON REVOLUTE DIV CHARLES BRUNING CO INC  
77 SOUTH AVE ROCHESTER 4 N Y  
PARAMOUNT PAPER TUBE CORP  
614 S LAFAYETTE ST FORT WAYNE 2 IND  
PARAPLEGICS MFG CO INC PMCO CABLES DIV  
BENSENVILLE ILL  
PARK ELECTROCHEMICAL CORP  
34-10 LINDEN PLACE FLUSHING N Y  
PARK NAMEPLATE CO  
34 10 LINDEN PL FLUSHING 54 N Y  
PARKER ELECTRICAL INSTRUMENT CORP  
200 HARVARO AVE STAMFORD CONN  
PARKER KALON GENERAL AMER TRAN CO  
1 PEEKAY OR CLIFTON N J  
PARKER METAL GOOOS CO  
85 PRESCOTT ST WORCESTER MASS

# ELECTRONIC MANUFACTURERS—A TO Z

PARKER SEAL CO DIV PARKER-HANNIFIN CORP  
10567 JEFFERSON BLVD CULVER CITY CALIF  
PARKS LAB HENRY FRANCIS  
P O BOX 1665 LAKE CITY STA SEATTLE 55 WASH  
PARMENTER & BULLOCH MFG CO LTD  
GANANOQUE ONTARIO CANADA  
PAR-METAL PRODUCTS CORP  
32-62 49 ST LONG ISLAND CITY 3 NY  
PAR PRODUCTS CORP  
602 COLORADO AVE SANTA MONICA CALIF  
PARR MFG CORP  
44 AUSTIN ST NEWARK 14 N J  
PARSONS CO RALPH M ELECTRONICS DIV  
151 S DE LACEY AVE PASADENA CALIF  
PARTLOW CORP  
211 CAMPION RD NEW HARTFORD N Y  
PARTRICK & WILKINS CO  
51 N 7 ST PHILA PA  
PARTRIDGE TRANSFORMERS LTD  
ROEBUCK RD TOLWORTH SURREY ENGLAND  
PASTORIZA ELECT INC  
285 COLUMBUS AVE BOSTON MASS  
PATTERSON MOOS RESEARCH DIV LEESONA CORP  
90 28 VAN WYCK EXPRESSWAY JAMAICA N Y  
PATWIN DIV PATENT BUTTON  
WATERBURY CONN  
PAUL F H & STEIN BROS INC  
235 S AVE NEW YORK N Y  
THE PAVELLE CORP  
32 DEPOT PLAZA WHITE PLAINS N Y  
PCA ELECTRONICS INC  
16799 SCHOENBORN ST SEPULVEDA CALIF  
PEARCE SIMPSON INC MARINE & COMM DIVISION  
2295 NW 14TH ST MIAMI 35 FLA  
PEARCE SIMPSON CO  
8040 S W 69TH AVE S MIAMI FLA  
PEARSON ELECTRONICS INC  
707 URBAN LA PALO ALTO CALIF  
PECK SPRING CO  
89 WHITING ST PLAINVILLE CONN  
PECK STOW WILCOX CO  
217 274 CENTER ST SOUTHINGTON CONN  
PEE WEE MOLDING CO  
1720 ATLANTIC AVE BROOKLYN N Y  
PEEBLES & CO LTD BRUCE  
EAST PILTON EDINBURGH 5 SCOTLAND  
PEER INC  
1200 MILTON ST BENTON HARBOR MICH  
PEER INC PROFESSIONAL ELECT ENG  
2624 SHELBY ST DALLAS TEXAS  
PEERLESS ELECT PRODS DIV ALTEC LANSING CORP  
1515 S MANCHESTER AVENUE ANAHEIM CALIF  
PEERLESS PRODUCTS INDUSTRIES  
812 N PULASKI RD CHICAGO 51 ILL  
PEGASUS LABS INC  
3500 W ELEVEN MILE RD BERKLEY MICH  
PEK LABS INC  
4024 TRANSPORT ST PALO ALTO CALIF  
PELLEY CO  
37 HURLEY ST CAMBRIDGE MASS  
PELTON DIV BALDWIN LIMA HAMILTON CORP  
2929 19TH ST SAN FRAN CALIF  
PELTON & CRANE CO THE  
200 CLANTON RD CHARLOTTE NC CAR  
PENCO DIV ALAN WOOD STEEL CO  
OAKS PENNA  
PENOAIR INC  
14744 ARMINTA ST VAN NUYS CALIF  
PENETONE CO  
TENAFLY N J  
PENN ENGG & MFG CORP  
DOYLESTOWN PA  
PENN FIBRE SPECIALTY CO  
2020 WESTMORELAND ST PHILA PA  
PENN KEYSTONE CORP  
P O BOX 350 DERBY CONN  
PENN METER CO  
4110 HAVERFORD AVE PHILA PA  
PENN TRANSFORMER CORP  
E BISHOP ST BELLEFONTE PA  
PENNWOOD NUMECHRON CO  
7249 FRANKSTOWN AVE PITTSBURG 8 PA  
PENINSULAR MFG CO INC  
1600 W SMITH ST ORLANDO FLA  
PENTA LAB INC  
312 NOPAL ST SANTA BARBARA CALIF  
PENTRON ELECT CORP  
777 S TRIPP AVE CHICAGO ILL  
PERENY EQUIP CO INC  
BOX 5064 TRIVILLAGE STA COLUMBUS OHIO  
PERFECT COMPONENTS INC  
43 MILBAR BLVD FARMINGDALE N Y  
PERFECTION MICA CO MAGNETIC SHIELD DIV  
1322 ELSTON AVE CHICAGO ILL  
PERFORMANCE MEASUREMENTS CO  
15120 THIRD AVE DETROIT 5 MICH  
PERKIN ELMER CORP  
MAIN AVE NORWALK CONN  
PERKIN ELMER CORP VERNISTAT DIV  
EMERALD ST NORWALK CONN  
PERKIN-ELMER CORP SD WILTON PL  
WILTON CONN  
PERKIN ELECTRONICS CORP  
345 KANSAS ST EL SEGUNDO CALIF  
PERMACOR DIV RADIO CORES INC  
9540 TULLEY AVE OAK LAWN ILL  
PERMAG CORP  
88 06 VAN WYCK EXPRESSWAY JAMAICA N Y  
PERMALI INC  
P O BOX 718 MT PLEASANT PA  
PERMA-POWER CO  
3102 N ELSTON AVE CHICAGO 18 ILL  
PERMOFLUX CORP  
4101 SAN FERNANDO RD GLENDALE CALIF  
PERMOFLUX DIV  
2300 W ARMITAGE AVE CHICAGO 47 ILL  
PERMONITE MFG CO  
910 JACKSON BLVD CHICAGO ILL  
PESCHEL ELECTRONICS INC  
TOWNERS RT 216-PATTERSON NEW YORK

PESCO PRODUCTS DIV WESTERN BRANCH  
3310 VANOWEN ST BURBANK CALIF  
PESCO PRODUCTS DIV BORG WARNER CORP  
24700 N MILES RD BEDFORD OHIO  
PETTINOS GRAPHITE CORP  
1 E 42ND ST NEW YORK 17 N Y  
PFANSTIEHL CHEMICAL CORP  
104 LAKE VIEW AVE WAUKEGAN ILL  
PFI PRODUCTS FOR INDUSTRY INC  
PENNDL PA  
PHALO PLASTICS CORP  
530 BOSTON TWPK SHREWSBURY MASS  
PHAOSTRON INSTRUMENT & ELECTRONIC CO  
151 PASADENA AVE S PASADENA CALIF  
P & M ELECTRONICS  
424 COLUMBIA LAFAYETTE IND  
P & H SALES CORP  
5650 N WESTERN AVE CHICAGO 45 ILL  
PHELPS DODGE COPPER PRODS CORP INCA MFG DIV  
FORT WAYNE IND  
PHELPS DODGE COPPER PRODUCTS CORP  
300 PARK AVE NEW YORK 22 N Y  
PHELPS DODGE ELECTRONIC PRDGS CORP  
60 DODGE AVE NO. HAVEN CONN  
PHEOLL MFG CO  
5700 W ROOSEVELT RD CHICAGO 50 ILL  
PHILA INSULATED WIRE CO  
333 NEW ALBANY RD MOORESTOWN N J  
PHILA SCIENTIFIC GLASS CO  
RIDGE AVE PERKASIE PENNA  
PHILBRICK RESEARCHES INC GEORGE A  
127 CLARENDON ST BOSTON MASS  
PHILCORP  
TIOGA & C STS PHILADELPHIA 24 PA  
PHILCORP  
SANDUSKY OHIO  
PHILCORP  
WILLOW GROVE PA  
PHILCORP  
SPRING CITY PENNA  
PHILCORP  
4700 WISSAHTICKON AVE PHILA PENN  
PHILCORP SPACE DIV  
3975 FABIAN WAY PALO ALTO CALIF  
PHILCORP COMMUNICATIONS & WEAPONS DIV  
4700 WISSAHTICKON AVE PHILA PENNA  
PHILCORP G & I DIV  
4700 WISSAHTICKON AVE PHILA 44 PENNA  
PHILCORP GOVT & INDUSTRIAL GROUP  
4700 WISSAHTICKON AVE PHILADELPHIA 44 PA  
PHILCORP LANSDALE DIV  
CHURCH RD LANSDALE PA  
PHILCORP SIERRA ELECTRONIC DIV  
3885 BOHANNAN DR MENLO PARK CALIF  
PHILIPS ELECTRONIC INSTRUMENTS  
750 S FULTON AVE MT VERNON N Y  
PHILIPS ELMET CORP  
LISBON RD LEWISTON ME  
PHILLIPS CONTROL CORP  
JOLIET ILL  
PHILLIPS PROCESS CO  
192 MILL ST ROCHESTER 14 N Y  
PHILAMON LABS INC  
90 HOPPER ST WESTBURY N Y  
PHILMORE MFG CO INC  
130-01 JAMAICA AVENUE RICHMOND HILL 18 N Y  
PHOENIX ENGINEERING & MFG CO  
1320 N 52ND ST PHOENIX ARIZ  
PHOENIX PRECISION INSTRUMENT CO  
3805 N 5 ST PHILADELPHIA 40 PA  
PHOTOVOLT INC  
280 POLARIS AVENUE MOUNTAIN VIEW CALIF  
PHOTOBEEL CO  
12 EAST 22ND ST NEW YORK N Y  
PHOTOCIRCUITS CORP  
31 SEA CLIFF AVE GLEN COVE N Y  
PHOTODN RESEARCH PRODUCTS  
421 N ALTADENA DR PASADENA CALIF  
PHOTO - CRYSTALS  
605 PRAIRIE ST ST CHARLES ILL  
PHOTO-RESEARCH CORP  
837 N CANHUENGA BLVD HOLLYWOOD 38 CALIF  
PHOTO-TRONIC PRODUCTS CORP  
517 OAK ST FORT ATKINSON WIS  
PHOTOVOLT CORP  
95 MADISON AVE NEW YORK 16 N Y  
PHOTRON INSTRUMENT CO  
6516 DETROIT AVE CLEVELAND 2 OHIO  
PHYS CHEMICAL RES CORP  
40 E 12TH ST NEW YORK N Y  
PHYSICAL SCIENCES CORP  
389 N FAIR AVE LOS ANG CALIF  
PHYSIONICS INC  
P O BOX 6420 FT WORTH 15 TEXAS  
PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV  
MAYFIELD PENNA  
PIASECKI AIRCRAFT CORP  
ISLAND RD INTL A P PHILA 42 PA  
PIC AUTOMATION CONTROLS  
8080 MCCORMICK BLVD SKOKIE ILL  
PIC DESIGN CORP SUB OF BENRUS WATCH CO INC  
477 ATLANTIC AVE E ROCKAWAY LI NY  
PICKARD & BURNS INC SUB GORHAM CORP  
103 FOURTH AVE WALTHAM 54 MASS  
PICKER X-RAY CORP WAITE MFG DIV INC  
17325 EUCLID AVE CLEVELAND OHIO  
PIERPONT INDUSTRIES INC  
77 15 25TH AVE EAST ELMHURST 69 N Y  
PIEZO CRYSTAL CO  
265 POWFRET ST CARLISLE PA  
PIEZO PRODUCTS CO  
WHITNEY ST SHERBORN MASS  
PIFER INDUSTRIES INC  
2210 PETTIGREW ST DURHAM NO CAR  
PILGRIM SCREW CORP  
P O BOX 1452 PROVIDENCE R I  
PILOT CHEMICALS INC  
36 PLEASANT ST WATERTOWN MASS  
PILOT RADIO CORP  
37-06 36 ST LONG ISLAND CITY 1 N Y

PIONEER ELECTRIC & RES CO  
743 CIRCLE AVE FOREST PARK ILL  
PIONEER INDUSTRIES INC  
2700 HAWKEYE DR SIOUX CITY IOWA  
PIONEER MAGNETICS INC  
850 PICO BLVD SANTA MONICA CALIF  
PIONEER PATENTS & PRODUCTS CO  
3720 N NEW ENGLAND AVE CHICAGO 34 ILL  
PIQUA MACHINE & MFG CO  
PIQUA OHIO  
PITOMETER LOG CORP  
237 LAFAYETTE ST NEW YORK 12 N Y  
PIONEER GEN-F-MOTOR CDRP  
5841 W DICKENS AVE CHICAGO 39 ILL  
PHOTOVOLT CORP  
1115 BROADWAY NEW YORK N Y

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FOR INFORMATION  
ON PRODUCTS  
SEE THE  
"PRODUCTS AND MANUFACTURERS"  
SECTION

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MCGRW EDISON CO PITTSBURGH LECTRODRYER DIV  
FOOT 32 ST PITTSBURGH PA  
PIX MFG CO  
75 HUDSON ST NEWARK NJ  
PLANAUTICS CORP  
485 FIRST BOX 665 ENCINITAS CALIF  
PLANET MFG CORP  
225 BELLEVILLE AVE BLOOMFIELD N J  
PLANET PLATING CO INC  
1333 FLUSHING AVE BKLYN N Y  
PLANETRONICS INC  
CENTER AT GLENDALE STS EASTON PA  
PLASTIC ASSOCIATES  
773 BROADWAY LAGUNA BEACH CALIF  
PLASTIC CAPACITORS INC  
2620 N CLYBOURN AVE CHICAGO 14 ILL  
PLASTIC FAB INC  
N MAIN ST FRANKLIN N H  
PLASTIC FACTORS INC  
926 BROADWAY REDWOOD CITY CALIF  
PLASTIC MOLD & ENGG CO  
WAMPANOAG TRAIL E PROVIDENCE 14 RI  
PLASTIC PROCESS DIV MONADNOCK MILLS  
11200 HINDRY AVE LOS ANG CALIF  
PLASTIC WIRE & CABLE CORP  
BOX 486 JEWETT CITY CONN  
PLASTICRAFT PRODUCTS CO  
1 STATION PLAZA WEST NYACK N Y  
PLASTICRAFTS INC  
2800 N SPEER BLVD DENVER COLO  
PLASTICS & RESINS DIV SHELL CHEMICAL CO  
110 W 51ST ST NEW YORK 20 N Y  
PLASTICS STAMPING CO  
932 PRINCE ST POMONA CALIF  
PLASTIGAGE CDRP  
915 E SOUTH ST JACKSON MICH  
PLASTOFILM INC  
916 W UNION AVE WHEATON ILL  
PLASTOID CORP  
45 GINGERBREAD RD HAMBURG N J  
PLASTOID CORP  
42 61 24TH ST LONG ISLAND CITY N Y  
PLAS TRON CORP  
815 S W VIEWMONT DR PORTLAND OREGON  
PLATRONICS INC  
500 COMMERCE RD LINDEN N J  
PLECTRON CORP  
OVERTON NEBR  
PLISCO WILLIAM B  
62 SCHENECTADY AVE BROOKLYN NY  
PLUG IN INSTRUMENTS INC  
1416 LEBANON RD NASHVILLE TENN  
PLYMOUTH RUBBER CO  
REVERE ST CANTON MASS  
P M DIV CRANE CO  
1960 BRIDGE ST JOHNSTOWN PA  
PM ELECTRONICS INC  
5221 UNIVERSITY AVE SAN DIEGO CALIF  
PNEU-HYDRO VALVE CORP  
52 HORSE HILL RD CEDAR KNOLLS N J  
PNEUMAFIL CORP  
2516 WILKINSON BLVD CHARLOTTE 8 N C  
PNEUMO DYNAMICS CORP INST & CONTROL DIV  
305 W FULTON ST GRAND RAPIDS MICH  
POBOG INDUSTRIES INC  
WHITTIER CALIF  
POLACOAT INC  
9750 CONKLIN RD BLUE ASH OHIO  
POLARAD ELECTRONICS CORP  
4320 34 ST LONG ISLAND CITY N Y  
POLLAK CORP JOSEPH  
81 FREEMONT ST BOSTON 22 MASS  
POLYCO INC  
145 ROSWELL RD SMYRNA GA  
POLY KOTE INC  
82 CHESTNUT NORTH ATTLEBORO MASS  
POLYMER CORP  
2120 FAIRMONT AVE READING PA  
POLYMICA & INSULATION CO INC  
WILLMANTIC CONN  
POLYPHASE INSTRUMENT CO  
E 4 ST BRIDGEPORT PA  
POLY-SCIENTIFIC CORP  
COLLEGE AVE BLACKSBURG VA  
POLYTRONIC RESEARCH INC  
7326 WESTMORE RD ROCKVILLE MD  
POLYTRONICS CO  
582 BATHURST ST TORONTO ONT CANADA  
POMONA ELECTRONICS CO INC  
1500 E NINTH ST POMONA CALIF  
POOLE INSTRUMENTS INC  
150 EXPRESS ST OALLAS 21 TEXAS



# ELECTRONIC MANUFACTURERS—A TO Z

PORCELAIN PRODUCTS CO  
224 N PATTERSON ST CAREY OHIO  
PORTER CO INC H K RIVERSIDE-ALLOY METAL DIV  
RIVERSIDE N J  
H K PORTER CO INC DELTA STAR ELECTRIC DIV  
WASHINGTON ST LISBON OHIO  
PORTER INC H K  
74 FOLEY ST SOMERVILLE 43 MASS  
PORT O VOX CORP  
521 W 43RD ST NEW YORK 36 N Y  
POSITIVE LOCK WASHER CO  
181 VANDERPOOL ST NEWARK 5 NJ  
POSSIS MACHINE CORP  
825 RHODE ISLAND AVE S MINNEAPOLIS MINN  
POST ELECTRONICS PROD  
12 LOTHROP ST BEVERLY MASS  
THE POTTER CO  
950 CONGRESS ST BROOKHAVEN MISS  
POTTER AERONAUTICAL CORP  
U S ROUTE 22 UNION N J  
POTTER & BRUMFIELD  
1200 E BROADWAY PRINCETON IND  
POTTER & BRUMFIELD  
DIV OF AMER & FOUNDRY CO  
FRANKLIN KY  
POTTER CO THE  
WESSON MISS  
POTTER ENG CO  
1410 SANTA ANNA DR DUNEDIN FLA  
POTTER INSTRUMENT CO  
SUNNYSIDE BLVD PLAINVIEW N Y  
POTTER PACIFIC CORP  
POTTER AERONAUTICAL CORP  
23917 CRAFTSMAN RD CALABASAS CALIF  
POWELL ELECTRONICS INC  
PO BOX 8765 PHILA 1 PA  
POWER COMPONENTS INC  
P O BOX 421 SCOTSDALE PA  
POWER DESIGN INC  
1700 SHAMES DR WESTBURY LI NY  
POWER OESIGNS INC  
89 25 130 ST RICHMOND HILL N Y  
POWER OEVICES INC  
8710 DARBY AVE NORTHRIDGE CALIF  
POWERDYNE DIVISION  
28 RANICK DRIVE AMITYVILLE L I NY  
POWER INSTRUMENTS INC  
7352 N LAWNOALE AVE SKOKIE ILL  
POWER SOURCES INC  
SOUTH AVE BURLINGTON MASS  
POWER SOURCES DIV TELECOMPUTING CORPORATION  
3850 OLIVE ST DENVER 7 COLO  
POWERTON ULTRASONICS CORP  
PATTERSON PL ROOSEVELT FIELD N Y  
POWERTRAN CORP  
10230 CAPITAL AVE OAK PARK MICH  
POWER TRONIC SYSTEMS INC  
10 PINE COURT NEW ROCHELLE N Y  
PRATT ALBERT  
114 W LAKE VIEW AVE MILWAUKEE WISC  
PRD ELECTRONICS INC  
202 TILLARY ST BROOKLYN N Y  
PRL ELECTRONICS INC  
232 WESTCOTT DR RAHWAY NJ  
PRECISE DIE STAMPING CO  
5931 N RAVENSWOOD CHICAGO ILL  
PRECISE ELECTRONICS & DEVELOPMENT CORP  
76 E 2ND ST MINEOLA NY  
PRECISE INST PARTS CO  
4520 SAN FERNANDO RD GLENDALE CALIF  
PRECISION APPARATUS CO  
70-31 84 ST GLENDALE 27 L I N Y  
PRECISION CAPACITORS INC  
150 W CYPRESS ST BURBANK CALIF  
PRECISION CIRCUITS INC  
85 WEYMAN ST NEW ROCHELLE N Y  
PRECISION CONNECTORS INC  
134-20 JAMAICA AVE JAMAICA L I N Y  
PRECISION CORPORATION  
236 W 23RD ST HIALEAH FLA  
PRECISION CRYSTAL LAB  
2223 WARWICK AVE SANTA MONICA CALIF  
PRECISION ELECTRONICS INC  
9101 KING ST FRANKLIN PK ILL  
PRECISION ELECTROPLATING CO  
6045 NORTH KEYSTONE AVE CHICAGO ILL  
PRECISION INSTRUMENT CO  
1011 COMMERCIAL ST SAN CARLOS CALIF  
PRECISION LAMINATES CORP  
7 E FRANKLIN ST DANBURY CONN  
PRECISION LINE INC  
63 MAIN ST MAYNARD MASS  
PRECISION MADE PRODUCTS INC  
7 HARRIS CT WORCHESTER MASS  
PRECISION METALCRAFT INC  
4748 FRANCE AVE N MINNEAPOLIS MINN  
PRECISION METAL PRODUCTS CO  
41 ELM ST STONEHAM MASS  
PRECISION METALSMITHS INC  
1081 E 200 ST CLEVELAND OHIO  
PREC METHODS & MCH DV TEXTRON INC  
CUMBERLAND DR WATERBURY CONN  
PRECISION PAPER TUBE CO  
2035 W CHARLESTON ST CHICAGO ILL  
PRECISION PAPER TUBE CO  
1 FLOWER ST HARTFORD CONN  
PRECISION RADIATION INSTRUMENTS INC  
5810 S NORMANDIE AVE LOS ANGELES CALIF  
PRECISION RESISTOR CO  
109 U S HWY 22 HILLSBORO N J  
PRECISION SCIENTIFIC CO  
3737 W CORTLAND ST CHICAGO 47 ILL  
PRECISION SENSORS INC  
789 ELLSWORTH ST BRIDGEPORT CONN  
PRECISION SENSORS INC  
1133 MAIN ST PATERSON N J

PRECISION SPECIALTIES INC  
PO BOX 118 PITMAN NJ  
PRECISION THERMETER & INST CO  
1434 BRANOWINE ST PHILA PA  
PRECISION TRANSFORMER CORP  
2483 GREENLEAF AVE ELK GROVE VILLAGE ILL  
PRECISION TUBE CO  
CHURCH RD & WISSACHICKON AVE N WALES PA  
PREIS ENGRAVING MACHINE CO H P  
651 U S HWY 22 HILLSIDE N J  
PREMAX PRODUCTS DIV CHISHOLM RYDER CO  
COLLEGE HIGHLAND AVES NIAGARA FALLS N Y  
PREMIER METAL PRODUCTS CO  
337 MANIDA ST NEW YORK 59 N Y  
PREMIER RESEARCH LABS INC  
79 7 AVE NEW YORK 11 N Y  
PREMMCO INC  
5470 VALLEY BLVD LOS ANG CALIF  
PREMMCO INC OF NORTHERN CALIF  
P O BOX 412 ALAMEDA CALIF  
PRENCO INCORP  
246 PARK AVENUE GARDEN CITY NY  
PRENTISS WIRE MILLS  
HOLYOKE MASS  
PRESCOTT TV CO  
920 CITRUS AVE LOS ANG CALIF  
PRESCRIPTION HEARING AID CO INC  
2233 UNIVERSITY AVE ST PAUL MINN  
PRESSED STEEL TANK CO  
1445 S 66TH ST MILWAUKEE WISC  
PRESIN CO INC  
2014 BROADWAY SANTA MONICA CALIF  
PRESSTEEL CO  
9705 GARVEY AVE EL MONTE CALIF  
PRESSTITE DIV AMER MARIETTA  
39TH & CHOUTEAU ST ST LOUIS MO  
PRESTOLE CORP  
1345 MIAMI ST TOLEDO OHIO  
PRESTO ELECTRONIC METAL PROJ CO INC  
1021 GRANO ST HOBOKEN NJ  
PRICE ELECTRIC CORP  
E CHURCH & 2 ST FREDERICK MO  
PRICE & RUTEBECK  
P O BOX 30 HAYWARD CALIF  
PRINCETON APPLIED RESEARCH CORP  
P O BOX 565 PRINCETON N J  
PRINCETON DIV ELECTRO MECHANICAL RESCH INC  
44 WALACE RD PRINCETON N J  
PRINCETON ELECT CORP  
PRINCETON N J  
PRINTED CIRCUITS INC  
7800 COMPUTER AVE MINNEAPOLIS 6 MINN  
PRINTED ELECT CORP  
INDUSTRIAL CENTER NEEDHAM HGTS MASS  
PRINTLOIO CORP DEPT E  
10-08 44TH AVE LONG ISLAND CITY 1 N Y  
PROBESCOPE CO INC  
8 SAGAMORE HILL DR PORT WASHINGTON N Y  
PROBESCOPE CO INC  
211 ROBBINS LANE SYOSSET N Y  
PROCESS & INSTRUMENTS  
15 STONE AVE BROOKLYN 33 N Y  
PROCESS GEAR CO INC  
3313 W NEWPORT CHICAGO ILL  
PRODELIN INC  
HIGHTSTOWN N J  
PROOUCERS SALES CORP & PHOTO-SONICS INC  
820 SOUTH MARIPOSA ST BURBANK CALIF  
PRODUCTION ELECTRONICS INC  
525 LEHIGH AVE UNION NJ  
PRODUCTS & INDUSTRIAL ENGRG CORP  
3806 S FOUR MILE RUN DR ARLINGTON VA  
PROFEXRAY INC  
1401 N 1 AVE HAYWOOD ILL  
PROFILE ELECTRONICS INC  
CONCORD N H  
PROJECTS UNLIMITED INC  
1926 E SIEBENTHLER AVE DAYTON OHIO  
PROSPECT MACHINE PROD INC  
REX LANE PROSPECT CONN  
PROTECTION EQUIPMENT CO INC  
1025 HILL STREET HOPKINS MINN  
PROTECTION EQUIPMENT CO INC  
2924 EMERSON AVE S MINNEAPOLIS MINN  
PROTECTIVE COATINGS CORP  
596 RIVER RD CLIFTON NJ  
PRO-TEX REEL BAND CO  
200 FILM BLDG CLEVELAND 14 OHIO  
PROVO TOOL CO LOS ANGELES CALIF  
BOX 351 TERMINAL ANNEX LOS ANGELES CALIF  
PROVIDENCE BASE PLANT  
586 ALWELLS AVE PROVIDENCE RI  
PRY WELDING & MFG INC  
MODENA PA  
PULSE ENG INC  
560 ROBERT AVE SANTA CLARA CALIF  
PULSE TECHNIQUES INC  
1411 PALISADE AVE W ENGLEWOOD N J  
PURULATOR PRODUCTS INC  
970 NEW BRUNSWICK AVE RAHWAY N J  
PYE CANADA LTD  
82 NORTHLINE RD TORONTO ONTARIO CANADA  
PYE CORP OF AMERICA  
1149 RARITAN AVE HIGHLAND PARK N J  
PYE TELECOMMUNICATIONS LTO  
NEWMARKET RO CAMBRIDGE ENGLAND  
PYLE-NATIONAL CO  
1334 N KOSTNER AVE CHICAGO 51 ILL  
PYLON CO INC  
ATTLEBORO MASS  
PYRAMID SCREEN CORP  
181 HARVARD ST BROOKLINE BOSTON MASS  
PYRAMID SCREEN CORP  
NICHOLS & CLARK BLDG OANVERS MASS  
PYROCIRCUITS DIV MICROTRON INC  
6 MANHASSET AVE PRT WASHINGTON N Y

PYRODYNE INC  
11876 WILSHIRE BLVD LOS ANGELES 25 CALIF  
PYRD-ELECTRIC INC  
BOX 65 MUSKIN RD WALKERTON IND  
PYRDFERRIC CO INC  
621 E 216ST NEW YORK 67 N Y  
PYROFILM RESISTOR CO  
U S HIGHWAY 46 PARSIPPANY N J  
PYROMETER INSTRUMENT CO  
92 PORTLAND AVE BERGENFIELD N J  
PYROTEL CORP  
MAMARONECK N Y

## Q

Q L C CORP  
409 MAIN ST GREENPORT N Y  
Q-MAX CORP  
MARLBORO NEW JERSEY  
QOS CORP  
621 E 216 ST BRONX N Y  
QUALITONE CO  
4318 UPTON AVE S MINNEAPOLIS 10 MINN  
QUALITY COMPONENTS INC  
ST MARYS PA  
QUALITY CONTROL CORP  
10 OEPOT PLAZA WHITE PLAINS N Y  
QUALITY STAMPING CO  
6311 CEDAR AVE MINNEAPOLIS 23 MINN  
QUAM NICHOLS CO  
234 E MARQUETTE RD CHICAGO 37 ILL  
QUANTAMETRIC DEVICES INC  
BOX 1107 BINGHAMTON N Y  
QUANTAMETRIC OEVICES INC  
109 WASHINGTON BINGHAMTON NY  
QUANTATRON INC  
2520 COLORADO AVE SANTA MONICA CALIF  
QUAN TECH LAB INC  
60 PARSIPPANY BLVD BOX 187 BOONTON N J  
QUELCOR INC  
670 W WASHINGTON ST NORRISTOWN PA  
QUICK CHARGE DIV LINE SCALE CO INC  
3737 NW 37TH ST OKLAHOMA CITY OKLA  
QUIETROLE CO  
395 ST JOHN ST SPARTANBURG S C  
QUIK CHEK CORP  
5212 PULASKI AVE PHILA PA  
QUINCY COMPRESSOR CO  
QUINCY ILL  
QUINCY SPEAKER MFG CORP  
221 OAK ST QUINCY ILL  
QUINDAR ELECTRONICS INC  
5 LAWRENCE ST BLOOMFIELD N J  
OUTRONIC TRANSFORMER CORP  
525 BROADWAY NEW YORK 12 N Y  
Q V S INC  
20 N 15 ST ORANGE N J

## R

RACAL ELECTRONICS LTD  
WESTERN RD BRACKNELL BERKS ENG  
RACINE HYDRAULICS & MACH INC  
2000 ALBERT RACINE WISC  
RACON ELECTRIC CO  
67 HANFORD ST MIDDLETOWN N Y  
RACON LOUDSPEAKER INC  
1261 BROADWAY NEW YORK 1 N Y  
RADA PRODUCTS CO  
2911 CARROLL AVE CHICAGO ILL  
RADAR DESIGN CORP  
PICKARD DR SYRACUSE N Y  
RADAR ENGINEERS  
4719 BROOKLYN SEATTLE 5 WASH  
RADAR MEASUREMENTS CORP  
190 DUFFY AVE HICKSVILLE LI N Y  
RADAR RELAY INC  
1631 TENTH ST SANTA MONICA CALIF  
RADATRON INC  
232 ZIMMERMAN ST N TONAWANDA NY  
RADEX CORP  
2076 ELSTON AVE CHICAGO ILL  
RADIANT LAMP CORP  
300 JELLIFF AVE NEWARK 8 NJ  
RADIAPHONE CO  
600 E EVERGREEN AVE MONROVIA CALIF  
RADIATION AT STANFORD  
3180 HANOVER ST PALO ALTO CALIF  
RAIOTATION COUNTER LABS INC  
5121 W GROVE ST SKOKIE ILL  
RAIOTATION ELECT CO DIV COMPOMETER CORP  
5600 JARVIS AVE CHICAGO ILL  
RADIATION ENGG LABS  
MAIN ST MAYNARD MASS  
RADIATION INC  
MELBOURNE FLA  
RADIATION INC PRODUCTION DIV  
501 COMMONWEALTH AVE ORLANDO FLA  
RADIATION INSTRUMENT CO  
PO BOX 733 SILVER SPRING MO



# ELECTRONIC MANUFACTURERS—A TO Z

RADIATION INSTRUMENT DEVELOPMENT LAB INC  
4501 W N AVE MELROSE PARK ILL  
RADIATION MATERIALS INC  
36-40 37TH ST LI CITY 1 NY  
RADIATION RESEARCH CORP  
314 FLORIDA AVE W PALM BEACH FLA  
RADIATION RESEARCH CORP  
1150 SHAMES DR WESTBURY N Y  
RADIATRONICS INC  
14801 CALIF ST VAN NUYS CALIF  
RADIO ACTIVITIES INC  
119 DAWSON AVE BOONTON N J  
RADIO CITY PROD CO  
CENTRE 6 GLENDALE ST EASTON PA  
RADIO COND CO SUB THOMPSON RAMO WOOLDRIDGE  
DAVIS & COPEWODD STS CAMDEN 3 NJ  
RADIO CONDENSER CO LTD  
6 BERMONDSEY RD TORONTO CANADA  
RADIO CONDENSER CO WESTERN CONDENSER DIV  
WATSEKA ILL  
RADIO CONDENSER CO WESTERN CONDENSER DIV  
HOOPSTON ILL  
RADIO CORES INC  
9540 S TULLEY AVE OAK LAWN ILL  
RADIO CORP OF AMERICA DEFENSE ELECT PRODUCTS  
11819 W OLYMPIC BLVD LOS ANGELES 64 CALIF  
RADIO CORP OF AMERICA DEFENSE ELECT PRODUCTS  
8500 BALBOA BLVD VAN NUYS CALIF  
RADIO CORP OF AMERICA ELECT DATA PRDC DIV  
3900 MONET ROAD WEST PALM BEACH FLA  
RADIO CORP OF AMERICA HOME INSTRS DIV  
1300 SOUTH ROGERS STREET BLOOMINGTON IND  
RADIO CORP OF AMERICA ELECTRN TUBE DIV  
501 N LASALLE ST INDIANAPOLIS IND  
RADIO CORP OF AMERICA HOME INSTRS DIV  
501 N LASALLE ST INDIANAPOLIS IND  
RADIO CORP OF AMERICA ELECTRN TUBE DIV  
3300 S ADAMS ST MARION INDIANA  
RADIO CORP OF AMERICA DEFENSE ELECT PRODUCTS  
BURLINGTON MASS  
RADIO CORP OF AM SEMI-CNDCTRS & MTRLS DIV  
64 A STREET NEEDHAM HEIGHTS MASS  
RADIO CORP OF AMER  
13541 AUBURN DETROIT MICH  
RADIO CORP OF AMERICA  
SEMICONDUCTOR & MATERIAL DIV SOMERVILLE NJ  
RADIO CORP OF AMERICA BRDCST & COMM PROD DIV  
FRONT & COOPER STS CAMDEN NJ  
RADIO CORP OF AMER DEFENSE ELECT PROD  
FRONT & COOPER STS CAMDEN 2 NJ  
RADIO CORP OF AMER ELECT TUBE DIV  
415 S 5TH ST HARRISON N J  
RADIO CORP OF AMERICA ASTRO ELCTS DIV  
EDINBURG ROAD LOCUST CORNERS NJ  
RADIO CORP OF AMERICA DEFENSE ELECTRONICS  
MARNE HWY 6 BORTON LANDING MOORESTOWN NJ  
RADIO CORP OF AMERICA ELECTRN TUBE DIV  
1550 ST GEORGE AVE WOODBRIDGE NJ  
RADIO CORP OF AMERICA DFNS ELECT PRODS  
CAMBRIDGE OHIO  
RADIO CORP OF AMERICA ELECT TUBE DIV  
5040 LESTER ROAD CINCINNATI OHIO  
RADIO CORP OF AMERICA SEMI CNDCTR MTRS DIV  
FINDLAY OHIO  
RADIO CORP OF AMERICA DFNS ELECT PRODS  
COVENTRY & LAKESIDE AVES CROYDON PA  
RADIO CORP OF AMERICA ELECTRN TUBE DIV  
NEW HOLLAND PIKE LANCASTER PA  
RADIO CORP OF AM BRDADCAST & COM PROD DIV  
BROADCAST & COMM PROD DIV MEADOW LANDS PA  
RADIO CORP OF AMERICA SEMI CNDCTRS & MTRS DIV  
CRESTWOOD ROAD MOUNTAINTOP PA  
RADIO ENGG CO  
8 STATE ST NEW YORK 4 N Y  
RADIO ENG LABS INC  
2901 BORDEN AVE LONG IS CITY N Y  
RADIO ENGG PRODUCTS  
ATHOLVILLE NEW BRUNSWICK CANADA  
RADIO ENGG PRODUCTS  
325 DECELLES STREET GRANBY QUEBEC CANADA  
RADIO FREQUENCY CO  
44 PARK ST MEDFIELD MASS  
RADIO FREQUENCY LABS INC  
BOONTON N J  
RADIO INDUSTRIES TRW ELECTRONICS  
666 GARLAND PL DES PLAINES ILL  
RADIO MFG ENGG INC  
501 WALNUT ST WASHINGTON ILL  
RADIO MATERIALS CO DIV PR MALLORY CO INC  
4242 W BRYNMAWR AVE CHICAGO 46 ILL  
RADIO MATIC OF AMERICAN INC  
1550 SPRINGFIELD AVEMAPLEWOOD N J  
RADIO RECEPTOR CO INC SELENIUM DIV  
240 WYTHE AVE BROOKLYN 11 N Y  
RADIO RECEPTOR CO GEN INST CORP SEMICN DIV  
120 WYTHE AVE BROOKLYN NY  
RADIO SPECIALTY MFG CO  
2023 S E 6 AVE PORTLAND ORE  
RADIO SWITCH CORP  
MARLBORO NEW JERSEY  
RADION CORP  
345 TERRA COTTA AVE CRYSTAL LAKE ILL  
RADIO T V PRODUCTS CORP  
308 N LAKE ST GRASS LAKE MICH  
RADIUM CHEMICAL CO  
6 27TH AVE WOODSIDE 77 N Y  
RADIX WIRE CO  
26260 LAKELAND BLVD CLEVELAND 32 OHIO  
RAECO  
1351 DELOSS INDIANAPOLIS 3 IND  
RAE MOTOR CORP  
BOX 518 MCHENRY ILL  
RAILWAY COMMUNICATIONS INC  
9351 E 39 ST RAYTOWN MO  
RAM CHEMICALS INC  
210 E OLIVE ST GARDENA CALIF

RAM METER INC  
1100 HILTON RD FERNDALE MICH  
RAMSEY ENG CO  
1853 COUNTY RD ST PAUL MINN  
RAMYR MFG CO  
1779 N MAIN LOS ANGELES 31 CALIF  
RANDALL INC DOUGLAS  
6 PAWCATUCK AVE WESTERLY R I  
RANDOLPH PRODUCTS CO  
CARLSTADT N J  
RANGERTONE INC  
73 WINTHROP ST NEWARK N J  
RANK CINTEL LTD  
WORSLEY BR RD LWR SYDENHAM ENGLAND  
RANSON RESEARCH  
BOX 269 SAN PEDRO CALIF  
RAPID ELECTRIC CO  
2881 MIDDLETOWN RD BRONX 61 N Y  
RAPID ELECTRIC CO  
BROOKFIELD CONN  
RAPID ELECTROPLATING PROCESS INC  
1414 S WABASH AVE CHICAGO 5 ILL  
RAPID SPECIALTIES CO  
327 W HURON ST CHICAGO 10 ILL  
RAPIDS STANDARD CO INC  
RAPISTAN BLDG GRAND RAPIDS MICH  
RATEL INC  
1 EL CAMINO RATEL GOLETA CALIF  
RA TONE ELECTRONIC SALES CO  
1848 W CAMPBELL AVE PHOENIX ARIZ  
RAU FASTENER CO  
102 WESTFIELD ST PROVIDENCE R I  
RAU FASTENER CO  
50 ALEPPO ST PROVIDENCE RI  
RAULAND CORP  
4245 N KNOX AVE CHICAGO ILL  
RAVEN INDUSTRIES INC  
205 E 6TH ST SIOUX FALLS S D  
RAWAY BEARING CO INC  
141 CHRYSITIE ST NEW YORK N Y  
RAWDON SMITH ASSOC INC  
1735 20 ST N W WASHINGTON D C  
RAWSON ELECTRICAL INSTRUMENT CO  
116 POTTER ST CAMBRIDGE 42 MASS  
RAYBESTOS-MANHATTAN INC  
P O BOX 1021 BRIDGEPORT 2 CONN  
RAYBESTOS-MANHATTAN INC  
61 WILLET ST PASSAIC N J  
RAYBESTOS-MANHATTAN INC PLASTIC PRODUCTS DIV  
MANHEIM PA  
RAYCHEM CORP  
OAKSIDE NORTHSIDE REDWOOD CITY CALIF  
RAYCHEM CORP  
2821 FAIR OAKS AVE REDWOOD CITY CAL  
RAYCLAD TUBES INC  
OAKSIDE AT NORTHSIDE REDWOOD CITY CALIF  
RAYCO ELECTRONIC MFG INC  
7229 ATOLL AVE N HOLLYWOOD CALIF  
RAYMOND ENGINEERING LABORATORY INC  
SMITH ST MIDDLETOWN CONN  
RAY O VAC INC  
WILLIAMSPORT PA  
RAY-O-VAC CO  
212 E WASHINGTON AVE MADISON WISC  
RAYPAR INC  
7800 W ADDISON ST CHICAGO 34 ILL  
RAY PROOF CORP  
843 CANAL ST STAMFORD CONN  
RAYTHEON COMPANY INDUSTRIAL OPERATION  
KEELER AVE S NORWALK CONN  
RAYTHEON CO SEMICOND DIV  
350 ELLIS ST MOUNTAIN VIEW CALIF  
RAYTHEON CO MICROWAVE & POWER TUBE DIVISION  
SPENCER LABORATORY BURLINGTON MASS  
RAYTHEON CO  
CORPORATE GOVT MKTG LEXINGTON MASS  
RAYTHEON CO INDUSTRIAL COMPONENTS DIV  
55 CHAPEL ST NEWTON MASS  
RAYTHEON COMM & DATA PROC OPER  
1415 BOSTON & PROVIDENCE TPK NORWOOD MASS  
RAYTHEON CO DIST PROD DIV  
PROVIDENCE TURNPIKE WESTWOOD MASS  
RAYTHEON CO COMM APPARATUS & SYSTEMS  
HOOKSETT PLANT MANCHESTER N H  
RAYTHERM CORP  
OAKSIDE AT NORTHSIDE REDWOOD CITY CALIF  
RAZDOW LABORATORIES INC  
377 5TH ST NEWARK 7 N J  
R B M CONTROLS DIV ESSEX WIRE CORP  
131 GODFREY ST LOGANSPOET IND  
RBM DEVELOPMENT CORP  
174 MAIN ST METUCHEN N J  
R B M DIV ESSEX WIRE CORP  
131 GODFREY ST LOGANSPOET IND  
R C L ELECTRONICS INC  
NEW JERSEY AVE RIVERSIDE N J  
RDF CORP  
HUDSON N H  
REA MAGNET WIRE CO  
3610 E PONTIAC ST FT WAYNE IND  
REACH CORP  
LEXINGTON NEBRASKA  
READY POWER CO  
11231 FREUD AVE DETROIT 14 MICH  
READY POWER CO  
3826 GRAND RIVER AVE DETROIT MICH  
RECORA CO  
POWIS RD BOX 68 ST CHARLES ILL  
RECORDED PUBLICATIONS LABS  
1558PIERCE AVE CAMDEN N J  
RECORDIO CORP  
600 SEMINARY ST CHARLOTTE MICH  
RECOTON CORP  
5235 BARNETT AVE LONG ISLAND CITY N Y  
RECTICO INC  
20 FACTORY ST CEDAR GROVE N J

RECTIFIER DIV AUDIO DEVELOPMENT  
620 E DYER RD SANTA ANA CALIF  
REDCOR CDRP  
7760 DEERING AVE CANOGA PARK CALIF  
RED DEVIL MFG CO  
1412 N DGDEN AVE CHICAGO 10 ILL  
REDFDRD CORP INSTRUMENT DIV  
33 CRANE ST STATION SCHENECTADY 3 NY  
REDMAN ELECTRONICS CORP  
92 PROSPECT ST THOMPSONVILLE CONN  
REDMOND CO  
MONROE ST OWOSSO MICH  
REDMOND CO INC  
ITHACA MICH  
RED POINT CORP  
105 W SPAZIER AVE BURBANK CALIF  
RED SEAL ELECTRIC CO  
10307 DETROIT AVE CLEVELAND 2 OHIO  
REEDER & CO CHARLES M  
173 VICTOR AVE DETROIT MICH  
REED RESEARCH INC  
1048 POTOMAC ST WASHINGTON D C  
REED & REESE INC  
717 LAKE AVE PASADENA CALIF  
REEVE ELECTRONICS INC  
609 W LAKE ST CHICAGO 6 ILL  
REEVES HOFFMAN DIV  
CHERRY & NORTH STS CARLISLE PA  
REEVES INSTRUMENT CORP  
ROOSEVELT FIELD GARDEN CITY NY  
REEVES PULLEY CO DIV RELIANCE ELEC & ENG CO  
1225 7TH ST COLUMBUS IND  
REEVES SOUNDRAFT CORP  
15 GREAT PASTURE ROAD DANBURY CONN  
REFLECTONE ELECT  
POST RD STAMFORD CONN  
REF MFG CORP  
393 JERICHO TURNPIKE MINEOLA N Y  
REGCO INC  
3025 W MISSION RD ALHAMBRA CALIF  
REGENCY ELECTRONICS INC  
7900 PENDLETON PIKE INDIANAPOLIS IND  
REGENT CONTROLS INC  
HARVARD AVE STAMFORD CONN  
REGO INSULATED WIRE CO  
830 MONROE ST HOBOKEN N J  
REICHOLD CHEMICALS INC  
525 N BROADWAY WHITE PLAINS N Y  
REID ENTERPRISES  
2610 E 67 ST LONG BEACH 5 CALIF  
REIGNER RECORDING LIBRARY  
3401BROOK RD RICHMOND 27 VA  
REILLY TAR & CHEMICAL CORP  
1615 MERCHANT BANK BLDG INDIANAPOLIS 4 IND  
REITER CO F  
3340 BONNIE HILL DR HOLLYWOOD 28 CALIF  
REK O KUT COMPANY INC  
38 19 108TH ST CORONA 68 L I N Y  
RELCOIL PRODUCTS  
75 & SPRING ST WINDSOR LOCKS CONN  
RELIANCE TIME CONTROLS INC  
1927 MEAD ST RACINE WISC  
RELIANCE ELECTRIC & ENGG CO  
24701 EUCLID AVE CLEVELAND 17 OHIO  
RELIANCE ELECTRIC & ENG CO IVANHOE DIV  
561A CLEVELAND OHIO  
RELIANCE MICA CO INC  
341 39TH ST BROOKLYN 32 N Y  
REMANCO INC  
1805 COLORADO SANTA MONICA CALIF  
REMINGTON CORP  
WILLEY ST AUBURN N Y  
REMINGTON RAND UNIVAC DIV SPERRY RAND  
UNIVAC PARK ST PAUL 16 MINN  
REMINGTON RAND UNIVAC DIV OF SPERRY RAND CRP  
1900 W ALLEGHENY AVENUE PHILADELPHIA 32 PA  
REMLER CO  
2101 BRYANT ST SAN FRAN CALIF  
RENRANDT INC  
6 PARMELEE ST BOSTON 18 MASS  
RENFREW ELECTRIC CO LIMITED  
349 CARLAW AVE TORONTO ONT CANADA  
RENWELL ELECTRONICS CORPORATION  
755 NEW LUDLOW RD SOUTH HADLEY FALLS MASS  
REON RESISTOR CORP  
153 SAWMILL RIVER RD YONKERS N Y  
REPUBLIC AVIATION CORP  
FARMINGDALE LI NY  
REPUBLIC ELECT INDUST CORP  
575 BROAD HOLLOW RD HUNTINGTON N Y  
REPUBLIC FLOW METERS CO  
2240 DIVERSEY PKWY CHICAGO ILL  
REPUBLIC FOIL & METAL MILLS INC  
55 TRIANGLE ST DANBURY CONN  
REPUBLIC LENS CO  
31 E 169TH ST NEW YORK 52 N Y  
REPUBLIC RUBBER DIV LEE RUBBER & TIRE CORP  
1410 ALBERT ST YOUNGSTOWN OHIO  
RESEDL CORP  
P O BOX 217 RIO GRANDE N J  
RESEDL ENGG CORP  
330 S FAIR OAKS AVE PASADENA CALIF  
RESEARCH CHEMICALS  
170 W PRODIENTENCIA BURBANK CALIF  
RESEARCH-COTTRELL INC  
BOX 740 BOUND BROOK NJ  
RESEARCH DEVELOPMENT MFG INC  
429 E COLLAM ST PHILADELPHIA 44 PA  
RESEARCH INC  
STATE HWY 169 @ CO RD 18 MINNEAPOLIS MINN  
RESEARCH INC  
PO BOX 6164 EDINA STA MINNEAPOLIS 24 MINN  
RESEARCH INDUSTRIAL LAB OF ELECTRONICS  
ROSLYN PA  
RESEARCH INST CO INC  
558 MAIN ST WESTBURY L I N Y

RESEARCH MFG CORP  
4152 VOLTAIRE SAN DIEGO 7 CALIF  
RESEARCH SPECIALTIES CO  
200 S GARRARD BLVD RICHMOND CALIF  
RESF ENGG INC  
A AND COURTLAND STS PHILA PA  
RESISTANCE PRODUCTS CO  
914 S 13 ST HARRISBURG PA  
RESISTOFLEX CORP  
WOODLAND RD ROSELAND N J  
RESISTOFLEX CORP SOUTHWESTERN DIV  
135 GLASS ST DALLAS 7 TEX  
RESISTOR NETWORKS INC  
556 W 168TH ST NEW YORK N Y  
RESISTORS INC  
5226 W 26 ST CHICAGO ILL  
RESITRON LABS INC  
3 860 CENTINELLA AVE LOS ANGELES 66 CALIF  
RESITRON LABS INC  
2908 NEBRASKA AVE SANTA MONICA CALIF

FOR INFORMATION ON PRODUCTS

SEE THE

"PRODUCT AND MANUFACTURERS" SECTION

REUTER INC  
3965 MEADOWBROOK RD MINN MINN  
REUTER STOKES ELECT COMPONENTS  
2149 HAMILTON AVE CLEVELAND OHIO  
REVCOR INC  
251 EDWARDS ST CARPENTERSVILLE ILL  
REVERE CORP OF AMERICA  
N COLONY RD WALLINGFORD CONN  
REVERE SCREW & RIVET CORP  
1728 W WALNUT ST CHICAGO ILL  
REVOLVATOR CO  
86TH ST US RT 169 N BERGEN N J  
REX RHEOSTAT CO  
149 BABYLON TURNPIKE ROOSEVELT N Y  
REYNOLDS DIV NATIONAL STANDARD CO  
DIXON ILL  
REYNOLDS ELECTRIC CO  
3000 RIVER RD RIVER GROVE ILL  
REYNOLDS INDUSTRIES INC  
2105 COLORADO AVE SANTA MONICA CALIF  
REYNOLDS METALS CO  
PO BOX 2346 RICHMOND VA  
REYNOLDS ROCKET SYSTEMS INC  
2301 ALEXDALE LA LA PUENTE CALIF  
REYNOLDS WIRE DIV NATIONAL STANDARD CO  
809 E 2ND ST DIXON ILL  
RF COMMUNICATIONS ASSOCIATES INC  
13 CANAL ST ROCHESTER N Y  
RF INTERONICS INC  
15 NEIL COURT OCEANSIDE L I N Y  
R F PRODUCTS INC DIV AMPHENOL BORG  
33 E FRANKLIN DANBURY CONN  
RFS ENGINEERING CO  
2ND & WESTMORELAND STS PHILA 40 PA  
R G CIRCUITS CO  
15216 MANSEL AVE LAWDALE CALIF  
RHEEM CALIFONE CORP  
5922 BOWCROFT ST LOS ANG CALIF  
RHEEM ELECTRONICS CORP  
5200 W 104TH ST LOS ANGELES 45 CALIF  
RHEEM SEMICONDUCTOR CORP  
350 ELLIS ST MOUNTAIN VIEW CALIF  
R H ELECTRONICS CO  
PO BOX 35121 DALLAS 35 TEXAS  
RHG ELECTRONICS LAB INC  
94 MILBAR BLVD FARMINGDALE N Y  
RHODES INC M H  
30 BARTHOLOMEW AVE HARTFORD CONN  
RHO ENG CO  
2242 SEPULVEDA BLVD LOS ANGELES CALIF  
RICHARDSON ALLEN CORP  
SUB STANDARD KOLLSMAN IND  
116 15 15 AVE COLLEGE POINT N Y  
RICHARDSON CO  
2790 LAKE ST MELROSE PARK ILL  
RICHARDSON CO  
409 CODWISE AVE NEW BRUNSWICK N J  
RICHARDSON LABS KENNETH  
254 VINCENT AVE LYNBROOK N Y  
RICHARDSON SCALE CO  
668 VAN HOUTEN AVE CLIFTON NJ  
RICH ELECTRONICS INC  
212 NW 8TH AVE MIAMI 36 FLA  
RICHFIELD COINED PRODUCTS CO  
722 BROAD ST CLIFTON N J  
RICHMOND ENGINEERING CO INC  
19 CONCORD ST S NORWALK CONN  
RICO PLASTIC CO  
3722 W NORTH AVE CHICAGO 47 ILL  
RIEDON DIV ON MARK ENGINEERING CO  
11728 VOSE ST NO HOLLYWOOD CAL  
RIEGEL PAPER CORP  
1143 E FOURTH ST CHARLOTTE N C  
RIESTER & THESMACHER CO  
1526 W 25 ST CLEVELAND OHIO  
RIGGS NUCLEONICS CORP  
177 W MAGNOLIA BLVD BURBANK CALIF  
RIKER INDUSTRIES INC  
875 E JERICHO TNPKE HUNTINGTON STA N Y  
RIL ELECTRONICS CORP  
STREET RD & 2ND ST PKE SOUTHAMPTON PA  
RIMAK ELECT INC  
10929 VANOWEN ST N HOLLYWOOD CALIF

RIPLEY CO  
L FACTORY ST MIDDLETOWN CONN  
RISCO  
1086 FOLSOM ST SAN FRAN CALIF  
RI TONE PRODS INC  
157 LIVINGSTON ST BROOKLYN N Y  
RIVERBANK LABS ENGG DEPT  
P O BOX 65 GENEVA ILL  
RIVERSIDE ALLOY METAL DIV  
1 PAVILION AVE RIVERSIDE N J  
RIVETT LATHE & GRINDER INC  
P O BOX 7 BOSTON 35 MASS  
RIXON ELECTRONICS INC  
2121 INDUSTRIAL PKWY SILVER SP MD  
R M E DIV ELECTRO VOICE INC  
BUCHANAN MICH  
R M S ASSOCIATES INC  
805 MAMARONECK AVE MAMARONECK NY  
RMS ENG INC  
95 BENNETT ST N W ATLANTA GA  
ROANWELL CORP  
180 VARICK ST NEW YORK 14 N Y  
ROBBINS & MYERS INC  
1345 LAGONDA AVE SPRINGFIELD OHIO  
ROBERTS ELECTRONICS INC  
1028 LABREA AVE HOLLYWOOD CALIF  
ROBERTSHAW-FULTON CONTROLS CO  
SANTA ANA FRWY EUCLID AVE ANAHEIM CALIF  
ROBERTSHAW CONTROLS CO ACRO DIV  
COLUMBUS 16 OHIO  
ROBERTSHAW-FULTON CO FULTON SYLPHON DIV  
P O BOX 400 KNOXVILLE 1 TENN  
ROBERTSON ELEC CO INC  
124 S ELMWOOD AVE BUFFALO N Y  
ROBERTSON INSTRUMENT CO  
240 MOTOR AVE BOX 834 AZUSA CALIF  
ROBERTS R O  
833B S ALLPORT SANTA FE SPRINGS CALIF  
ROBERTS TOLEDO RUBBER CO  
4143 MONROE ST TOLEDO 6 OHIO  
ROBINAIR MANUF CORP  
1224 S E AVE MONTEPELLIER OHIO  
ROBINS INDUSTRIES CORP  
15 58 127 ST FLUSHING N Y  
ROBINSON MACHINE CO INC  
286 BREAKNESS AVE PATERSON N J  
ROBINSON MACHINE WORKS INC  
802 E EIGHTH ST NEW ALBANY IND  
ROBINSON RECORDING LABS  
35 S 9 ST PHILA PA  
ROBINSON TECHNICAL PRODUCTS INC  
TETERBORO N J  
ROBINSON VIBRASHOCK DIV ROBINSON TECH PROD  
ROBINSON TECHNICAL PRODUCTS INC  
TETERBORO AIR TERM TETERBORO N J  
ROBOT INDUSTRIES INC  
7041 ORCHARD AVE DEARBORN MICH  
ROBOTOMICS ENTERPRISES INC  
4504 N 16TH ST PHOENIX 16 ARIZ  
ROBOTOMICS ENTERPRISES INC  
2422 INDIAN SCHOOL PHOENIX ARIZ  
ROBOTRON CORP  
21300 W 8 MILE RD DETROIT 19 MICH  
ROCHESTER INSTRUMENT SYS INC  
275 N UNION ST ROCHESTER 5 N Y  
ROCKBESTOS WIRE & CABLE CO DIV OF CERRO CORP  
NICOLL & CANNER STS NEW HAVEN CONN  
ROCKER SOLENOID CO  
140 MARINE ST WILMINGTON CALIF  
ROCKWELL ENGINEERING  
2133 E 45 ST INDIANAPOLIS 5 IND  
ROCKWELL MFG  
510 LANSING AVE TULSA OKLA  
ROCKWELL PRODUCTS CORP  
146 CENTRAL AVE NEWARK N J  
RODALE ELECTRONICS INC  
562 GRAND BLVD WESTBURY N Y  
RODALE MFG CO  
6 & MINOR STS EMMAUS PA  
RODE INC  
5 GREEN ST WOBURN MASS  
RODNEY METALS INC  
1357 RODNEY FRENCH BLVD NEW BEDFORD MASS  
ROEBLINGS SONS JOHN A DIV  
640 S BROAD ST TRENTON N J  
ROESCH COMMUNICATIONS DOUGLAS  
2727 SAN FERNANDO RD LOS ANG CALIF  
ROGAN BROS INC  
8031 MONTICELLO SKOKIE ILL  
ROGERS CORP  
ROGERS CONN  
ROGERS ELECTRONIC CORP  
49 BLECKER ST NEW YORK 12 N Y  
ROHDE & SCHWARZ  
111 LEXINGTON AVE PASSAIC NEW JERSEY  
ROHDE MFG CO INC  
4739 W MONTROSE AVE CHICAGO 41 ILL  
ROHN MFG CO  
BOX 2000 PEORIA ILL  
ROHR AIRCRAFT CORP  
FOOT OF H ST VISTA CALIF  
ROLA CO  
ROUTE 28 HAWTHORNE PA  
ROLA CO  
2530 SUPERIOR AVE CLEVELAND OHIO  
ROLLAN ELECTRIC CO  
8233 S PRINCETON AVE CHICAGO 20 ILL  
ROLOCK INC  
1390 KINGS HWY FAIRFIELD CONN  
ROMAC PRODUCTS CO  
48-01 25 AVE LONG ISLAND CITY 3 N Y  
ROME CABLE DIV ALCOA  
RIDGE ST ROME N Y  
ROME TURNEY RADIOATOR CO  
BOX 32 ROME N Y  
RONAN & KUNZL INC  
502 S KALAMAZOO AVE MARSHALL MICH

RONDO OF AMERICA INC  
100 SANFORD ST HAMDEN CONN  
RON ELECTRONICS CORP  
150 PINE ST MONTCLAIR NJ  
ROSEMOUNT ENG CO  
4900 W 78TH ST MINN MINN  
ROSENTHAL ISOLATOREN GMBH OF UNITED  
MINERAL & CHEM CO 16 HUDSON ST NY 13  
ROSS METALS CO MILTON  
237 JACKSONVILLE RD HATBORO PA  
ROSS CO MILTON  
511 SECOND ST PIKE SOUTHAMPTON PA  
ROSTAN CORP  
101 VARICK AVE BROOKLYN N Y  
ROSTONE CORP  
STATE RD 52 S LAFAYETTE IND  
ROTARY LIFT CORP DIV DOVER CORP  
1054 KANSAS ST MEMPHIS TENN  
ROTATING COMPONENTS INC  
1560 FIFTH AVE BAY SHORE L I N Y  
ROTATING ELECTR SYSTEMS CO  
14755 BESSEMER ST VAN NUYS CALIF  
ROTEK INSTRUMENT CORP  
11 GALEN ST WATERTOWN 72 MASS  
ROTOTEST LABS INC  
2800 LOS FLORES BLVD LYNWOOD CALIF  
ROTRON MFG CO  
HASBROUCK LANE WOODSTOCK N Y  
ROUGE ELECTRONICS CO  
4921 N LINCOLN OKLAHOMA CITY 5 OKLA  
ROWAN CONTROLLER CO  
30 BRIDGE AVE RED BANK N J  
ROWAN CONTROLLER CO  
2315 HOMEWOOD AVE BALTIMORE 18 MD  
ROWE ENGRAVERS INC  
68 UNION AVE CLIFTON N J  
ROWE INDUSTRIES  
1702 WAYNE ST TOLEDO OHIO  
ROY CO MILTON  
1300 E MERMAID LANE PHILA 18 PA  
ROYAL COMMUNICATION SYSTEMS  
4501 PROSPECT AVE CLEVELAND 3 OHIO  
ROYAL ELECTRIC CORP  
95 GRAND AVE PAWTUCKET RI  
ROYAL MCBEE INST DEVELOP LAB  
67 MECHANIC ST ATTLEBORO MASS  
ROYCO INSTRUMENTS INC  
440 OLIVE ST PALO ALTO CALIF  
ROYSON ENGRG CO  
HATBORO PA  
R S ELECTRONICS CORP  
BOX 11368 STA PALO ALTO CALIF  
RUBBER & ASBESTOS CORP  
225 BELLEVILLE AVE BLOOMFIELD N J  
RUBBERCRAFT CORP OF CALIFORNIA  
1800 W 220TH ST TORRANCE CALIF  
RUBBER TECK INC  
19115 S HAMILTON ST GARDENA CALIF  
RUBY CHEMICAL CO  
68-70 MCDOWELL ST COLUMBUS 16 OHIO  
RUCKELSHAUS LABORATORIES INC JOHN G  
110 POMEROY RD MADISON NJ  
RUCKER CO  
EMERYVILLE CALIF  
RUE PRODUCTS  
10539 CLARKSON RD LOS ANG CALIF  
RUNZEL CORP & WIRE CO  
4727 MONTROSE ST CHICAGO ILL  
RUSSELL BURDSALL & WARD BOLT & NUT CO  
P O BOX 110 PORT CHESTER N Y  
RUSSELL GASKET CO  
7424 BESSEMER AVE CLEVELAND 27 OHIO  
RUSSELL REINFORCED PLASTICS CORP  
521 HOFFMAN AVE LINDENHURST N Y  
RUST-LICK INC  
755 BOYLESTON ST BOSTON 16 MASS  
RUTHERFORD ELECTRONICS CO  
8944 LINDBLADE ST CULVER CITY CALIF  
RUTHERFORD RESEARCH PRODS CO  
P O BOX 162 RUTHERFORD N J  
RYE CONTROLS INC  
710 S 33RD ST RICHMOND CALIF  
RYTRON CO INC  
7303 LANKERSHIM BLVD HOLLYWOOD CALIF

## S

S & A ELECTRONICS  
102 NEVADA ST TOLEDO 5 OHIO  
SAFE-T-MIKE CORP  
2904 CHAPMAN ST OAKLAND CALIF  
SAGE CRAFT INC  
NORWICH N Y  
SAGE ELECTRONICS CORP  
O BOX 126 ROCHESTER 10 NY  
SAGE LABORATORIES INC  
3 HURON DR E NATICK MASS  
SAG HARBOR INDUSTRIES  
BOX N SAG HARBOR NY  
SAINÉ EQUIPMENT LAB HARRY T  
RT 2 BOX 407 E MAIN AVE MORGAN HILL CALIF  
SAMPSON CHEMICAL & PIGMENT CORP  
2830 W LAKE ST CHICAGO 12 ILL  
SANBORN CO  
175 WYMAN ST WALTHAM 54 MASS  
SANDERS ASSOCIATES  
95 CANAL ST NASHUA N H



# ELECTRONIC MANUFACTURERS—A TO Z

SAN FERNANDO ELECTRIC MFG CO  
1509 1 ST SAN FERNANDO CALIF  
SANFORD MILLER CO  
89 THROOP AVE BROOKLYN 6 N Y  
SANGAMO ELECTRIC CO  
1207 N 11TH ST SPRINGFIELD ILL  
SANGAMO MICROSONICS INC  
60 WINTER ST WEYMOUTH 88 MASS  
SANTA ANITA ENGG CO OF CALIF  
3270 E FOOTHILL BLVD PASADENA CALIF  
SARASOTA ENG CO INC  
2010 PINE TERRACE SARASOTA FLA  
SARATOGA INDUSTRIES  
CONGRESS & BALLSTON AVES SARATOGA SPGS N Y  
SARATOGA PLASTICS INC  
N WALPOLE NH  
SARGEANT & WILBUR HEAT TREATING CORP  
170 YORK AVE PAWTUCKET R I  
SARGENT ELECTRIC CORP  
23-16 40 AVE LONG ISLAND CITY NY  
SARKES TARZIAN INC  
EAST HILLSIDE DR BLOOMINGTON IND  
SARKES TARZIAN INC  
415 N COLLEGE AVE BLOOMINGTON IND  
SARTON INC  
114 MAIN ST NEWBERG ORG  
SATELLITE CORP OF AMERICA  
CHEWONKI RO WISCASSET MAINE  
SATURN ELECTRONICS CORP  
10665 HARRY HINES BLVD  
BOX 13305 DALLAS TEXAS  
SAUERREISEN CEMENTS CO  
SAUERREISEN BLVD PITTSBURGH PENNA  
SAVAGE-ROWE PLATING CO INC  
2152 PORTAGE ST KALAMAZOO MICH  
SAVOY ELECTRONICS INC  
P O BOX 584 GRIFFIN GA  
SAVOY ELECTRONICS INC  
1314 NE 17 CT BOX 7127 FT LAUDERDALE FLA  
SAXONBURG CERAMICS INC  
BOX 157 SAXONBURG PA  
SAXTON PRODUCTS INC  
4320 PARK AVE NEW YORK 57 N Y  
SAYRE ELECTRONICS  
BLOOMFIELD N J  
SBD SYSTEMS  
90 ROME ST FARMINGDALE N Y  
SCAICO CONTROLS INC  
210 TAYLOR ST RIVERSIDE NJ  
SCALA RADIO CO  
2814 19 ST SAN FRANCISCO 10 CALIF  
SCANTLIN ELECTRONICS INC  
2215 COLBY AVE LOS ANGELES 64 CALIF  
SCHAEVITZ ENGG  
US RTE 130 & SCHAEVITZ BLVD CAMDEN NJ  
SCHAFER CUSTOM ENGG  
235 S 3 ST BURBANK CALIF  
SCHAEFFER AIR INDUSTRIES  
290 N HENRY ST BROOKLYN 22 N Y  
SCHAUER MFG CORP  
4501 ALPINE AVE CINCINNATI OHIO  
SCHENECTADY CHEMICALS INC  
SCHENECTADY 1 NEW YORK  
SCHENECTADY VARNISH CANADA LTD  
409 COMSTOCK RD SCARBOROUGH ONT CANADA  
SCHENECTADY VARNISH CO  
ROTTERDAM JCT N Y  
SCHERMA MFG CO F A  
424 BROOME ST NEW YORK 13 N Y  
SCHINDLERS  
195 GREENFIELD AVE LOS ANGELES 49 CALIF  
SCHIRMER-NATIONAL ALARM CORP  
20 WESTSIDE AVE BERGENFIELD N J  
SCHJELDHAL CO G T  
BOX 170 NORTHFIELD MINN  
SCHLIEBUS ELECTRONIC INSTRUMENT CO  
14 ABBOTT LANE CHELMSFORD MASS  
SCHMELING ELECTRONICS DIV RARITAN INDS CORP  
20 1ST ST KEYPORT NJ  
SCHMITT MFG CO  
1821 UNIVERSITY AVE ST PAUL MINN  
SCHMOENE ELECTRONICS LABORATORY  
915 WASHINGTON AVE EVANSVILLE 13 IND  
SCHONSTEDT ENG CO  
9170 BROOKVILLE RD SILVER SPRING MD  
SCHOTT CO OSCAR A  
500 11TH AVE S MINNEAPOLIS 4 MINN  
SCHRACK ELECTRICAL SALES CORP  
1100 MAQUION AVE NEW YORK 28 NY  
SCHULMERICH ELECTRONICS INC  
CARILLON HILL SELLERSVILLE PA  
SCHLUMBERGER RIDGEFIELD INSTRUMENTS  
RIDGEFIELD CONN  
SCHUTTE & KOERTING CO  
CORNWELL HTS BUCKS CO PA  
SCHWARZER CORP  
46 SALMI RD FRAMINGHAM MASS  
SCHWEITZER DIV P J KIMBERLY CLARK CORP  
MT HOLLY SPRINGS PA  
SCHWEITZER INC PETER J DIVN  
LEE MASS  
SCIARY BROS  
4915 W 67 ST CHICAGO 38 ILL  
SCIENTIFIC ATLANTA INC  
2162 PIEDMONT RD NE ATLANTA 9 GA  
SCIENTIFIC ELECTRIC INC  
105 119 MONROE ST GARFIELD N J  
SCIENTIFIC ELECTRONIC LABS INC  
24 WOODSIDE AVE LITTLE FALLS NJ  
SCIENTIFIC RADIO PRODS INC  
2303 W 8TH ST LOVELAND COLORADO  
SCIENTIFIC RADIO SERVICE  
4301 SHERIDAN ST UNIV PK HYATTSVILLE MD  
SCINTILLA DIV BENDIX CORP  
DELAWARE AVE SIDNEY NY  
SCINTILLONICS INC  
P O BOX 701 FT COLLINS COLO

SCIOTO SIGN CO  
370 VINE ST KENTON OHIO  
SCOPES CO INC  
PO BOX 36 MONSEY NY  
SCOTT INC H H  
111 POWDER MILL RD MAYNARD MASS  
SEABOARD ELECTRONIC CORP  
417-421 CANAL STREET NEW YORK 13 NY  
SEABORD PACIFIC DIV ASSOC SPRING  
15001 S BROADWAY PO BX 231 GARDENA CALIF  
SEAGER STANDARD CARBON CO  
291 CHURCH ST NEW YORK 13 N Y  
SEAL-A-METIC CO DIV OF FILTERS INC  
1 JOHN ST MALEDON N J  
SEALECTRIC SWITCH & RELAY CORP  
6025 N KEYSTONE AVE CHICAGO 3 ILLINOIS  
SEALECTRO CORP  
610 FAYETTE AVE MAMARONECK NY  
SEALECTRO CORP  
139 HOYT ST MAMORONECK N Y  
SEALOL INC  
WARWICK INDUSTRIAL PARK PROVIDENCE 5 RI  
SEAL PEEL INC  
775 STEPHENSON HWY ROYAL OAK MICH  
SEALTRON CORP  
READING RD AT AMITY CINCINNATI 15 OHIO  
SECOA ELECTRONICS CORP  
86 KYLVESTER ST WESTBURY LI NY  
SECODE CORP  
555 MINNESOTA ST SAN FRANCISCO 7 CALIF  
SECO ELECTRONICS INC  
5015 PENN AVE S MINN MINN  
SECO ELECTRONICS INC  
1201 S CLOVER DR MPLS MINN  
SECON METALS CORP  
7 INTERVALE ST WHITE PLAINS NY  
SECTRON INC  
ONE PINGREE ST SALEM MASS  
SECURITY CONTROLS INC  
503 FRANKLIN ST BUFFALO 2 N Y  
SECURITY DEVICES INC  
818 S CHOCTAW AVE EL RENO OKLAHOMA  
SECURITY DEVICES LAB  
24 SENECA AVE ROCHESTER 21 NY  
SEEBURG CORP  
1500 N DAYTON ST CHICAGO 22 ILL  
SEELY INSTRUMENT CO INC  
377 4TH ST PO BOX 387 NIAGARA FALLS NY  
SEGAL EDWARD INC  
132 LAFAYETTE ST NEW YORK 13 NY  
SEG ELECTRONICS CO INC  
12 HINSDALE ST BROOKLYN 7 NY  
SEISCOR MFG CO DIV SEISMOGRAPH SERVICE CORP  
P O BOX 1590 TULSA OKLAHOMA  
SEKONIC INC  
130 WEST 42ND ST NEW YORK 36 NY  
SELAS CORP OF AMERICA  
DRESSER PENNA  
SELETRONS LTD  
520 FIFTH AVE NEW YORK 36 NY  
SEL REX CORP  
75 RIVER RD NUTLEY 10 N J  
SEMCOM  
262 E 16 ST PATERSON 4 NJ  
SEMCO  
3536 W OSBORN RD PHOENIX ARIZ  
SEMI-ALLOYS INC  
550 S FULTON AVE MOUNT VERNON N Y  
SEMICON ASSOCIATES INC  
PO BOX 832 LEXINGTON KY  
SEMICON INC  
SWEETWATER RD PO BOX 328 BEAUFORD MASS  
SEMICON OF CALIF INC  
70 MARIPOSA AVE WATSONVILLE CALIF  
SEMI ELEMENTS INC  
SAXONBURG BLVD SAXONBURG PENNA  
SEMIMETALS INC  
172 SPRUCE ST WESTBURY LI  
SEMITRONICS INC  
63 SCRANTON ST WINCHESTER MASS  
SEMITRONICS CORP  
265 CANAL ST NEW YORK 13 N Y  
SEMTRAN INSTRUMENTS INC  
RTE 73 INDUSTRIAL CTR MAPLE SHADE N J  
SENECA FALLS MACHINE CO  
314 FALL ST SENECA FALLS NY  
SENSORY INC  
7 MAPLE AVE MORRISTOWN N J  
SEQUENTIAL ELECTR SYSTEM INC  
66 SAW MILL RD ELMFORD NY  
SEQUOIA WIRE  
2201 BAY RD REDWOOD CITY CALIF  
SERCO ELECT RESEARCH CORP  
15735 AMBAUM BLVD SEATTLE WASH  
SERDEX INC  
12 BOWDOIN SO BOSTON MASS  
SERVICE ASSOCIATED INC  
9236 S VINCENNES ST CHICAGO 20 ILL  
SERVICE INSTRUMENTS CORP  
426 S WESTGATE DR ADDISON ILL  
SERVICE INSTRUMENT CORP  
171 OFFICIAL RD ADDISON ILL  
SERVICE PARTS SYSTEMS  
13380 E 9 MILE RD E ODETTE MICH  
SERVO CONSULTANTS LTD  
70 STATE ST WESTBURY NY  
SERVO CONTROL DIV OILGEAR CO  
160 BEAR HILL RD WALTHAM 34 MASS  
SERVO CORP OF AMERICA  
111 NEW SOUTH RD HICKSVILLE NY  
SERVO DYNAMICS CORP  
MAIN ST SOMERSWORTH NH  
SERVOMECHANISMS INC  
200 N AVIATION BLVD EL SEGUNDO CALIF  
SERVO SYSTEMS CO  
14 CARMER AVE BELLEVILLE N J

SERVOMECHANISMS INC  
625 MAIN ST WESTBURY NY  
SERVOMECHANISMS INC  
200 AVIATION BLVD EL SEGUNDO CALIF  
SERVONIC INSTRUMENTS INC  
1644 WHITTIER AVE COSTA MESA CALIF  
SERVOSPEED DIV ELECTRO DEVICES INC  
4 GODWIN AVE PATERSON NJ  
SERVO TEK PRODUCTS CO  
1086 GOFFLE RD MAWTHORNE NJ  
SERVWELL PRODUCTS CO  
6541 EUCLID AVE CLEVELAND OHIO  
SESSIONS CLOCK CO INDUSTRIAL TIMING DIV  
61 E MAIN ST FORESTVILLE CONN  
SETCHELL-CARLSON INC  
NEW BRIGHTON ST PAUL 12 MINN  
SETHCO MFG CORP  
228A BABYLON TPKE MERRICK N Y  
SETTER BROS INC  
CATARRAUGUS N Y  
SMALLCROSS MFG CO  
PRESTON ST SELMA NC  
SHAMBAN & CO W S  
11617 W JEFFERSON BLVD CULVER CITY CALIF  
SHAMBAN & CO W S  
2531 BREMER DRIVE FT WAYNE 8 IND  
SHAND & JURS CO  
2600 8TH ST BERKELEY 10 CALIF  
SHAW INSULATOR CO  
201 1ST ST STROUDSBURG PENNA  
SHAW INSULATOR CO  
276 SNYDER AVE BERKELEY HEIGHTS N J  
SHEFFCO MFG CORP  
FAIRVIEW N J  
SHEFFIELD CORP SUB THE BENDIX CORP  
BOX 893 SPRINGFIELD ST DAYTON OHIO  
SHELL ELECTRONIC MFG CORP  
112 STATE ST WESTBURY N Y  
SHELTERED WORKSHOPS INC  
2619 MAIN ST SANTA MONICA CALIF  
SHEPARD LABS INC  
480 MORRIS AVE SUMMIT NJ  
SHEPHERD INDUSTRIES INC  
103 PARK AVE NUTLEY 10 NJ  
SHERIDAN GRAY INC  
21000 S NORMANDIE TORRANCE CALIF  
SHERIDAN-GRAY INC  
24701 CRENSHAW BLVD TORRANCE CALIF  
SHERMAN MFG CO H B  
22 BARNEY ST BATTLE CREEK MICH  
SHEROLD CRYSTALS INC  
1510-12 MGEE TRAFFICWAY KANSAS CITY 8 MO  
SHERWOOD ELECTRONIC LABS INC  
4300 N CALIFORNIA AVE CHICAGO 18 ILL  
SHIELDALLOY CORP  
NEWFIELD N J  
SHIELDING INC  
N READ AVE RIVERTON N J  
SHIPLEY CO INC  
WALNUT ST WELLESLEY 81 MASS  
SHORT BROS & HARLAND LTD  
CASTLEREAGH BELFAST NORTHERN IRELAND  
F W SHROOER CO  
11623 S BROADWAY LOS ANG CALIF  
SHURCLOSE SEAL CO  
17411 E WARREN AVE DETROIT 24 MICH  
SHURE BROS  
222 HARTREY AVE EVANSTON ILL  
SHURITE METERS  
130 WALLACE ST NEW HAVEN 8 CONN  
SHUR-LOK CORP  
879 S EAST ST PO BOX 563 ANAHEIM CALIF  
SIBLEY CO  
BRIDGE ST HADDAM CONN  
SICKLES F W DIV GIC  
165 FRONT ST CHICOPEE MASS  
SIEMON MFG CO  
BOX 275 WAYNE ILL  
SIERRA ELECTRONIC DIV PHILCO CORP  
3885 BOHANNON DR MENLO PARK CALIF  
SIERRA ENGG CO  
123 E MONTECITO AVE SIERRA MADRE CALIF  
SIFCO METACHEMICAL INC  
935 E 63RD ST CLEVELAND 22 OHIO  
SIGHTMASTER CORP  
50 ALEPPO ST PROVIDENCE R I  
SIGMA INSTRUMENTS INC  
170 PEARL ST S BRAINTREE MASS  
SIGMUND CONN CORP  
121 S COLUMBUS AVE MT VERNON N Y  
SIGNALITE INC  
1933 HECK AVENUE NEPTUNE NJ  
SIGNAL TRANSFORMER CO  
1661 MCDONALD AVE BROOKLYN N Y  
SIGNETICS CORP  
680 W MAUDE AVE SUNNYVALE CALIF  
SILICON TRANSISTER CORP  
150 GLEN COVE RD CARLE PLACE NY  
SILICONE INSULATION INC  
1383 SEABURY AVE BRONX 61 NY  
SILICONE SEALS INC  
894 MILWAUKEE AVE CHICAGO 41 ILL  
SILICONIX INC  
1140 W EVELYN AVE SUNNYVALE CALIF  
SILKROME DIV APH-HEXSEAL CORP  
41 HONECK ST ENGLEWOOD N J  
SILCOCKS MILLER CO  
MAPLEWOOD N J  
SIMMONDS AEROACCESSORIES INC  
VERGENNES VT  
SIMMONDS PRECISION PRODUCTS INC  
105 WHITE PLAINS RD TARRYTOWN NY  
SIMMONDS PRECISION PRODUCTS INC  
1515 S GARDENA AVE GLENDALE CALIF  
SIMMONS FASTENER CORP  
N BROADWAY ALBANY 1 NY



# ELECTRONIC MANUFACTURERS—A TO Z

SIMONDS SAW & STEEL CO  
INTERVALE RD FITCHBURG MASS

SIMPLATROL PRODUCTS CORP  
24 SALISBURY ST WORCESTER MASS

SIMPLEX TIME RECORDER CO  
24 S LINCOLN ST GARDNER MASS

SIMPSON ELECTRIC CO DIV AMER GAGE MACH CO  
5200 W INZIE ST CHICAGO 44 ILL

SIMPSON ELECTRIC CO DIV AMER GAGE MACH CO  
BOX 249 LAC DU FLAMBEAU WISC

SIMPSON ELECTRIC CO  
MERCER WISC

SIMS CASTING CORP  
2174 E ERIE BLVD SYRACUSE

SINCLAIR MFG CO  
5 WORCESTER ST CHARTLEY MASS

SINGER MFG  
FINDERNE NJ

SINGER METRICS DIV SINGER MFG CO  
915 PEMBROKE ST BRIDGEPORT 8 CONN

SINGER METRICS PANORAMIC DIV  
915 PEMBROKE ST BRIDGEPORT 8 CONN

SINGER METRICS SENSITIVE RES DIV  
915 PEMBROKE ST BRIDGEPORT 8 CONN

SINGLETON CO  
11770 BEREA RD CLEVE OHIO

SITTLER CORP  
18 N ADA ST CHICAGO 7 ILL

SIVERS LAB  
BOX 42018 STOCKHOLM SWEDEN

C SJOBERG & SON  
115 STATIN ST BRANSTON 10 R I

SKF INDUSTRIES  
TULIP & KENNEDY ST PHILA PA

SKIATRDN ELECTRONICS TV CORP  
180 VARICK ST NEW YORK 14 NY

SKIDMORE-WILHELM MFG CO  
442 GREEN RD CLEVELAND 21 OHIO

SKIL CORP  
5033 ELSTON AVE CHICAGO 30 ILL

SKINNER PREC INDUST INC POLYNOID DIV  
NEW BRITAIN CONN

SKOTTIE ELECTRONICS INC  
204 BRIDGE ST PECKVILLE PA

SKYDYNE INC  
RIVER RD PDRT JERVIS NY

SKYRDN CORPORATION  
106 20 ATLANTIC AVE OZONE PARK 16 N Y

SKYSWEeper INC  
PQ BOX 92 MCHENRY ILL

SKYTRON ELECTRONICS  
2032 SCOTT ST HOLLYWOOD FLA

SLATER ELECTRIC INC  
45 SEA CLIFF AVE GLEN COVE NY

SLAUGHTER CO  
YOUNG AND COLLEGE STS PIQUA 9 OHIO

SLIP RING CO OF AMERICA  
3622 W JEFFERSON BLVD LOS ANGELES 16 CAL

SLOAN CO THE  
7704 SAN FERNAND RD SUN VALLEY CAL

SLOCUMB CO J  
68 MATSON HILL RD S GLASTONBURY CONN

SMALL MOTORS INC  
2076 ELSTON AVE CHICAGO 14 ILL

SMALLWOOD LTD S G  
391-397 KING ST E KITCHENER ONTARIO CANADA

SMITH CORP A O  
531 N 4 ST TIPP CITY OHIO

A D SMITH CO  
ELKHORN WIS

SMITH ELECTRONIC INC  
8200 SNOWVILLE RD BRECKSVILLE OHIO

SMITH-FLORENCE INC  
OVERLAKE IND PARK BOX 717 REDMOND WASH

SMITH INC HERMAN H  
2326 NOSTRAND AVE BROOKLYN 10 NY

SMITH-MEEKER ENGG CO  
157 CHAMBERS ST NEW YORK 7 N Y

SMITH THERMOTRONICS INC  
FORREST HECTOR STS CONSHOHOCKEN PA

SNAP TITE INC  
201 TITUSVILLE RD UNION CITY PENNA

SNC MFG CO  
PD BOX 277 OSHKOSH WISC

SNYDER ELECTRONICS CORP  
212 E NORTH ST WAUKESHA WIS

SNYDER MFG CO  
22 & DNTARID STS PHILADELPHIA 4 PA

SODERBERG MFG CO  
628 S PALM AVE ALHAMBRA CALIF

SOHOT DIV DF THERMOLAB CORP  
69400 FARMDALE AVE N HOLLYWOOD CALIF

SOLA ELECT CO SOLA TRANSFORMER DIV  
BUSSE RD AT LUNT AVE ELK GROVE ILL

SOLAR MFG CORP  
4553 SEVILLE AVE LOS ANGELES 58 CALIF

THE SOLARTRON ELECTRONIC GROUP LTD  
VICTORIA ROAD FARNBOROUGH HANTS ENGLAND

SOLAR VOLT CO INC  
118 E SAMPLE SOUTH BEND IND

SOLID STATE CONTROL INC  
P D BOX 63 FLUSHING 52 N Y

SOLID STATE ELECTRONICS CO  
15321 RAYEN ST SEPULVEDA CALIF

SOLID STATE PRODUCTS INC  
1 PINGREE ST SALEM MASS

SOLITRON DEVICES INC  
500 LIVINGSTON ST NORWOOD N J

SOLVERE INC  
1902 W CHESTNUT ST SANTA ANA CALIF

SOMERS BRASS CO  
94 BALDWIN AVE WATERBURY CONN

SONAR RADIO CORP  
3050 W 21 ST BROOKLYN 24 NY

SONEX INC  
20 E HERMAN ST PHILA 44 PA

SONIC MEMORY CORP  
494 OAK ST COPLAQUE NY

SONOBOND CORP SUB OF AEROPROJECTS INC  
202 W MARKET WEST CHESTER PA

SONOTONE CORP  
PO BOX 200-SAW MILL RIVER RD ELMSFDRD NY

SONOTONE CORP  
COLO SPRING NY

SDNY CORP  
514 BROADWAY NEW YORK N Y

SORENSEN INDUSTRIAL ELECTRONIC CO  
RDUTE 10 DVVER NJ

SORENSEN-UNIT DF RAYTHEDN CD  
RICHARDS AVENUE SOUTH NORWALK CONN

SOROBAN ENGG INC  
PO BOX 1717 MELBDRNE FLA

SDSTMAN & CO HE  
PO BOX 60 CRANFORD NJ

SOUNDScriber CORP  
6 MIDDLETOWN AVE NEW HAVEN CONN

SOUTH BEND LATHE WORKS  
425 E MADISON ST SOUTH BEND 22 IND

SOUTHCO DIV SOUTH CHESTER CORP  
LESTER PA

SOUTHERN ELECTRONICS CORP  
150 W CYPRESS AVE BURBANK CALIF

SOUTHERN ELECTRONICS CO INC  
MOSHEIM TENN

SOUTHERN INSTRUMENTS COMPUTER DIV  
FRITLEY RD CAMBERLEY SURREY ENGLAND

SOUTHERN PLASTICS CO  
408 PENDELTON ST COLUMBIA SC

SOUTHERN SCREW CO  
PO BOX 1360 E I D STATESVILLE NC

SOUTHERN TOOL & MACH CO  
NEW BIRMINGHAM HWY ANNISTON ALA

SOUTHWESTERN INDUSTRIAL ELECT CO  
10201 W HEIMER RD HOUSTON TEXAS

SOUTHWIRE CO  
FERTILLA ST CARROLLTON GA

SOUTHWORTH MACH CO  
30 WARREN AVE PORTLAND MAINE

SPACE CONTROL CORP  
1416 W 166TH ST GARDENA CALIF

SPACE INSTRUMENTATION CORP  
907 PICO BLVD SANTA MONICA CALIF

SPACEONICS & PORTABLE ELECTRIC TOOLS INC  
1200 E STATE ST GENEVA ILL

SPACE SYSTEMS INC  
P O BOX 122 HICKSVILLE L I N Y

SPARTA MFG CO  
DOVER OHIO

SPARTON ELECTRONICS  
JACKSON MICH

SPASORS INC SUB SILICON TRANSISTOR  
1090 MORENA BLVD SAN DIEGO 10 CALIF

SPATCO MFG CO  
40-24 22ND ST L I N Y

SPAULDING FIBRE CO INC  
1325 SAN JULIAN ST LOS ANGELES 15 CALIF

SPAULDING FIBRE CO  
310 WHEELER ST TONAWANDA N Y

SPAULDING FIBRE CO  
N ROCHESTER NH

SPAULDING FIBRE CO INC  
MILTON N H

SPAULDING PRODUCTS CO  
550 W BARNER ST FRANKFORT IND

SPEC-HEATING INC  
13942 SATICOY ST VAN NUYS CALIF

SPEC-PLATING INC  
13871 SATICOY ST VAN NUYS CALIF

SPEC-SWITCH INC  
13901 SATICOY ST VAN NUYS CALIF

SPEC-TRONICS  
13901 SATICOY ST VAN NUYS CALIF

SPECIAL CHEMICALS CORP  
100 S WATER ST OSSINING N Y

SPECIAL INSTRUMENTS LABORATORY INC  
312 W VINE AVE KNOXVILLE 2 TENN

SPECIALTIES INC  
CHARLOTTESVILLE VA

SPECIALTY AUTOMATIC MACHINE CORP  
80 CAMBRIDGE ST BURLINGTON MASS

SPECIALTY ELECTRONICS DEVELOPMENT CORP  
131-03 39TH AVE FLUSHING NY

SPECIFIC PLATING CORP  
3002 DOWNEY RD LOS ANGELES CALIF

SPECIFIC PROD  
P D BOX 425 WOODLAND HILLS CALIF

SPEC TOOL CO  
9626 E BEVERLY RD PICO RIVERA CALIF

SPECTRA ELECT CORP  
250 E THIRD ST MT VERNON N Y

SPECTRA-STRIP WIRE & CABLE CORP  
10052 LARSON AVE GARDEN GROVE CALIF

SPECTRAL DYNAMICS CORP OF SAN DIEGO  
1162 MORENA BLVD SAN DIEGO 10 CALIF

SPECTRAN ELECTRONICS CORP  
146 MAIN ST MAYNARD MASS

SPECTRO MAGNETIC INDUST  
PD BOX 3306 HAYWARD CALIF

SPECTROLAB DIV TETRON ELECTRONICS INC  
SYLMAR CALIF

SPECTROL ELECTRONICS CORP  
AMES CT PLAINVIEW NY

SPECTRODL ELECTRONICS CORP  
1704 S DEL MAR AVE SAN GABRIEL CALIF

SPECTRUM INSTRUMENTS INC  
BOX 61 STEINWAY STA L I CITY 3 N Y

SPEER CARBON CO DIV AIR REDUCTION CO  
THERESIA ST ST MARYS PA

SPEER RESISTOR DIV SPEER CARBON CO  
BRADFORD PA

SPEIDEL CORP PRESSURE CONT GRP  
WARWICK RHODE ISLAND

SPELLMAN HIGH VOLTAGE CO INC  
1930 ADEE AVE NEW YORK 69 NY

SPENCE CORP ADAM  
964 FRELINGHUYSEN AVE NEWARK NJ

SPENCER-KENNEDY LABS INC  
1320 SOLDIERS FIELD RD BOSTON 35 MASS

SPERRY ELECTRONIC TUBE DIV SPERRY RAND CORP  
GAINESVILLE FLA

SPERRY FARRAGUT CD DIV SPERRY RAND CORP  
FARRAGUT RD BRISTDL TENN

SPERRY GYRSCOPE CO DIV SPERRY RAND CORP  
GREAT NECK NY

SPERRY ELECTRONIC TUBE DIV  
SPERRY RAND CORP  
GREAT NECK L I N Y

SPERRY MICROWAVE ELECT INC  
BOX 1828 CLEAWATER FLA

SPERRY PHENIX CO DV  
19TH & DEER VALLEY RD PHENIX ARIZ

SPERRY PIEDMONT CD DIV SPERRY RAND CORP  
CHARLOTTEVILLE VA

SPERRY PRODUCTS CO DIV HOWE SOUND CO  
SHELTER ROCK RD DANBURY CONN

SPERRY RAND REMINGTON RAND DIV  
311 TURNER ST UTICA N Y

SPERRY RNAD REMINGTON RAND DIV  
7 SPRUCE ST ILION N Y

SPERRY RAND CORP WRIGHT DIV  
PD BOX 2211 DURHAM ND CAR

SPERRY SEMICONDUCTOR DIV SPERRY RAND CORP  
NORWALK CONN

SPERRY UTAH CO DV SPERRY RAND CORP  
322 N 21ST WEST SALT LAKE CITY UTAH

SPERTI FARADAY INC  
1322 E CHURCH ST ADRIAN MICHIGAN

THE SPHERE CO INC  
25 AMITY ST LITTLE FALLS N J

SPICO ELECTRONICS INC  
HENRIETTA & DUFFY HICKSVILLE N Y

SPINCRRAFT INC  
4122 W STATE ST MILWAUKEE 8 WISC

SPIRLING PRODUCTS CO  
HENRIETTA ST & DUFFY AVE HICKSVILLE LI NY

SPIROTECH CORP  
160 MARINE ST FARMINGDALE LI NY

SPIVEY INC JAMES S  
4908 HAMPTON LANE WASHINGTON 14 DC

SPLIT BALLBEARING DIV INC  
LEBANON NEW HAMPSHIRE

SPRAGUE ELECTRIC CO  
NORTH ADAMS MASS

SPRINGER AIRCRAFT RADIO CORP  
IND IND

SPRUCE PINE MICA CO  
PO BOX 456 SPRUCE PINE N CAROLINA

SPS WESTERN  
5625 CENTURY BLVD LOS ANG CALIF

SQUARE D CO COMM CDNTROL DIV  
BIGHAM RD ASHEVILLE NO CAR

SQUARE D EC & M DIV  
4500 LEE RD CLEVELAND OHIO

S RIVER METAL PRODUCTS CO  
377 TURNPIKE S RIVER N J

ST CROIX PLASTICS CORP  
PRODUCTION DIV UNITED FAB & ELECT  
DRESSER WIS

ST JOE MACHINES INC  
ST JOSEPH MICH

ST JOHN X-RAY LABORATORY  
CALIFON NJ

ST MARYS CARBON CO  
STATE ST ST MARYS PA

STACKPOLE CARBON CO  
ST MARYS PA

STACKPOLE CARBON CO  
KANE PENNA

STACO INC STANDARD ELEC PRODS DIV  
2240 E 3RD ST DAYTON 3 OHIO

STAHLIN BROS INC  
500 MAPLE ST BELDING MICH

STAINLESS INC  
3 ST NORTH WALES PA

STA LIT LIGHTER CD ELECTRD LAB DIV  
647 NORTH ST DAYTON BEACH FLA

STANFORD METAL SPECIALTY CO  
427 W BRADWAY NEW YORK N Y

STANAT MFG CO  
523 SHAMES DR WESTBURY NY

STANCIL-HOFFMAN CORP  
845 N HIGHLAND AVE HOLLYWOOD 38 CALIF

STANCOR ELECTRONICS INC  
3501 W ADDISON ST CHICAGO 18 ILL

STANDARD AUTO CORP  
333 CEDAR ST WYANDOTTE MICH

STANDARD COIL PRODUCTS CO  
2085 N HAWTHORNE AVE MELROSE PARK ILL

STANDARD COMPONENTS CORP  
780 S 3RD AVE MOUNT VERNON N Y

STANDARD CONTROLS INC  
1130 POPLAR PLACE SEATTLE WASHINGTON

STANDARD ELECTRIC MFG CO  
HADDON AVE W BERLIN NJ

STANDARD ELECTRIC PRODUCTS  
2240 E THIRD ST DAYTON OHIO

STANDARD ELECTRIC TIME CO  
89 LDGAN ST SPRINGFIELD 2 MASS

STANDARD ELECTRONICS  
FARMINGDALE NJ

STANDARD GLOVE CO DF N J  
101 FRELINGHUYSEN AVE NEWARK NJ

STANDARD INSTRUMENT CORP  
657 BROADWAY NEW YORK 12 NY

STANDARD KILLSMAN  
BOX 618 DSHKOSH WISC

STANDARD KOLLSMAN INDUSTRIES INC TUMER DIV  
920 RATHBONE AURORA ILL

# ELECTRONIC MANUFACTURERS—A TO Z

STANDARD KOLLSMAN INDUSTRIES INC TUNER DIV  
MELROSE PARK ILL  
STANDARD LOCKNUT & LOCKWASHER INC  
2250 VALLEY AVE INDIANAPOLIS 18 IND  
STANDARD METALS CORP  
262 BROAD ST N ATTLEBORO MASS  
STANDARD PLASTICS CO INC  
62 WATER ST ATTLEBORO MASS  
STANDARD PRESSED STEEL CO  
BOX 899 JENKINTOWN PA  
THE STANDARD PRODUCTS CO  
FORT LAUDERDALE FLA  
STANDARD PRODUCT INC SUB ELECTR COMM INC  
WICHITA KANS  
STANDARD RECORD MFG CO  
70 N SAN GABRIEL BLVD PASADENA 8 CALIF  
STANDARD REGISTER CO  
626 ALBANY ST DAYTON 1 OHIO  
STANDARD TELEVISION & TUBE CORP  
3233 CONTI ST NEW ORLEANS 19 LA  
STANDARD T V TUBE CORP  
700 DRYADES ST NEW ORLEANS 12 LA  
STANDARD WINDING CO DIV OF OVI TRON CORP  
44-62 JOHNES ST NEWBURGH NY  
STANLEY TRANSFORMER CO  
31-23 VERNON BLVD LONG ISLAND CITY N Y  
STANPAT CO  
150 42 12TH RD WHITESTONE N Y  
STANWYCK WINDING CO  
137-151 WALSH AVE NEWBURGH N Y  
STAPLEX CO  
775 5 AVE BROOKLYN 32 NY  
STAR-A ELECTRIC MFG CO INC  
41 VARICK AVE BROOKLYN 37 NY  
STAR ENGRAVING & NAME PLATE CO  
3222 E OLYMPIC BLVD LOS ANG CALIF  
STARK TOOL CO  
BOX 288 ANN HARBOR MICH  
STAR PORCELAIN CO  
21 MUIRHEAD AVE TRENTON 9 NJ  
STAR-TRONICS INC  
MOULTON ST GERGETOWN MASS  
STATES CO  
19 NEW PARK AVE HARTFORD 6 CONN  
STATES ELECTRONICS CORP BLUDWORTH MARINE DIV  
96 GOLD ST NEW YORK 38 NEW YORK  
STATHAM INSTRUMENTS INC OF PUERTO RICO  
HATO REY IND SUBDIV  
HATO REY PUERTO RICO  
STATHAM INSTRUMENTS INC  
12401 W OLYMPIC BLVD LOS ANGELES 64 CALIF  
STATIKIL INC  
1220 W 6TH ST CLEVELAND OHIO  
STAVER CO  
41-51 N SAXON AVE BAY SHORE L I N Y  
STA WARM ELECTRIC CO  
222 CHESTNUT ST RAVENNA OHIO  
STEARNS MAGNETIC PRODUCTS  
635 S 28 ST MILWAUKEE 46 WISC  
STEINEN MFG CO WM  
43 BRUEN ST NEWARK 5 N J  
STELMA INC  
200 HENRY ST STAMFORD CONN  
STEPHENS ADAMSON MFG CO SEAL MASTER BEARING  
RIDGWAY AVE AURORA ILL  
STEPHENS TRU-SONIC INC  
8538 WARNER DR CULVER CITY CALIF  
STEPPER MOTOR DIV LAND AIR INC  
16226 BROADWAY GARDENA CALIF  
STERLING ELECT MOTORS INC  
4610 SMITH RD NORWOOD CINN OHIO  
STERLING ELECTRIC MOTORS INC  
5401 TELEGRAPH RD LOS ANGELES 22 CALIF  
STERLING MFG CO  
2880 DETROIT AVE CLEVELAND 13 OHIO  
STERLING INSTRUMENT DIV DESIGNATRONICS INC  
76 E 2ND ST MINEOLA N Y  
STERLING TRANSFORMER CORP  
510 DRIGGS AVE BROOKLYN NY  
STEVENS-EVANS INC  
3801 HICOCK ST SAN DIEGO 10 CALIF  
STEVENS MFG CO GEO  
6001 N KEYSTONE CHICAGO 46 ILL  
STEVENS MFG CO  
PO BOX 1007 ANNEX MANSFIELD OHIO  
STEVENS PAPER MILLS INC  
PO BOX 347 WINDSOR CONN  
STEVENS PAPER MILLS INC  
77 MILL ST WESTFIELD MASS  
STEVENS PRODUCTS INC  
86 MAIN ST E ORANGE N J  
STEWART MFG CO D M  
CHATTANOOGA TENN  
STEWART ENGG CO  
467 BEAN CREEK RD SANTA CRUZ CALIF  
STEWART & STEVENSON SERVICES INC  
4316 HARRISBURG BLVD HOUSTON 1 TEXAS  
STEWART TRANS LUX CORP  
1111 W SEPULVEDA BLVD TORRANCE CALIF  
STEWART WARNER ALEMITE & INST DIV  
1826 DIVERSEY PKWY CHICAGO ILL  
STEWART WARNER ELECT DIV STEWART-WARNER CORP  
1300 KOSTNER AVE CHICAGO ILL  
STODDART AIRCRAFT RADIO CO  
6644 SANTA MONICA BLVD HOLLYWOOD 36 CALIF  
STOELTING CO C H  
424 N HOMAN AVE CHICAGO 24 ILL  
STOKES CORP F J  
5500 TABOR RD PHILADELPHIA 20 PA  
STONE CITY-PRODUCTS CO  
1206 7 ST BEDFORD IND  
STONE PAPER TUBE CO DIV OF STONE STRAW CORP  
900 FRANKLIN ST NE WASHINGTON 17 OC  
STONE & SMITH INC  
5965 ALCOA AVE LOS ANGELES CALIF  
STONHARD CO INC  
401 N BROAD ST PHILADELPHIA 8 PA

STONITE COIL CORP  
RT 130 YARVOVILLE N J  
STRANDBERG ENGG LABS INC  
1001 S ELM ST GREENSBORO N CAROLINA  
STRAND LABS INC  
294 CENTRE ST NEWTON 58 MASS  
STRATOCON CORP  
BOX 10 MORRISTOWN NJ  
STRAT-O-SEAL MFG CO  
9039 W FULLERTON AVE CHICAGO 47 ILL  
STREETER AMET  
GRAYS LAKE ILL  
STROBLITE CO INC  
75 W 45 ST NEW YORK 36 NY  
STROMBERG DIV GENERAL TIME CORP  
135 S MAIN ST THOMASTON CONN

## FOR INFORMATION

ON PRODUCTS

SEE THE

"PRODUCTS AND MANUFACTURERS"

SECTION

STRONG ELECTRIC CORP  
87 CITY PARK AVE TOLEDO 1 OHIO  
STRUTHERS-DUNN INC  
LAMBS RD PITMAN NJ  
STUCKER & YALE INC  
GREEN ST MARBLEHEAD MASS  
STUDEBAKER HYDRAULIC PRODUCTS CO  
2511 ST CHARLES ROAD BELLWOOD ILLINOIS  
STUDIO TV PRODUCTS SALES  
356 W 40TH ST NEW 18 NY  
STUECK INC W WHITNEY  
BOX 335E1 OLD SAYBROOK CONN  
STURRUP INC  
50 SILVER ST MIDDLETOWN CONN  
STURTEVANT CO P A  
ADDISON ILL  
STYROFORMICS  
17 HAWKINS ST SOMERVILLE MASS  
SUBMINIATURE INST CORP  
3236 KANSAS AVE RIVERSIDE CALIF  
SUCKLE ELECTRONICS CO  
22 & HAYES AVE CAMDEN 5 N J  
SULLIVAN INDUSTRIES INC  
1050 W EVELYN ST SUNNYVALE CALIF  
SULLIVAN LTO H W  
70 STATE ST WESTBURY NY  
SULZER LABORATORIES INC  
621 LOFSTRAND LANE ROCKVILLE MD  
SUMMERS & MILLS INC  
1511 LEVEE ST DALLAS TEX  
SUMMIT COIL CO  
4 CLAREMONT RD BERNARDSVILLE NJ  
SUMMIT INDUSTRIES INC  
2104 W ROSECRANS AVE GARDENA CALIF  
SUNAIR DYNAMICS CORP  
4415 E TENTH LANE HIALEAH FLA  
SUNAIR ELECT INC  
3101 S W 3RD AVE FT LAUDERDALE FLA  
SUNBANK ELECTRONICS INC  
2516 N ONTARIO ST BURBANK CALIF  
SUN CHEMICAL CORP ELECTRO TECH PROD DIV  
113 E CENTRE ST NUTLEY 10 N J  
SUNCOAST INSTRUMENTS DIV MILTON ROY CO  
6301 49TH ST ST PETERSBURG FLA  
SUNOSTRAND CORP  
2531 11 ST ROCKFORD ILL  
SUNDSTRAND DENVER  
2480 W 70TH AVE DENVER COLO  
SUN ELECTRIC CORP  
HARLEM & AVONDALE AVE CHICAGO ILL  
SUN ENG INC OF ST PETERSBURG  
2399 26 AVE ST PETERSBURG FLA  
SNYVL DEV CTR SPRY PHOENIX CO SPRY RAND CORP  
294 COMMERCIAL ST SUNNYVALE CALIF  
SUNSHINE SCIENTIFIC INSTRUMENT  
1810 GRANT AVE PHILADELPHIA 15 PENNA  
SUPA INSULATIDNS INC  
RTE 301 A NORTH ROCKY MOUNT NC  
SUPEREX ELECTRONICS CORP  
4-6-RADFORD PL YONKERS NY  
SUPERIOR CABLE CORP  
P O BOX 489 HICKORY NO CAR  
SUPERIOR ELECTRIC CO  
383 MIDDLE ST BRISTOL CONN  
SUPERIOR ELECTRONICS CORP  
208 PIAGET AVE CLIFTON N J  
SUPERIOR ELECT CO  
1011 S FIFTH ST MINN MINN  
SUPERIOR FLUX & MFG CO  
1536 ST CLAIR AVE CLEVELAND OHIO  
SUPERIOR INSULATED WIRE CO  
WASHBURNS LANE STONY POINT N Y  
SUPERIOR RESISTOR & ELECTRONICS CORP  
333 W SUPERIOR PL BOX 274 FRANKFORT IND  
SUPERIOR SPINNING & STAMPING CO  
4057 63 FITCH RD TOLEDO 13 OHIO  
SUPERIOR STEATITE & CERAMIC CORP  
83 91 W FOREST ST ENGLEWOOD NJ  
SUPERIOR TUBE CO  
BOX 191 MORRISTOWN PA  
SUPERIOR TUBE CO  
WAPAKONETA OHIO  
SUPREME ELECTRO-MAGNETIC CO DIV OXFORD ELEC  
2331 N WASHTENAW AVE CHICAGO 47 ILL  
SUPREME ELECTRONICS CORP  
1714 CARROLLTON AVE GREENWOOD MISS  
SUPREME TRANSFORMER CORP  
PO BOX 237 HERRIN ILL

OXFORD ELECTRIC CORP DIV SUPREME TRANSFORMER  
4308 W ARMITAGE CHICAGO ILL  
SURFACE COMBUSTION CORP  
2375 DORR ST TOLEDO OHIO  
SURFACE CONDUCTION INC  
PARAMOUNT BLDG 1501 BROADWAY NEW YORK N  
SURPRENANTMFG CO  
172 STERLING ST CLINTON MASS  
SWAN ENGINEERING CO  
417 VIA DEL MONTE OCEANSIDE CALIF  
SWEDLOW PLASTICS CO  
394 N MERIDIAN RD YOUNGSTOWN OHIO  
SWEENEY MFG CO B K  
6300 E 44TH AVE DENVER 16 COLO  
SWEET MFG CO  
84 DUNHAM ST ATTLEBORO MASS  
SWIFT LUBRICATOR CO INC  
780 LAKE ST ELMIRA NY  
SWIFT TEXTILE METALLIZING & LAMINATING CORP  
10 LOVE LANE HARTFORD 1 CONN  
SWING O LITE INC  
15 MOONACHIE RD HACKENSACK N J  
SWITCHCRAFT INC  
5555 N ELSTON AVENUE CHICAGO ILL  
FULLERTON CALIF  
SYLVANIA ELECT PRODS MICROWAVE DEVICE DIV  
BOX 997 MOUNTAIN VIEW CALIF  
SYLVANIA ELECTRIC PRODUCTS INC  
MICROWAVE DEVICE DIVISION  
EAST 3RD ST WILLIAMSPORT PENNSYLVANIA  
SYLVANIA ELECTRONIC SYSTEMS  
PO BOX 941 SANTA CRUZ CALIF  
SYLVANIA ELECTRIC PRODUCTS  
ESTES ST IPSWICH MASS  
SYLVANIA ELECTRIC PRODS INC  
DATA SYSTEMS OPERATIONS  
189 B ST NEEDHAM MASS  
SYLVANIA ELECTRIC PRODUCTS  
60 BOSTON ST SALEM MASS  
SYLVANIA ELECTRIC PRODS INC WALTHAM LABS  
100 FIRST AVE WALTHAM MASS  
SYLVANIA ELECTRIC PRODS SEMICONDUCTOR DIV  
WOBBURN MASS  
SYLVANIA ELECTRIC PRODS INC  
BUFFALO OPER ELECTR SYSTEMS  
175 GREAT ARROW BUFFALO NY  
SYLVANIA ELECTRIC PRODUCTS INC  
SENECA FALLS N Y  
SYLVANIA ELECTRIC PRODUCTS INC  
EMPORIUM PENNA  
SYLVANIA ELECTRIC PRODS INC  
COMPUTER PROD PLANT  
PO BOX 360 MUNCY PA  
SYLVANIA ELECTRIC PRODUCTS INC  
CHEM & METALLURGI CL DIV  
TOWANDA PA  
SYLVANIA ELECTRIC PROD INC PARTS DIV  
12 2ND AVE WARREN PA  
SYNCRON PRODUCTS CO  
30 EASTERN AVE BOX 51 MALDEN 48 MASS  
SYNCRON CORP ELECT DIV  
MEUSSE ARGONNE AVE HICKSVILLE OHIO  
SYNTHANE CORP  
MONTGOMERY AVE OAKS PA  
SYNTRON CO  
263 LEXINGTON AVE HOMER CITY PA  
SYNTRONIC INSTRUMENTS INC  
100 INDUSTRIAL RD ADDISON ILL  
SYSTEMATICS OF MO INC  
2222 OLIVE ST ST LOUIS MO  
SYSTEMS DEVELOPMENT INC  
307 WATER ST BINGHAMTON NY  
SYSTEMS ENGRG LABORATORIES INC  
PO BOX 9148 FT LAUDERDALE FLA  
SYSTEMS INC  
2400 DIVERSIFIED WAY ORLANDO FLA  
SYSTEMS MATRIX INC  
2219 NOTTINGHAM WAY BOX 3020 TRENTON N J  
SYSTRON DONNER CORP  
CONCORD CALIF

## T

TABER INSTRUMENT CORP  
107 GOUNDRY ST NORTH TONAWANDA N Y  
TABET MFG CO  
1336 BALLENTINE BLVD NORFOLK 12 VA  
TAFFE ELECTRONICS INC  
27-05 BROOKLYN-QUEENS EXP W WOODSIDE 77 NY  
TAFT PEIRCE MFG CO  
32 MECHANIC AVE WOONSOCKET RI  
TABER INSTRUMENT CORP  
AEROSPACE ELECTRONICS DIV  
107 GOUNDRY ST NORTH TONAWANDA N Y  
TAKK CORP  
P O BOX 346 NEWARK OHIO  
TALK-A-PHONE CO  
5013 NORTH KEDZIE CHICAGO ILL  
TALKING DEVICES CO  
4447 IRVING PARK RD CHICAGO 41 ILL  
TALKMASTER INC  
534 LAUREL ST SAN CARLOS CALIF  
TALLER & COOPER INC  
75 FRONT ST BROOKLYN 1 N Y  
TALLEY CORP THE  
NEWBURY PARK CALIF



## ELECTRONIC MANUFACTURERS—A TO Z

- TALLY REGISTER CORP  
1310 MERCER SEATTLE 9 WASH
- TA MFG CORP  
4607 ALGER ST LOS ANGELES 39 CALIF
- TAMAR ELECTRONICS INC  
2045 ROSECRANS AVE GARDENA AVE  
TANDBERG OF AMERICA INC  
8 THIRD AVE PELHAM N Y
- TANN CONTROLS CO DIV TANN CORP  
DETROIT 34 MICH
- TANSITOR ELECTRONICS INC  
WEST RD BENNINGTON VT
- TAP A LINE MFG CO  
71 S W 5TH ST POMPAND BEACH FLA
- TAPCO GROUP THOMPSON RAMO WOOLDRIDGE INC  
23555 EUCLID AVE CLEVELAND 17 OHIO
- TAPE ATON  
523 S HINDRY INGLEWOOD CALIF
- TAPE CABLE CORP  
790 LINDEN AVE ROCHESTER 10 N Y
- TAPECOE  
142 N HAWTHORNE AVE LANGHORNE PENNA
- TARC ELECTRONICS INC  
48 URBAN AVE WESTBURY L I N Y
- TAURUS CORP  
ACADEMY HILL LAMBERTVILLE NJ
- TAYLOR EMMETT CONTROLS INC  
449 E TURKEY FOOT LAKE RD AKRON OHIO
- TAYLOR FIBRE CO  
BOX 471 NORRISTOWN PA
- TAYLOR INSTRUMENT CO INC  
557 E TALLMADGE AVE AKRON 10 OHIO
- TAYLOR INSTRUMENTS COMPANIES  
95 AMES ST ROCHESTER 1 N Y
- TAYLOR WINFIELD CORP  
1052 MAHONING AVE N W WARREN OHIO
- TEALE MACHINE CO INC  
1425 UNIVERSITY AVE ROCHESTER 7 NY
- TE CO THE  
415 E MONTECITO ST SANTA BARBARA CALIF
- TECH ART PLASTICS CO  
111 RIDGEDALE AVE MORRISTOWN NJ
- TECH-MASTER CORP  
75 FRONT ST BROOKLYN 1 N Y
- TECHNIBILT CORP  
905 AIRWAY GLENDALE CALIF
- TECHNICAL APPARATUS BUILDERS  
109 LIBERTY ST NEW YORK 6 N Y
- TECHNICAL APPLIANCE CORP  
SHERBURNE NY
- TECHNICAL ASSOCIATES  
140 W PROVIDENCIA AVE BURBANK CALIF
- TECHNICAL ASSOCIATES OF NEW ORLEANS INC  
511 S CARROLLTON AVE NEW ORLEANS LA
- TECHNICAL CERAMICS & LAVA CORP  
85 5TH AVE PATERSON NJ
- TECHNICAL DEVELOPMENT CO  
303 S CHESTER PK GLENOLDEN PA
- TECHNICAL DEVICES CO  
11242 PLAYA COURT CULVER CITY CALIF
- TECHNICAL DYNAMICS DIV JAMIESON IND INC  
P O BOX 4098 SANTA BARBARA CALIF
- TECHNICAL LABS  
BERGEN & EDSALL BLVD PALISADES PK N J
- TECHNICAL MEASUREMENT CORP  
411 WASHINGTON AVE NORTH HAVEN CONN
- TECHNICAL OIL TOOL CORP  
1057 N LA BREA LOS ANGELES 38 CALIF
- TECHNICAL PRODUCTS CD INSTRUMENT DIV  
6670 LEXINGTON AVE LOS ANGELES 38 CALIF
- TECHNICAL SERVICE CORP  
917-19 S THIRD LOUISVILLE 3 KY
- TECHNICAL WIRE PRODUCTS INC  
129 DERMODY ST CRANFORD NJ
- TECHNI CAST CORP  
11455 CHECK AVE LYNNWOOD CALIF
- TECHNIC INC  
88 SPECTACLE ST CRANSTON R I
- TECHNICRAFT CO  
1156 COMMONWEALTH AVE BOSTON 34 MASS
- TECHNICRAFTDIV  
THDMASTON CONN
- TECHNIQUE ASSOCIATES  
1413 N CORNELL AVE INDIANAPOLIS 2 IND
- TECHNIQUES INC  
40 JAY STREET ENGLEWOOD N J
- TECHNI RITE ELECTRONICS INC  
65 CENTERVILLE RD WARWICK R I
- TECHNIT SALES CO  
48 BROWN AVE SPRINGFIELD N J
- TECHNITROL ENG CO  
1952 E ALLEGHENY AVE PHILADELPHIA 34 PA
- TECHNO COMPONENTS CORP  
18232 PARTHENIA ST NORTHRIDGE CALIF
- TECHNOGRAPH PRINTED ELECTRONICS INC  
920 NORTHWEST BLVD WINSTON-SALEM N C
- TECHNOLOGY INC  
3090 RICHFIELD CTR DAYTON 30 OHIO
- TECHNOLOGY INSTRUMENT CORP  
ACTON MASS
- TECH-OHM ELECTRONICS INC  
36-11 33 ST LONG ISLAND CITY 6 N Y
- TECH PANEL CO INC  
PO BOX 293 37 MILFORD STREET BINGHAMTON NY
- TECHRON CORP  
20 SIMMONS ST BOSTON 20 MASS
- TECH SERV INC  
5451 HOLLAND DR BELTSVILLE MD
- TECT INC  
LIVINGSTON & PEGASUS ST NORTHVALE N J
- TECHTROMATIC  
N WALPOLE NEW HAMPSHIRE
- TEG MFG CORP  
11415 JOHNSON DR SHAWNEE KANSAS
- TEKTRONIX INC  
PO BOX 500 BEAVERTON OREGON
- TELAUTOGRAPH CORP  
8700 BELLANCA AVE LDS ANGELES 45 CALIF
- TELCO ELECTRONICS MFG COMPANY  
400 S WYMAN ST ROCKFORD ILL
- TELCOM METALS TELCON WORKS  
MANOR ROYAL CRAWLEY SUSSEX ENGLAND
- TELE-COIL CO INC  
2733 SAUNDERS ST CAMDEN 5 NJ
- TELE COMMUNICATIONS CORP  
50 DRUMM ST SAN FRAN CALIF
- TELECHROME MFG CORP  
28 RANICK DR AMITYVILLE LI NY
- TELECOMPUTING CORP ELECTR SYS & DATA INST DV  
12838 SATICOY ST N HOLLYWOOD CALIF
- TELECOMPUTING CORP POWER SOURCES DIV  
3850 OLIVE STREET DENVER 7 COLO
- TELECOMPUTING SERVICES INC  
8949 RESEDA BLVD NORTHRIDGE CALIF
- TELECONTROL CORPORATION  
20 DILLER AVE NEWTON N J
- TELECYTO INDUSTRIES CORP  
35-18 37 ST LONG ISLAND CITY 1 N Y
- TELECYTRON CO  
4050 SW 14TH AVE FT LAUDERDALE FLA
- TELECTROSONIC CORP  
3516 37TH ST LONG ISLAND CITY N Y
- TELE-DYNAMICS DIV AMER BOSCH ARMA CORP  
5000 PARKSIDE AVE PHILA 31 PA
- TELEDYNE PRECISION INC  
3155 WEST EL SEGUNDO HAWTHORNE CALIF
- TELEGRAPH CONDENSER CO  
N ACTON LONDON W 3 ENGLAND
- TELEGRAPH CONSTRUCTION & MAINTENANCE CO LTD  
MERCURY HOUSE THEOBALDS RD LONDON WC 1 ENG
- TELE MEASUREMENTS INC  
72 N MITCHELL AVE LIVINGSTON N J
- TELEMET CO  
185 DIXON AVE AMITYVILLE N Y
- TELEMETER MAGNETICS INC  
9937 JEFFERSON BLVD CULVER CITY CALIF
- TELEMETRICS INC  
12927 S BUDLONG AVE GARDENA CALIF
- TELEPHONICS CORP  
770 PARK AVE HUNTINGTON L I N Y
- TELEPROMPTER CO  
300 W 43RD ST NEW YORK N Y
- TELERAD DIV OF THE LIONEL CORP  
1440 BROADWAY NEW YORK 18 NY
- TELERAD MFG CORP  
FLEMINGTON N J
- TELE-SIGNAL CORP  
198 MILLER PLACE HICKSVILLE LI N Y
- TELETEST INSTRUMENT CORP  
136-10 31 RD FLUSHING 34 N Y
- TELE-TONE CO OF AMERICA  
1668 WEBSTER AVE NEW YORK 37 NY
- TELETRAY ELECT SYSTEMS INC  
5462 3RD ST N E WASH D C
- TELETRONICS CORP  
12786 WESTERN AVE GARDEN GROVE CALIF
- TELETRONIX ENG CO  
4688 EAGLE ROCK BLVD LOS ANGELES CALIF
- TELETYPE CORP  
5555 W TOUHY AVE SKOKIE ILL
- TELETYPE CORP  
4400 W 65TH ST LITTLE ROCK ARK
- TELEVISIONLABS INC  
333 MILL STREET WAUCONDA ILL
- TELEVISION SPECIALTY CO DIV F M E  
1055 STEWART AVE GARDEN CITY LI NY
- TELEVISION UTILITIES CORP DIV NORD  
300 DENTON AVE NEW HYOLE PARK L I N Y
- TELEWAVE LABS INC DIV POLARAD ELECT  
43 20 34TH ST LONG ISLAND CITY N Y
- TELEX/BALLASTRA  
1701 N CALHOUN ST FT WAYNE 7 IND
- TELEX/AEMCO DIV OF TELEX INC  
10 STATE ST MANKATO MINN
- TELEX INC  
1633 EUSTIS ST ST PAUL MINN
- TELEX INC COMM ACCT DIV  
1633 EUSTIS AVE ST PAUL MINN
- TEL-INSTRUMENT ELECTRONICS CORP  
728 GARDEN ST CARLSTADT N J
- TELKOR INC  
BOX 186 ELYRIA OHIO
- TEL-LABS INC  
1050 2 ST MANCHESTER N H
- TELONIC ENGINEERING CORP  
773 BROADWAY LAGUNA BEACH CALIF
- TELONIC INDUSTRIES INC  
60 N FIRST AVE BEECH GROVE IND
- TELOSTAT CORP  
1003 FIRST ST HOPKINS MINN
- TEMESCAL METALLURGICAL CORP  
2850 7TH ST BERKELEY CALIF
- TEMPCO TV PROD CO  
21341 ROSCOE BLVD CANOGA PK CALIF
- TEMPEL STEEL CO  
1939 BRYN MAWR AVE CHICAGO 26 ILL
- TEMPERATURE ENGG CORP  
1600 UNION LANDING ROAD RIVERTON N J
- TEMPIL CORP  
132 W 22 ST NEW YORK 11 N Y
- TEMPLET INDUSTRIES INC  
701 ATKINS AVE BROOKLYN N Y
- TEMPO INSTRUMENT INC  
BETHPAGE RD PLAINVIEW NY
- TEMPRESS RESEARCH INC  
566 SAN XAVIER AVE SUNNYVALE CALIF
- TENATRONICS LTD  
1011 POWER AVE CLEVELAND 14 OHIO
- TEN BOSCH INC M  
PLEASANTVILLE NY
- TENNALAB  
417 S 10 ST QUINCY ILL
- TENNA MFG CO  
7580 GARFIELD BLVD CLEVELAND 25 OHIO
- TENNEY ENGG INC  
1090 SPRINGFIELD RD UNIDN N J
- TENSITRON INC  
PIN HILL HARVARD MASS
- TENSOLITE INSULATED WIRE CO INC  
198 W MAIN ST TARRYTOWN N Y
- TENSOR ELECT DEVELOP CO  
1873 EASTERN PKWY BROOKLYN 33 NY
- TEPRO ELECTRIC CORP  
5 ST PAUL ST ROCHESTER 4 NY
- TEPRO OF FLORIDA INC  
375 PATRICIA AVENUE DUNEDIN FLORIDA
- TERADO CO  
1068 RAYMOND AVE ST PAUL MINN
- TERADYNE INC  
87 SUMMER ST BOSTON 10 MASS
- TERRY CO GEORGE A  
356 S ELMWOOD AVE BUFFALO 1 NY
- TEST EQUIPMENT CORP  
3009 S POST OAK RD HOUSTON 27 TEXAS
- TESTING MACHINES INC  
73 JERICHO TNPKE MINEOLA L I N Y
- TEVCO INSULATED WIRE  
108 E PROSPECT AVE BURBANK CALIF
- TEXAS CAPACITOR CO DIV K-C-K CORP  
4310 LANGLEY RD HOUSTON 16 TEXAS
- TEXAS CRYSTALS  
1000 CRYSTAL DR FORT MYERS FLA
- TEXAS ENST INC SEMICONDUCTOR COM DIV  
DALLAS TEXAS
- TEXAS INSTRUMENTS INC APPARATUS DIV  
BOX 6015 6000 LEMMON AVE DALLAS 22 TEX
- TEXAS INSTRUMENT SEMICON-COMPONENTS DIV  
135000 CENTRAL EXPRESSWAY DALLAS TEX
- TEXAS INSTRUMENTS INC APPARATUS DIV  
P O BOX 66027 HOUSTON 6 TEXAS
- TEXSTAR PLASTICS DIV TEXSTAR CORP  
1400 HENOERSON ST BOX 1440 FT WORTH 2 TEX
- TEXTRAN CORP  
PO BOX 9207 AUSTIN 17 TEXAS
- TEXTRON ELECTG GENERAL CEMENT CO  
400 S WYMAN ST ROCKFORD ILL
- TEXTRONIX ENG CO  
4688 EAGLE ROCK BLVD LOS ANG CALIF
- THERMADOR ELECTRICAL MFG CO  
715 S RAYMOND AVE ALAHMBA CALIF
- THERMAL AMERICAN FUSED QUARTZ CO  
202 & CHANGE BRIDGE RD MONTVILLE NJ
- THERMAL DYNAMICS CORP  
LEBANON NH
- THERMALLOY CO  
414 EXPOSITION DALLAS 5 TEXAS
- THERMAL WIRE OF AMERICA  
KEELERS BAY SOUTH HERO VT
- THERMATICS INC  
ELM CITY NO CAR
- THERMATRON DIV WILCOX & GIBBS  
214 W 39TH ST NEW YORK N Y
- THERMAX WIRE CORP  
304 E 45TH ST NEW YORK 17 N Y
- THERMOCAL DIV OF JAMIESON LABORATORIES  
7900 HASKELL AVE VAN NUYS CALIFORNIA
- THERM-O-DISC INC  
MAIN ST RD MANSFIELD OHIO
- THERMO ELECTRIC CO  
109 S ST SADDLE BROOK N J
- THERMOLYNE CORP  
2555 KERPER BLVD DUBUQUE IOWA
- THERMONETICS INC  
7246 ETON AVENUE CANOGA PARK CALIF
- THERMOSEN INC  
375 FAIRFIELD AVE STAMFORD CONN
- THETA INSTRUMENT CORP  
520 VICTOR STREET SADDLE BROOK NJ
- THIKOL CHEMICAL CORP NATL ELECTRONICS DIV  
1713 KALARAMA RD NW WASHINGTON 9 DC
- THOMAS & BETTS CO INC  
36 BUTLER ST ELIZABETH 1 N J
- THOMAS ELECTRONICS INC  
118 9TH ST PASSAIC N J
- THOMAS INDUSTRIES INC  
700 OAK ST FORT ATKINSON WIS
- THOMAS INSTRUMENT CO  
BOX 41 OSWEGO RD PHOENIX N Y
- THOMAS MOLD & DIE CO  
249 W HENRY ST WOOSTER OHIO
- THOMAS & SKINNER INC  
1120 E 23 ST INDIANAPOLIS 7 IND
- THOMPSON LIGHTNING PROTECTION INC  
616 41ST AVE MINN 12 MINN
- THOMPSON MACHINE & TOOL CORP  
PO BOX 12289 ST PETERSBURG FLA
- THOR CERAMICS INC  
225 BELLEVILLE AVE BLOOMFIELD N J
- THORSEN CORP L S  
BOX 60 ELLSWORTH MAINE
- THWING ALBERT INSTRUMENT CO  
5351 PULASKI AVE PHILA 44 PA
- TIBBETTS INDUSTRIES INC  
COLCORD AVE CAMDEN ME
- TICKLE ENGG WORKS ARTHUR  
21 DELAVAN ST BROOKLYN 31 N Y
- TIMBER-TOP INC  
38 BROOKLYN AVE FREEPORT 6 NY
- TIME & FREQUENCY  
127 S BATAVIA AVE BATAVIA ILL
- TIMES WIRE & CABLE DIV THE INTL SILVER CO  
358 HALL AVE WALLINGFORD CONN
- TINNERMAN PRODUCTS INC  
DEPT 16 P O BOX 6688 CLEVELAND 1 OHIO
- TIPPTRONIC INC  
P O BOX 306 CHARGIN FALLS OHIO
- TI TAL INC  
2001 MAIN ST SANTA MONICA CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

TITAN METAL MFG CO DIV CERRO DE PASCO CORP  
BELLEFONTE PA  
TITANIUM ALLOY MFG DIV NATL LEAD CO  
HYDE PARK BLVD NIAGARA FALLS N Y  
TITCHENER CO E H  
67 CLINTON ST BINGHAMTON NY  
TITELFLEX INC  
HENDEE ST SPRINGFIELD MASS  
TKM ELECTRIC CORP  
820 LINDEN AVE ROCHESTER 25 N Y  
TODD ELECTRIC CO INC  
20 HARRISON AVE YONKERS NY  
TOLEDO COMMUTATOR CO  
1101 S CHESTNUT ST OWASSO MICH  
TOLEDO SCALE DIV TOLEDO SCALE CORP  
1027 TELEGRAPH RD TOLEDO 12 OHIO  
TOMORROW INC  
7 W JACKSON HAYWARD CALIF  
TOPATRON INC  
11601 ANABEL AVE GARDEN GROVE CALIF  
TOPAZ TRANSFORMER PRODUCTS INC  
3802 HOUSTON SAN DIEGO 10 CALIF  
TOPPER MFG CO INC  
1100 SHAMES DRIVE WESTBURY LI NY  
TOPPING ELECTRONICS LTD F V  
94 LAIRD AVE TORONTO 17 ONTARIO CANADA  
TORK TIME CONTROLS INC  
1 GROVE ST MT VERNON NY  
TOR MANUFACTURING CO  
1533 E WALNUT ST PASADENA CAL  
TORNGREN CO C W  
236 PEARL ST SOMERVILLE 45 MASS  
TOROIDS UNLIMITED  
3830 TERRACE ST PHILA PA  
TOROTEL INC  
5512 E 110 ST KANSAS CITY 34 MO  
TOROTRON CORP  
256 E 3RD ST MOUNT VERNON N Y  
TORO ENGINEERED PRODUCTS INC  
32 W MONROE BEDFORD OHIO  
TORQUE CONTROLS INC  
825 E BROADWAY SAN GABRIEL CALIF  
TORRES ENGG CO INC  
5 CAROLINE ST S HACKENSACK NJ  
TORRINGTON CO THE SPECIALTIES DIV  
59 FIELD ST TORRINGTON CONN  
TORRINGTON MFG CO SPECIALTY BLOWER DIV  
100 FRANKLIN DR TORRINGTON CONN  
TORSION BALANCE CO  
35 MONHEGAN ST CLIFTON N J  
TORWICO ELECTRONICS INC  
ROUTE 70 LAKEWOOD NJ  
TOUCH-PLATE MFG CORP  
PO BOX 1970 LONG BEACH 1 CALIF  
TOWACO ELECTRONICS  
PINE BROOK RD TOWACO NJ  
TOWER COMMUNICATIONS CO  
2700 HAWKEYE DRIVE SIOUX CITY IOWA  
TOWER CONSTRUCTION CO  
2700 HAWKEYE DR SIOUX CITY 2 IOWA  
TOWNSEND CO  
PO BOX 71 ELLWOOD CITY PA  
TOWNSEND CO CHERRY RIVET DIV  
1224 E DELHI RD SANTA ANA CALIF  
TRACERLAB INC  
2030 WRIGHT AVE RICHMOND CALIF  
TRACERLAB INC  
1601 TRAPELO RD WALTHAM 54 MASS  
TRA-CON RESIN SYSTEMS DIV  
25 SHIP AVE MEDFORD 55 MASS  
TRADE WINDS MFG CO  
5718 N 25 AVE OMAHA NEBR  
TRAK ELECTRONICS COMPANY INC  
59 DANBURY ROAD ROUTE 7 WILTON CONN  
TRAK MICROWAVE CORP  
5006 N COOLIDGE AVE TAMPA FLA  
TRANCOA CHEMICAL CORP  
312-326 ASH ST READING MASS  
TRANE CO  
CAMERON & 2 ST LA CROSSE WISC  
TRANSCON MFG CO  
8410 CRAIGHILL DALLAS 9 TEX  
TRANSCO PRODUCTS INC  
12210 NEBRASKA AVE LOS ANGELES 25 CALIF  
TRANSCRIBER CO  
98 COUNTY ST ATTLEBORO MASS  
TRANSDATA INC  
1000 N JOHNSON AVE EL CAJON CALIF  
TRANSELECTRIC MFG CO  
PO BOX 97 OXFORD PA  
TRANS ELECTRONICS DIV BURTON MFG CO  
8910 WINNETKA AVE NORTHRIDGE CALIF  
TRANSFORMER & ELECTRONIC SPECIALTIES  
3824 28 TERRACE ST PHILA 28 PA  
TRANSFORMER DESIGN INC OF MILWAUKEE  
7377 N 76TH ST MILWAUKEE 18 WISC  
TRANSFORMER ELECTRONICS CO  
BOULDER IND PARK BOULDER COLO  
TRANSFORMER ENGINEERS  
1039 E VALLEY BLVD SAN GABRIEL CALIF  
TRANSFORMER TECHNICIANS INC  
2608NN CICERO AVE CHICAGO 39 ILL  
TRANSFORMERS MFG INC  
NORRIDGE ILL  
TRANSFORMERS INC  
200 STAGE RD VESTAL NY  
TRANSICOIL CORP  
CHURCH RD WORCESTER PA  
TRANSISTOR AUTOMATION CORP  
101 ERIE ST CAMBRIDGE MASS  
TRANSISTOR DEVICES INC  
40 FACTORY ST CEDAR GROVE NJ  
TRANSISTOR ELECTRONICS CO  
3357 REPUBLIC AVE MINNEAPOLIS 26 MINN  
TRANSITEL INTERNATIONAL CORP  
615 WINTERS AVE PARAMUS N J

TRANSITRON ELECTRONIC CORP  
WAKEFIELD MASS  
TRANSLINE ELECT COMMUNICATIONS CO  
503 MCCARTER HWY NEWARK N J  
TRANS-LUX CORP  
W SEPULVEDA BLVD TORRANCE CAL  
TRANSMAGNETICS INC  
40 66 LAWRENCE ST FLUSHING 34 N Y  
TRANSMASK  
1541 W OLYMPIC BLVD LOS ANGELES 15 CALIF  
TRANS METRICS INC  
P O BOX 2014 NEWPORT BCH CALIF  
TRANS-SIL CORP  
55 HONECK ST ENGLEWOOD NJ  
TRANSONIC INC  
808 16 ST BAKERSFIELD CALIF  
TRANSONIC INC  
700 16TH ST BAKERSFIELD CALIF  
TRAN SONICS  
MIDDLESEX TURNPIKE BURLINGTON MASS  
TRANS-TECH INC  
PO BOX 457 GAITHERSBURG MD  
TRANVISION INC  
460 NORTH AVE NEW ROCHELLE NY  
TRELCON ENGINEERING CO  
P O BOX 6209 BALTIMORE 6 MD  
TRFENT INC  
211 LEVERINGTON AVE PHILA PA  
TRENTON TRANSFORMER CORP  
P O BOX 568 822 E STATE ST TRENTON N J  
TREPAC CORP OF AMERICA  
30 W HAMILTON AVE ENGLEWOOD N J  
TRESKO INC  
3824 TERRACE ST PHILADELPHIA 28 PA  
TRG INC  
2 AERIAL WAY SYOSSETT LI N Y  
TRG INCORPORATED  
400 BORDER ST EAST BOSTON 28 MASS  
TRIAD TRANSFORMER CORP  
4055 REDWOOD AVE VENICE CALIF  
TRI ACRE ELECTRONICS  
EAST PINE ST PLAISTOW N H  
TRIANGLE MACHIN  
7700 MARBLE AVE CLEVELAND OHIO  
TRICON MFG CO  
8008 WALLACE ST CHICAGO 20 ILL  
TRICONIX INC  
BEAR HILL WALTHAM MASS  
TRICRAFT PRODUCTS CORP  
1124 W NEWPORT AVE CHICAGO 22 ILL  
TRI-DEX ELECTRONICS  
P O BOX 1207 LINDSAY CALIF  
TRI-EX TOWER CORP  
127 E INYO ST TULARE CALIF  
TRI-KRIS CO  
WALNUT & HATFIELD STS LANSDALE PA  
TRILSCH INC JOHN D  
P O BOX 14201 HOUSTON 21 TEXAS  
TRIMETAL WORKS INC  
1600 BANNARD ST RIVERTON NJ  
TRIMOUNT INSTRUMENT DIV GENERAL CONTROLS CO  
8080 MCCORMICK BLVD SKOKIE ILLINOIS  
TRIMM INC  
400 W LAKE ST LIBERTYVILLE ILL  
TRIMOUNT PLASTIC CO  
INDUSTRIAL PARK NEW BEDFORD MASS  
TRINDL PRODUCTS LTD  
1807-11 S CLARK ST CHICAGO 16 ILL  
TRINITY EQUIPMENT CORP  
CORTLAND NY  
TRIO LABS INC  
PLAINVIEW LI NY  
TRIO MFG CO  
GRIGGSVILLE ILL  
TRION INC  
1000 ISLAND AVE MCKEES ROCKS PA  
TRIONICS CORP  
4600 W BELTLINE HWY MADISON WIS  
TRIPLETT ELECTRICAL INSTRUMENT CORP  
202 VIA DEL MONTE OCEANSIDE CALIF  
TRIPLETT ELECTRICAL INSTRUMENT CO  
HARMON RD BLUFFTON OHIO  
TRIPLEX RUBBER & SUPPLY CO  
5819 ARMOUR HOUSTON TEXAS  
TRI-POINT INDUSTRIES INC  
175 1 U WILLETS RD ALBERTSON L 1 N Y  
TRI-R INSTRUMENTS  
144-13 JAMAICA AVE JAMAICA 35 N Y  
TRITON MFG CO  
4000 TOWNE ST E HADDAM CONN  
TRI-TRONICS CO  
2607 ST CHARLES RD BELLWOOD 13 ILL  
TRI-TRONICS LAB INC  
EULESS TEXAS  
TRI-VI-TRON INC  
8139 ENGINEER RD SAN DIEGO 11 CALIF  
TROMPETER ELECTRONICS  
7238 ETON CANOGA PARK CALIF  
TRONEX INC  
6 STREET MILLVILLE NJ  
TRONIC COIL WINDING CO INC  
58 WESLEY ST WATERBURY CONN  
TROPICAL SCREW PRODUCTS  
3275 N W 28TH ST MIAMI FLA  
TROTT ELECTRONICS INC  
412 SMITH ST ROCHESTER 6 N Y  
TROXLER ELECTRONICS LAB INC  
3048 MEDLIN DR RALEIGH NO CAR  
TRU BEAM PROD  
4141 BROADWAY OAKLAND CALIF  
TRU-CONNECTOR CORP  
416 UNION ST LYNN MASS  
TRU CONNECTOR CORP  
245 LYNNFIELD ST PEABODY MASS  
TRU-OHM PRODUCTS DIV MODEL ENG & MFG CO  
3426 W DIVERSEY CHICAGO 47 ILL

TRUTONE ELECTRONICS INC  
14660 RAYMER ST VAN NUYS CALIF  
TRW COMPUTERS CO  
8433 FALLBROOK AVE CANOGA PARK CALIF  
T T ELECTRONICS INC  
P O BOX 180 CULVER CITY CALIF  
TRYGON ELECTRONICS INC  
111 PLEASANT AVE ROOSEVELT LI NY  
TUBULAR RIVET & STUD CO  
WESTON AVE WOLLASTON 70 MASS  
TUCK MFG CO  
19 ELLIS AVE W BRIDGEWATER MASS  
TUCOR INC  
59 DANBURY RD WILTON CONN  
TUNG-SOL ELECTRIC INC  
200 BLOOMFIELD AVE BLOOMFIELD N J  
TUNG SOL ELECTRIC INC  
ONE SUMMER AVE NEWARK 4 NJ  
TUNG SOL ELECT  
545 ARLINGTON AVE ORANGE N J  
TURBO JET PRODUCTS INC  
424 S SAN GABRIEL BLVD SAN GABRIEL CALIF  
TURBO MACHINE CO  
LANSDALE PA  
TURCO PRODUCTS INC  
24600 MAIN ST WILMINGTON CAL  
TURNER CO  
909 17 ST N E CEDAR RAPIDS IOWA  
TUTTLE ELECTRIC PRODUCTS INC  
KIRKLAND ILL  
TV DEVELOPMENT CORP  
469 JERICHO TURNPIKE MINEOLA NY  
TV UTILITIES CORP DIV NORD PHOTOCOPY CO  
300 DENTON AVE NEW HYDE PARK NY  
TWEezer WELD CORP  
4820 PARK BLVD PINELLAS PARK FLA  
TWINCO INC  
9 ERIE DR NATICK MASS  
TYCO INCORP  
585 BOYLSTON ST BOSTON MASS

## U

U B S CHEMICAL CORP  
491 MAIN ST CAMBRIDGE 42 MASS  
U S CAPACITOR CORPORATION  
8917 MELROSE AVE LOS ANGELES 69 CALIF  
U S COMPONENTS  
1320 ZEREGA AVE NY 62 NY  
U S CONTROLS INC  
161 GRAND ST NEW YORK N Y  
US CONTROLS INC  
410 4TH AVE BROOKLYN 15 N Y  
U S DIELECTRIC INC  
181 GREENWOOD ST WORCESTER 6 MASS  
U S DYNAMICS CORP  
1250 COLUMBUS AVE BOSTON MASS  
US ELECTRICAL MOTORS INC  
200 E SLAUSON AVE LOS ANGELES 54 CALIF  
U S ELECTRICAL MOTORS INC  
MILFORD CONN  
THE U S ELECTRIC MOTOR CO  
CADIZ OHIO  
U S ELECTRONICS CORP  
278 WARREN ST LYNDHURST N J  
U S ELECTRONICS CORP  
800 SLATERS LANE ALEXANDRIA VA  
U S ENG CO  
5873 RODEO RD LOS ANG CALIF  
U S GEAR CORP  
81 BAY STATE RD WAKEFIELD MASS  
U S GRAPHITE CO DIV WICKLES CORP  
1621 HOLLAND AVE SAGINAW MICH  
U S INDUSTRIES INC AUTOMATION DIV  
12345 NEW COLUMBIA PIKE SILVER SPRING MD  
U S INSTRUMENT CORP  
PO BOX 1288 CHARLOTTEVILLE VA  
U S PLASTIC MOLDING CORP  
150 CARLTON ST WALLINGFORD CONN  
U S PLYWOOD CORP  
55 W 44 ST NEW YORK 36 N Y  
U S RADIUM CORP  
5420 VINELAND AVE N HOLLYWOOD CALIF  
U S RADIUM CORP  
BLOOMSBURG PENNA  
U S RECORDING CO  
1347 S CAPITOL ST WASHINGTON 5 D C  
U S RUBBER CO  
1230 AVE OF THE AMERICAS NEW YORK 20 N Y  
U S SCIENCE CORP  
5221 W 102ND ST LOS ANGELES 45 CALIF  
US SEMCOR  
3540 W OSBORN RD PHOENIX 19 ARIZ  
US SEMICONDUCTOR PRODUCTS  
3540 W OSBORN RD PO BOX 11098 PHOENIX ARIZ  
U S STEEL AMER STEEL & WIRE DIV  
767 MILLBURY ST WORCESTER MASS  
U S TAXIMETER CORP  
516 W 54 ST NEW YORK 19 N Y  
US TIME CORP  
WATERBURY 20 CONN  
US TRANSISTOR CORP  
149 EILEEN WAY SYOSSETT NY  
UCINITE CO DIV UNITED CARR FASTENER CORP  
459 WATERTOWN ST NEWTONVILLE 60 MASS  
ULANET CO GEORGE  
413 MARKET ST NEWARK 5 NJ  
ULMER CO THE DIV MICROTRON INDUSTRIES INC  
3018 SAN LUIS REY RD OCEANSIDE CALIF

# ELECTRONIC MANUFACTURERS—A TO Z

ULTEK CORP  
920 COMMERCIAL ST PALO ALTO CALIF  
ULTRA CARBON CORP  
1310 N MADISON ST BAY CITY MICH  
ULTRA ELECTROFORMING MFG CO  
110 CEDAR AVE PITMAN 15 NJ  
ULTRASONIC ENGG CO  
618 LAKE ST MAYWOOD ILL  
ULTRASONIC DEVICES INC  
695 RAHWAY AVE UNION NJ  
ULTRASONIC INDUSTRIES INC  
AMES COURT PLAINVIEW L I N Y  
ULTRASONIC LABS INC  
1695 ELIZABETH AVE RAHWAY N J  
ULTRASONIC MACHINING CO  
1015 ASBURY AVE ASBURY PARK NJ  
ULTRAUDIO DIV OBERLINE INC  
PO BOX 921 BEVERLY HILLS CALIF  
ULTRAUDIO PRODUCTS  
6573 ST MONICA BLVD LOS ANGELES CALIF  
ULTRA-VIOLET PRODUCTS INC  
5114 WALNUT GROVE AVE SAN GABRIEL CALIF  
ULTRONICS INC  
12 FRANKLIN AVE CLINTON N Y  
ULTRONIX INC  
GRAND JUNCTION COLO  
ULTRONIX INC  
111 E 20TH AVE SAN MATEO CALIF  
UNBRACO SOCKET SCREW CO LTD  
BURNABY RD COVENTRY ENGLAND  
UNDERWOOD CORP CANOGA DIV  
736 BEAL ST WALTON BEACH FLA  
UNDERWOOD ELECTRIC & MFG CO INC  
148 SO 8TH AVE MAYWOOD ILL

UNGAR ELECT TOOLS INC  
1475 E EL SEGUNDO BLVD HAWTHORNE CALIF  
UNHERSOLL PRODUCTS  
1000 W 120TH ST CHICAGO 43 ILL  
UNHOLTZ DICKIE CORP  
2994 WHITNEY AVE HAMDEN CONN  
UNIT SEAL INC  
NORTH AVE & MAPLE ST GARWOOD N J  
UNIFORM TUBES INC  
LEVEL RD COLLEGEVILLE 2 PA  
UNIFORM TUBES INC MICRO DELAY DIV  
COLLEGEVILLE PA  
UNIMAX SWITCH MAXSON ELECT CORP  
IVES RD WALLINGFORD CONN  
UNION CARBIDE CONSUMER PRODUCTS CO  
270 PARK AVE NEW YORK 17 N Y  
UNION CARBIDE CORP SILICONES DIV  
P O BOX 180 SISTERVILLE W VA  
UNION CARBIDE UNION CARBIDE CONSUMER PROD CO  
501 GAGE ST RENNINGTON VT  
UNION CARBIDE CONSUMER PROD CO  
BOX 749 CHARLOTTE N C  
UNION CARBIDE PLASTICS CO  
270 PARK AVE NEW YORK NY  
UNION CITY FILAMENT CORP  
540 39TH ST UNION CITY N J  
UNION SWITCH & SIGNAL DIV  
1789 1807 BRADDOCK AVE  
SWISSVALE P O PITTSBURGH PENNA  
UNION ULTRA-SONICS CORP  
576 LAWRENCE ST LOWELL MASS  
UNIQUE WIRE WEAVING CO INC  
762 RAMSEY AVE HILLSIDE N J  
UNISON ELECTRONICS  
1634 MARION ST GRAND HAVEN MICH  
UNISTRUT PRODS CO  
933 W WASHINGTON BLVD CHICAGO 7 ILL  
UNIT PROCESS ASSEMBLIES INC  
53-15 37TH AVE WOODSIDE 77 NY  
UNITED AERO PRODUCTS CORP  
DIV AERO CHATILLON CORP  
COLUMBUS RD BURLINGTON N J  
UNITED AIRCRAFT PRODUCTS INC  
50 E 42ND ST NEW YORK 17 N Y  
UNITED AIRCRAFT PRODUCTS INC  
137 W 157TH ST GARDENA CALIF  
UNITED AIRCRAFT PROD INC  
FOREST OHIO  
UNITED CONDENSER CORP  
3400 PARK AVE NEW YORK N Y  
UNITED CONTROL CORP OVERLAKE INDUSTRIAL PK  
PO BOX 3104 SEATTLE 14 WASH  
UNITED DATA CONTROL INC  
380 N HALSTEAD ST PASADENA CALIF  
UNITED ELECTRIC CONTROLS CO  
85 SCHOOL ST WATERTOWN 72 MASS  
UNITED ELECTRODYNAMICS  
200 ALLENDALE RD PASADENA CALIF  
UNITED ELECTRONIC MFG CORP  
542 39 ST UNION CITY NJ  
UNITED ELECTRONICS  
42 SPRING ST NEWARK N J  
UNITED ENGRS ELECTRO NUCLEAR INSTRS DIV  
2139 S SHERIDAN TULSA OKLA  
UNITED MFG CO DIV UMC ELECTRONICS  
41 HAIG ST HAMDEN 14 CONN  
UNITED MINERAL & CHEMICAL CORP  
16 HUDSON ST NEW YORK 13 N Y  
UNITED PROCESS MACHINERY CO  
1649 12TH ST SANTA MONICA CALIF  
UNITED SENSOR & CONTROL CORP  
89 91 CHURCH ST E HARTFORD 8 CONN  
UNITED SHOE MACHINERY CORP  
SHELTON CONN  
UNITED STATES GASKET CO  
P O BOX 93 CAMDEN N J  
UNITED TESTING LABS  
573 MONTEREY PASS RD MONTEREY PARK CALIF  
UNITED TRANSFORMER CORP  
150 VARICK ST NEW YORK 13 N Y  
UNITED TRANSFORMER CORP PACIFIC DIV  
4008 JEFFERSON BLVD LOS ANG CALIF

UNITED WIRE & SUPPLY CORP  
1497 ELMWOOD AVE PROVIDENCE 7 R I  
UNITRODE TRANSISTOR PRODUCTS  
214 CALVARY ST WALTHAM MASS  
UNITRON INC  
1624 N FIRST BOX 1331 GARLAND TEX  
UNIVERSAL CIRCUIT CONTROLS  
3610 OAKTON ST SKOKIE ILL  
UNIVERSAL CONDENSER CO  
3435 N KIMBALL AVE CHICAGO ILL  
UNIVERSAL DRAFTING MACHINE CORP  
7960 LORAIN AVE CLEVELAND 2 OHIO  
UNIVERSAL ELECTRIC CO  
300 E MAIN ST OHOSSO MICH  
UNIVERSAL ELECTRONICS CO  
1720 22 ST SANTA MONICA CALIF  
UNIVERSAL INDUSTRIAL EQUIPMENT CORP  
1625 PATERSON PLANK RD SECAUCUS N J  
UNIVERSAL INSTRUMENTS CORP  
139 E FREDERICK ST BINGHAMTON NY  
UNIVERSAL MATCH CO UNDYNAMICS DIV  
472 PAUL AVE ST LOUIS 35 MO  
UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT  
4407 COOK AVE ST LOUIS 13 MISSOURI  
UNIVERSAL MFG CO INC  
1168 GROVE ST IRVINGTON 11 N J  
UNIVERSAL MOTOR CO  
1552 HARRISON ST OSHKOSH WISC  
UNIVERSAL PRODUCTS ENGG CO  
4100 TAYLOR AVE RACINE WISC  
UNIVERSAL RELAY CORP  
42 WHITE ST NEW YORK 13 NY  
UNIVERSAL SCIENTIFIC CO INC  
1102 SHELBY ST VINCENNES IND  
UNIVERSAL SHELLAC & SUPPLY CO  
540 IRVING AVE BROOKLYN NY  
UNIVERSAL SYNAMICS CORP  
130 LOS AGUAJES AVE SANTA BARBARA CALIF  
UNIVERSAL TOROID COIL WINDING INC  
171 COIT STREET IRVINGTON 11 NJ  
UNIVERSAL TRANSISTOR PROD CORP  
380 OAK ST COPIAQUE N Y  
UNIVERSITY LOUDSPEAKERS INC  
80 S KENSICO AVE WHITE PLAINS NY  
UNIVOX CORP  
4301 W JEFFERSON BLVD LOS ANGELES CALIF  
UNIVOX CORP  
102 WARREN ST NEW YORK 7 N Y  
UNIWAIVE INC  
109 MARINE ST FARMINGDALE N Y  
UNMANCO INCORP  
712 S FEDERAL SR CHICAGO ILL  
UPPCO INC  
900 S DESPLAINES ST CHICAGO 7 ILL  
UTAH RADIO CORP  
1124 E FRANKLIN ST HUNTINGTON IND  
UTILITIES SERVICE CO  
PO BOX 627 ALLENTOWN PA  
UTILITY METAL PRODUCTS CO INC  
117 ELLIOTT ST BEVERLY MASS  
UTRAD CORP DIV LITTON IND  
305 N BRIANT ST HUNTINGTON IND

VACAP CORP  
1905 SUMMIT AVE UNION CITY N J  
VACO PRODUCTS CO  
317 E ONTARIO ST CHICAGO 11 ILL  
VACTITE  
1890 EMBARCADERO RD PALO ALTO CAL  
VACTRONIC LAB EQUIPMENT INC  
21 MONMOUTH CT E NORTHPORT N Y  
VACUDDENT MFG CO  
975 E 5 ST SALT LAKE CITY UTAH  
VACUUM APPARATUS CO  
906 INDUSTRIAL AVE PALO ALTO CALIF  
VACUUM ELECTRONICS CORP  
TERMINAL DR LONG ISLAND N Y  
VACUUM SPEC INC  
34 LINDEN ST SOMERVILLE MASS  
VALCO AMPLIFIERS INC  
4701 GRAND AVE CHICAGO ILL  
VALCOR ENG CORP  
365 CARNEGIE AVE KENILWORTH N J  
VALOR ELECTRONICS CO  
13214 CRENSHAW BLVD GARDENIA CALIF  
VALOR INSTRUMENTS INC  
13214 CRENSHAW BLVD GARDENIA CALIF  
VALPEY CRYSTAL CORP  
1244 HIGHLAND ST HOLLISTON MASS  
VALUE ENG PROD INC  
890 MONTEREY PASS RD MONTEREY PARK CALIF  
VALVERDE LABS  
292 LAFAYETTE ST NEW YORK 12 N Y  
VANGUARD ELECTRONICS CO  
3384 MOTRO AVE LOS ANGELES 34 CALIF  
VANGUARD ELECTRONIC LABS  
190 48 99TH AVE HOLLIS N Y  
VANISTOR MFG DIV WESTON ELEC INST CORP  
UNION N J  
VANITY FAIR ELECTRONICS  
50 S 45T BROOKLYN N Y  
VANTON PUMP & EQUIPMENT CORP  
201 SWEETLAND AVE HILLSIDE 5 N J

VAP AIR DIV VAPOR CORP  
6444 HOWARD ST CHICAGO ILL  
VARD INC  
2981 E COLORADO PASADENA 8 CALIF  
VARE INDUSTRIES  
128 W FIRST AVE ROSELLE N J  
VARFLEX CORP  
512 W COURT ST RDME N Y  
VARI CORP  
2825 CEDAR AVE MINN MINN  
VARI L CO  
207 GREENWICH AVE STAMFORD CONN  
VARIAN ASSOC  
611 HANSEN WAY PALO ALTO CALIF  
VAR-LAC-OID CHEMICAL CO  
116 BROAD ST NEW YORK 4 N Y  
VARO INC  
402 E GUTIERREZ ST SANTA BARBARA CALIF  
VARO MFG CO  
2201 WALNUT ST GARLAND TEXAS  
VECTOR ELECTRONIC CO  
1100 FLDWR ST GLENDALE 1 CALIF  
VECTOR MFG CO  
KEYSTONE RD SOUTH HAMPTON PA  
VECTOR MANUFACTURING CO  
5616 LAWNDALE HOUSTON 23 TEXAS  
VEEDER ROOT INC ELECT CONTROLS DIV  
5 MAPLE ST DANVERS MASS  
VEET INDUSTRIES  
25753 GROSBECK HWY E DETROIT MICH  
VELONEX DIV PULSE ENGR  
560 ROBERT AVE SANTA CLARA CALIF  
VEMALINE PRODUCTS CO  
PO BOX 1 FRANKLIN LAKES N J  
VENNER ELECTRONICS LTD  
KINGSTON BY-PASS NEW MALDEN SURREY ENGLAND  
VERCO INC  
1430 130TH N E BELLEVUE WASH  
VERITRON WEST INC  
533 STROHM AVE N HOLLYWOOD CALIF  
VERMONT RESEARCH CORP  
SPRINGFIELD VERMONT  
VERNITRON CORP  
50 GAZZA BLVD FARMINGDALE LI N Y  
VERNITRON CORP  
1742 S CRENSHAW BLVD TORRANCE CALIF  
VERSA-TRONICS  
RT 1 BOX 264 MARENGO ILL

VIBRAC CORP  
ALPHA IND PK RTE 129 CHELMSFORD MASS  
VIBRA SEAL CORP  
2832 E GRAND BLVD DETROIT 11 MICH  
VIBRATION ENGINEERING PLANT  
781 WHALLEY AVE NEW HAVEN CONN  
VIBRO MFG CO INC  
6117 ROOSEVELT AVE WOODSIDE 77 NY  
VICKERS INC ELECTRIC PRODUCTS DIV  
1887 LOCUST ST ST LOUIS 3 MO  
VICTOR ADDING MACHINE CO  
3900 N ROCKWELL ST CHICAGO 18 ILL  
VICTOR ELECTRIC WIRE CABLE CORP  
618 MAIN ST WARWICK R I  
VICTOR METAL PRODUCTS CORP  
813 N MAIN ST HARRISONBURG VA  
VICTOR RF MICROWAVE CO  
36 W WATER ST WAKEFIELD MASS  
VICTOREEN INSTRUMENT CO TULLAMORE DIV  
5857 WEST 95 TH ST OAKLAWN ILL  
VICTOREEN INSTRUMENT CO  
5806 HOUGH AVE CLEVELAND OHIO  
VICTORY ENGG CO  
124-28 SPRINGFIELD AVE SPRINGFIELD NJ  
VICTORY MICA MFG CO INC  
1313 39TH ST BROOKLYN N Y  
VIDAIRE ELECTRONICS MFG CORP  
365 BABYLON TURNPIKE ROOSEVELT N Y  
VIDEO INDUSTRIES CO  
242 MADISON AVE PORT CHESTER N Y  
VIDEO DIV OF DEVENCO  
161 EAST CALIFORNIA BLVD PASADENA CALIF  
VIDEON CORP  
3456 E 10TH LANE HIALEAH FLA  
VIEWLEX INC  
HOLBROOK N Y  
VIKING INDUSTRIES INC  
21343 ROSCOE BLVD CANOGA PARK CALIF  
VIKING TOOL & DIE CO  
9600 ARDICH AVE SOUTH MINNEAPOLIS MINN  
VINCO ELECTRONICS CORP  
65 WALLACE ST NEW HAVEN CONN  
VINSON ENGG & SALES CORP  
8044 WOODLEY AVE VAN NUYS CALIF  
VINSON MFG INC  
8044 WOODLEY AVE NUYS CALIF  
VIRGINIA ELECTRONICS CO  
RIVER RD WASHINGTON D C  
VIRGINIA PLAK COMPANY  
270 MADISON AVE NEW YORK 16 N Y  
VISHAY INSTR INC PHOTOTRONICS DIV  
63 LINCOLN HWY MALVERN PA  
VISHAY INSTR INC PREC RESISTOR DIV  
63 LINCOLN HWY MALVERN PA  
VITRAMON INC  
111 MAIN ST STEPNEY CONN  
VITRO CHEMICAL CO  
261 MADISON AVE NEW YORK N Y  
VITRO ELECTRONICS DIV OF VITRO CORP OF AM  
919 JESUP-BLAIR DR SILVER SPRING MARYLAND  
VITRO LABORATORIES  
200 PLEASANT VALLEY WAY W ORANGE NJ  
VITROSEAL CORP  
RACE & VINE STRS RIDGWAY PA  
VLCKEK PLASTICS CO  
MIDDLEFIELD OHIO  
VOAK ENG CO  
129 EAST A ST UPLAND CALIF



# ELECTRONIC MANUFACTURERS—A TO Z

VOCALINE CO OF AMERICA  
COULTER ST OLD SAYBROOK CONN  
VOGUE INSTRUMENT CORP  
2350 LINDEN BLVD BROOKLYN 8 NY  
VOLK RADIOCHEMICAL CO  
8260 ELWOOD SKOKIE ILL  
VOLKERT STAMPINGS INC  
222-34 96 AVE QUEENS VILLAGE 29 N Y  
VOLTARC TUBES INC  
44 CROSS ST NORWALK CONN  
VOLTRON PRODUCTS  
1020 S ARROYO PARKWAY PASADENA CALIF  
VORAC CO  
147 MEADOW RD RUTHERFORD N J  
VORON ELECTRONICS CORP  
1230 E MERMAID LANE PHILA 18 PA  
VUE TRONICS INC DV OF PRESCOTT CO  
920 CITRUS AVE LOS ANGELES 38 CALIF  
VULCAN ELECTRIC CO  
88 HOLTEN ST DANVERS MASS  
VULCAN-TV MAST & TOWER CO INC  
PO BOX 6537 BIRMINGHAM 7 ALA

## W

WAAGE ELECTRIC INC  
720 COLFAX AVE KENILWORTH N J  
WABASH MAGNETICS INC  
FIRST & WEBSTER STS WABASH IND  
WABASH METAL PRODUCTS CO  
1569 MORRIS ST WABASH IND  
WABASSO PRODUCTS INC  
WABASSO FLA  
WABER ELECTRONICS INC  
HANCOCK & SOMERSET STS PHILA 33 PA  
WACL:NE INC  
35 S ST CLAIR ST DAYTON OHIO  
WADDELL DYNAMICS INC  
5015 WEEKS AVE SAN DIEGO CALIF  
WADE ELECTRIC PRODUCTS CO  
BOX 271 STURGIS MICH  
WAHLGREN MAGNETICS  
1900 WALKER AVE MONROVIA CALIF  
WAIMET ALLOYS CO  
5320 OAKMAN BLVD DEARBORN 2 MICH  
WAKEFIELD ENGINEERING INC  
WAKEFIELD MASS  
WALCO ELECT CO INC  
60 FRANKLIN ST E ORANGE N J  
WALDES KOHINOOR INC  
47 16 AUSTEL PL LONG ISLAND CITY N Y  
WALDOM ELECTRONICS INC  
4625 W 53 ST CHICAGO 32 ILL  
WALES STRIPPIIT INC UNIT OF HOUDAILLE IND INC  
66 WILOBOLY ST BROOKLYN N Y  
WALES STRIPPIIT INC  
AKRON NEW YORK  
WALKER CO GEORGE  
118 AMSTERDAM AVE PASSAIC NJ  
WALKIRT CO  
10321 S LA CIENAGA BLVD LOS ANGELES 45 CAL  
WALLINGFORD STEEL CO  
VALLEY ST WALLINGFORD CONN  
WALLIN OPTICAL SYSTEMS INC  
18670 VENTURA BLVD TARZANA CALIF  
WALL MFG CO P  
ERIE ST GROVE CITY PA  
WALLSON ASSOC INC  
35 E RUNYON ST NEWARK N J  
WALSCO ELECTRONICS MFG CO  
100 W GREEN ST ROCKFORD ILL  
WALTHAM ELECTRONICS CORP  
751 MAIN ST WALTHAM MASS  
ELECTRO MEC DIV OF WALTHAM PRE INSTR CO  
47 51 33 ST LONG ISLAND CITY 1 N Y  
WALTHAM SCREW CO  
77 RUMFORD AVE WALTHAM 54 MASS  
WANG LABS INC  
12 HURON DRIVE NATICK MASS  
WARD LEONARD ELECTRIC CO  
MT VERNON N Y  
WARD PRODUCTS CORP  
EDSON ST AMSTERDAM N Y  
WARE MARINE PRODUCTS INC  
6763 S W 81ST ST MIAMI FLA  
WARMINSTER FIBERGLASS CO  
WARMINSTER PA  
WARNECKE ELECTRON TURES INC  
175 W OAKTON ST DES PLAINES ILL  
WARNER ELECTRIC BRAKE & CLUTCH CO  
INDUSTRIAL DIV BELOIT WISC  
WARNER & SWASEY CO  
32 16 DOWNING ST FLUSHING N Y  
WARREN COMPONENTS DIV EL-TRONICS INC  
S IRVINE ST WARREN PA  
WARREN MFG CO  
NEWTOWN RD LITTLETON MASS  
WARREN WIRE CO  
POWNAI VT  
WARRICK CO CHARLES F  
1964 W 11 MILE RD BERKLEY MICH  
WARSAW COIL CO  
RD 25 WEST WARSAW IND  
WARWICK MANUFACTURING CORP  
27TH & DEBORAH STS ZION ILL

WARWICK MFG CORP  
5900 W TOUHY ST NILES ILL  
WARWICK MFG CORP  
7300 N LEIGH AVE CHICAGO ILL  
WASHINGTON PORCELAIN CO  
WASHINGTON N J  
WASHINGTON SCIENTIFIC INDUST  
13111 WAYZATA BLVD MINN MINN  
WASHINGTON TECHNOLOGICAL ASSOC INC  
979 ROLLINS AVE ROCKVILLE MD  
WATERBURY COS INC  
835 S MAIN ST P O BOX 1032 WATERBURY CONN  
WATERBURY PRESSED METAL CO  
300 CHASE AVE WATERBURY 14 CONN  
WATERMAN PRODUCTS CO  
2445 EMERALD ST PHILADELPHIA 25 PA  
WATERS CONLEY CO INC  
ROCHESTER MINN  
THE WATERS CORP  
18 S W 14TH ST ROCHESTER MINN  
WATERS MFG INC  
BOSTON POST RD WAYLAND MASS  
WATKINS-JOHNSON CO APPL ENGRG  
3333 HILLVIEW AVE PALO ALTO CALIF  
WATLOW ELECTRIC MFG CO  
12001 LARKLAND RD ST LOUIS MO  
WATSCO INC  
1800 W 4TH AVE HIALEAH FLA  
WATSON MFG CO  
63 TAYLOR ST JAMESTOWN NY  
WAVEFORMS INC  
333 & AVE NEW YORK N Y  
WAVEGUIDE INC  
851 W 18 ST COSTA MESA CALIF  
WAVELABS INC  
4343 THAIN ST SAN DIEGO 20 CALIF  
WAVELINE INC  
P O BOX 718 CALDWELL N J  
WAYNE GEORGE CORP  
322 NEEDHAM ST NEWTON MASS  
WEATHERS INDUSTRIES DIV ADVANCE INDS  
66 E GLOUCESTER PIKE BARRINGTON NJ  
WEBBER ENGINEERING CORP  
P O BOX 217 INDIANAPOLIS IND  
WEBBER MANUFACTURING CO INC  
PO BOX 217 INDIANAPOLIS 6 IND  
WEBCOR ELECTRONICS  
2431 WOLCOTT CHICAGO ILL  
WEBCOR INC LAMINATION DIV  
3912 W MCLEAN AVE CHICAGO 47 ILL  
WEBCOR ELECTRONICS  
3912 W MCLEAN AVE CHICAGO 47 ILL  
WEBCOR ELECTRONICS  
1516 WABASH CHICAGO ILL  
WEBCOR INC  
5610 BLOOMINGDALE AVE CHICAGO ILL  
WEBCOR INC-ELECTRONICS DIV  
816 N KEDZIE CHICAGO 51 ILL  
WEBER AIRCRAFT CORP  
2820 ONTARIO ST BURBANK CALIF  
WEBER ELECT DIV  
3050 CALIF ST BURBANK CALIF  
WEBSTER MFG  
317 ROEBLING RD S SAN FRANCISCO CALIF  
WECKESSER  
5701 NORTHWEST HWY CHICAGO ILL  
WEDGELock CORP OF CALIF  
11323 HARTLAND ST N HOLLYWOOD CALIF  
WEIDHOFF CORP  
ALGONA IOWA  
WEIGHING & CONTROL DIAGONAL TRANS WIGH  
KING OF PRUSSIA PA  
WEINSCHEL ENGG  
10503 METROPOLITAN AVE KENSINGTON MD  
WEITERMANN ELECTRONICS  
4549 N 38TH ST MILWAUKEE 9 WIS  
WEKSLER INSTRUMENTS CORP  
195 E MERRICK RD FREEPORT L I N Y  
WELCH SCIENTIFIC CO W M  
1515 SEDGWICK ST CHICAGO ILL  
WELDEX DIVISION  
23361 TELEGRAPH SOUTHFIELD MICH  
WELDMATIC DIV UNITEK CORP  
950 ROYAL OAKS DRIVE MONROVIA CALIF  
WELX ELECTRONICS CORP  
1000 16TH ST N W WASHINGTON 6 D C  
WELLCOR INC  
1218 N WELLS ST CHICAGO ILL  
WELLER ELECTRIC CORP  
601 STONES CROSSING RD EASTON PENNA  
WELLMAN BRONZE & ALUMINUM CO  
801 ANDRE ST BAY CITY MICH  
WELLS GARDNER ELECT CORP  
2701 KILDARE AVE CHICAGO ILL  
WELLS INDUSTRIES CORP  
6880 TROOST AVE N HOLLYWOOD CALIF  
WELSH CO INC WM H  
224 INDIANA AVE CHICAGO ILL  
WELTRONIC CO  
19500 W 8 MILE RD DETROIT 19 MICH  
WELWYN CANADA LTD  
125 BRYDGES ST LONDON CANADA  
WELWYN ELECTRIC LIMITED  
BEDLINGTON NORTHUMBERLAND ENGLAND  
WEMS INC  
4807 W 118TH PL HAWTHORNE CALIF  
WEN PRODUCTS INC  
5810 NORTHWEST HIGHWAY CHICAGO 31 ILL  
WERNER CO INC R D  
GREENVILLE PA  
WESCHE ELECTRIC CO B A  
9027 SHELL RD CINCINNATI 36 OHID  
WESCO ELECTRIC & MFG CO  
27 OLIVE ST GREENFIELD MASS  
WEST COAST ELECTRICAL MFG CORP  
233 W 116 LOS ANGELES CALIF

WEST COAST RESEARCH CORP  
2102 S SEPULVEDA BLVD LOS ANG CALIF  
WEST INSTRUMENT CORP  
4363 MONTROSE AVE CHICAGO ILL

## FOR INFORMATION ON PRODUCTS

SEE THE

## "PRODUCT AND MANUFACTURERS" SECTION

WESTBERG MFG CO  
144 S COOMBS ST PO BOX 239 NAPA CALIF  
WESTERN APPARATUS  
2001 GREENLEAF EVANSTON ILL  
WESTERN ARC WELDING INC  
749 KOHLER ST LDS ANG CALIF  
WESTERN COATING CO  
BOX 598 OAKRIDGE STA ROYAL OAK MICH  
WESTERN COIL & ELECTRICAL CO  
215 STATE ST RACINE WISC  
WESTERN DESIGN & ELECT  
6312 HOLLISTER AVE SANTA BARBARA CALIF  
WESTERN DEVELOPMENT LABS PHILCO CORP  
918 INDUSTRIAL PALO ALTO CALIF  
WESTERN DEVICES INC  
600 W FLORENCE AVE INGLEWOOD 1 CALIF  
WESTERN DEVICES INC  
555 FRONT ST BURBANK CALIF  
WESTERN DIV PENN CONTROLS INC  
BOX 553 COSTA MESA CALIF  
WESTERN ELECTRO ACOUSTIC LAB INC  
2222 SO BARRINGTON LOS ANGELES 49 CALIF  
WESTERN ELECTRONIC PRODUCTS CO  
2420 NORTH LAKE AVE ALTADENA CALIF  
WESTERN ELECTRONICS CO  
717 DEXTER AVE SEATTLE WASH  
WESTERN ELECT KANSAS CITY PLANT  
777 N 50 HIGHWAY LEES SUMMIT MO  
WESTERN ELECTRIC CO  
6655 WEST RENO OKLAHOMA CITY OKLA  
WESTERN ELECTRIC  
3300 LEXINGTON RD WINSTON-SALEM NC  
WESTERN ELECTRODYNAMICS  
PO BOX 98 COLORADO SPRINGS COLO  
WESTERN FELT WORKS  
402 OGDEN AVE CHICAGO ILL  
WESTERN GEAR CORP  
P O BOX 126 BELMONT CALIF  
WESTERN GEAR CORP ELECTRO PRODUCTS DIV  
132 W COLORADO BLVD PASADENA CALIF  
WESTERN GOLD & PLATINUM CO  
525 HARBOR BLVD BELMONT CALIF  
WESTERN INSTRUMENT CO  
826 VICTORY BLVD BURBANK CALIF  
WESTERN INSULATED WIRE CO  
E 30TH ST AT SANTE FE LOS ANGELES CALIF  
WESTERN INTAGLIO INC  
4801 W JEFFERSON LOS ANGELES CALIF  
WESTERN INTL CO  
45 VESEY ST NEW YORK 7 N Y  
WESTERN RADIATION LAB  
1107 W 24 ST LOS ANGELES 7 CALIF  
WESTERN RUBBER CO  
GOSHEN 6 INDIANA  
WESTERN SEMICONDUCTORS INC  
605 ALTON ST SANTA ANA CALIF  
WESTERN SKY INDUSTRIES  
21300 CLOUD WAY HAYWARD CALIF  
WESTERN TRANSISTOR CORP  
13021 BUDLONG AVE GARDENA CALIF  
WESTFIELD METAL PRODUCTS CO  
1035 LOWER UNION ST WESTFIELD MASS  
WESTGATE LAB INC  
P O BOX 63 YELLOW SPRING OHIO  
WESTINGHOUSE ELEC CORP ASTROELECTRONICS DEPT  
BOX 245 NEWBURY PARK CAL  
WESTINGHOUSE ELECT CORP APPARATUS DIV  
BLOOMINGTON IND  
WESTINGHOUSE ELECTRIC CO DIV AIR ARM DIV  
PO BOX 746 FRIENDSHIP INTL AP BALTIMORE MD  
WESTINGHOUSE ELEC CORP TV RADIO DIVISION  
METUCHEN N J  
WESTINGHOUSE ELEC CORP ELEC TUBE DIV  
ELMIRA NY  
WESTINGHOUSE ELECTRIC CORP STANDARD CONTROL  
BEAVER PENNA  
WESTINGHOUSE ELECTRIC CORP  
MATERIALS MFG DEPT BLAIRSVILLE PENNA  
WESTINGHOUSE ELECTRIC CORP BENOLITE MICARTA  
MANOR PENNA  
WESTINGHOUSE MOLECULAR ELECTRONICS DIV  
CHURCHILL BORO PITTSBURGH 35 PA  
WESTINGHOUSE ELECTRIC CORP TRANSFORMER DIV  
SHARON PA  
WESTINGHOUSE ELECTRIC CORP MICARTA DIV  
HAMPTON SC  
WESTINGHOUSE ELECTRIC CORP  
SEMICONDUCTOR DEPT YOUNGWOOD PA  
WESTLAB INC  
390 TUCKAHOE RD YONKERS N Y  
WESTLAKE PLASTICS CO  
133 LENNI RD LENNI MILLS PA  
WESTLINE PRODUCTS DIV WESTERN LITHOGRAPH CO  
600 E 2 ST LOS ANGELES 54 CALIF  
WESTMORE INC  
137 SOUTH AVE FANWOOD NJ  
WESTREX CO DIV OF LITTON SYS INC  
540 W 58 ST NEW YORK N Y  
WESTREX CO RECORDING EQUIP DIV LITTON SYS IN  
335 N MAPLE DR BEVERLY HILLS CALIF  
WESTRONICS INC  
3605 MCCART FT WORTH TEXAS



# ELECTRONIC MANUFACTURERS—A TO Z

WESTWOOD CABLE CORP  
3440 OVERLAND AVE LOS ANGELES CALIF  
WESTWOOD CABLE CORP  
3416 S ORANGE DR LDS ANG CALIF  
WHEELABRATOR CORP  
1471 BYRKITST MISHAWAKA IND  
WHEELER ELECTRONIC CORP SUB SPERRY RAND CORP  
150 AURORA A ST WESTERBURY CONN  
WHEELOCK SIGNALS INC  
LONG BRANCH N J  
WHITAKER CABLE CORP  
1301 BURLINGTON ST KANSAS CITY MO  
WHITE AVIONICS CORP  
TERMINAL ROAD PLAINVIEW LI NY  
WHITE DENTAL MFG CO SS INDUSTRIAL DIV  
10 E 40 ST NEW YORK 16 N Y  
WHITEFORD LAB  
258 BROAD ST LYNN 9 MASS  
WHITEHALL ELECTRONICS CORP  
1645 HENNEPIN AVE MINN MINN  
WHITEHEAD METALS INC  
303 W 10TH ST NEW YORK 14 NY  
WHITE INSTRUMENT LABS  
BOX 9006 AUSTIN 17 TEXAS  
WHITE MFG CO  
2326 UNIVERSITY AVE ST PAUL MINN  
WHITE & SON JAMES L  
374 VERONA AVE NEWARK 4 N J  
WHITEWATER ELECTRONICS INC  
136 MAIN ST WHITEWATER WISC  
WHITING & DAVIS CO  
23 E BACON ST PLAINVILLE MASS  
WHITNEY METAL TOOL CO  
110 FORBES ST ROCKFORD ILL  
WHITSO INC  
9330 BYRON ST SCHILLER PARK ILL  
WHITTAKER CONTROLS & GUIDANCE  
16217 LINDBERGH ST VAN NUYS CALIF  
WIANCKO ENG CO  
255 N HALSTEAD ST PASADENA CALIF  
WICKES ENGG & CONSTRUCTION CO  
12TH ST & FERRY AVE CAMDEN 4 N J  
WIEGAND MFG CO  
882 BALFOUR ST VALLEY STREAM L I N Y  
WILBRECHT ELECTRONICS  
GRIGGS MIDWAY BDG  
1821 UNIVER AVE ST PAUL MINN  
WILCO CORP  
4030 TENTH ST IND IND  
WILCOLATOR CO  
1001 NEWARK AVE ELIZABETH N J  
WILCOX ELECTRIC CO INC  
1400 CHESTNUT ST KANSAS CITY 27 MO  
WILCOX PRODUCTS CO  
3455 DAKOTA AVE MINNEAPOLIS 16 MINN  
WILDER MFG CO  
MECHANIC ST & ERIE R R PORT JERVIS N Y  
WILEY ELECTRONIC PROD CO  
2045 W CHERYL DR PHOENIX ARIZONA  
WILKENS INC ALWIN FR  
PAWLING NY  
WILKINSON CO  
1660 9TH ST SANTA MONICA CALIF  
WILK INSTRUMENTS DIV QUALITY ELEC CO  
3700 SO BROADWAY LOS ANGELES 7 CALIF  
WILKS PRECISION INST CO INC  
4821 BETHESDA AVE BETHESDA MD  
WILLIAMS & CO J H DIV UNITED GREENFIELD CORP  
400 VULCAN ST BUFFALO 7 N Y  
WILLIAMS & CO C K  
2001 LYNCH AVE E ST LOUIS ILL  
WILLIAMS & CO C K  
640 N 13 ST EASTON PA  
WILLIAMS SHIP RADIO CO  
4366 MENTONE ST SAN DIEGO 7 CALIF  
WILLSON CAMERA CO INC  
1395 LAWRENCE RD HAVERTOWN PENNA  
WILMINGTON FIBRE SPECIALTY CO  
NEW CASTLE DELA  
WILRITE PRODUCTS INC SUB GLOBE UNION INC  
3835 W 150TH ST CLEVELAND OHIO  
WILSON & CO G C  
1915 B AVE HUNTINGTON W VA  
WILSONS OF CLEVELAND  
6502 N W 16TH ST FORT LAUDERDALE FLA  
WILTON TOOL MFG CO  
9525 IRVING PK SCHILLER PK ILL  
WILTRON CO  
717 LOMA VERDE AVE PALO ALTO CALIF  
WINATIC CORP  
50 STAGE RD VESTAL NY

WINCHARGER CORP SUB ZENITH RADIO CORP  
P O BOX 1168 SIOUX CITY IOWA  
WINCHESTER ELECTRONICS INC  
19 WILLARD RD NORWALK CONN  
WINCHESTER ELECT INC  
NEW MILFORD CONN  
WIND TURBINE CO  
E MARKET ST & P RR WEST CHESTER PA  
WINDSOR ELECTRONICS INC  
999 N MAIN ST GLEN ELLYN ILL  
WINEGARD CO  
3000 KIRKWOOD BURLINGTON IOWA  
J H WINN INC  
620 WASHINGTON ST WINCHESTER MASS  
WINPOWER MFG CO  
1207 FIRST AVE E NEWTON IOWA  
WINSO INSTRUMENTS & CONTROLS CO  
1533 26TH ST SANTA MONICA CALIF  
WINSLOW PRODUCT ENGG CORP  
47 ST JOSEPH ST ARCADIA CALIF  
WINSTROM  
353 FLORENCE RD FLORENCE MASS  
WINTERBURN MFG CO  
11 WHITTEMORE ST PUTNAM CONN  
WINTRONICS INC  
213 HAWTHORNE BLVD HAWTHORNE CALIF  
WINZELER MFG & TOOL CO  
7355 W WILSON AVE CHICAGO ILL  
WINZEN RESEARCH INC  
8401 LYNDALE AVE SO MINNEAPOLIS MINN  
WIRE CO OF AMER SUB WARREN WIRE CO  
POWNAW VERMONT  
WIRE CO OF AMER SUB WARREN WIRE CO  
400 DAVID LOVE PLACE GOLETA CALIF  
WIRECRAFT PRODUCTS INC  
RT 9 W BROOKFIELD MASS  
WISCONSIN PORCELAIN CO  
121 LINCOLN ST SUN PRAIRIE WISC  
WITTEK MFG CO  
4305 W 24TH PL CHICAGO ILL  
WOLLAM AIRCRAFT & MARINE PRODUCTS CO  
222 S MILL ST CELINA OHIO  
N WOOD COUNTER LAB INC  
1525 E 53 ST CHICAGO 15 ILL  
WOOD ELEC CORP  
244 BROAD ST LYNN MASS  
WOODBURY GLASS CO  
34 BURNSIDE AVE E HARTFORD 8 CONN  
WOODLAND ELECTRONICS CO INC  
503 MC CARTER HWY NEWARK 2 NJ  
WOODWELDING INC  
355 N NEWPORT BLVD NEWPORT BEACH CALIF  
WOODWORTH METAL FAB DIV SHELburne INDUSTRIES  
182 BROAD AVE BINGHAMTON N Y  
WORKMAN ELECT PROD INC  
BOX 5397 PACKINGHOUSE RD SARASOTA FLA  
WORLD WIDE WIRE INC  
119 FLORIDA ST FARMINGDALE LI N Y  
WORNER ELECTRONIC DEVICES  
RANKIN ILL  
WRIGHT & SONS CO WM E  
WEST WARREN MASS  
WRIGHT ELECTRONICS INC  
2537 GRAND AVE KANSAS CITY MO  
WRIGHT EQUIPMENT CORP  
LUKACK COURT MILLTOWN N J  
WRIGHT MACHINERY CO DIV SPERRY RAND CORP  
BOX 2211 DURHAM N C  
WRIGHT METALCOATERS INC  
255 WEST ST S HACKENSACK N J  
WRIGHT ZIMMERMAN INC  
NEW BRIGHTON ST PAUL 12 MINN  
WUERTH PRODUCTS CORP  
1949 MOFFETT ST HOLLYWOOD FLA  
WURLITZER CO  
NORTH TONAWANDA N Y  
WYCO METAL PRODUCTS  
6918 BECK AVE HOLLYWOOD CALIF  
WYE INDUSTRIES  
6 GEN DEVINE WAY BOSTON MASS  
WYETH ENG INC  
9911 WALDEN PKWY CHICAGO ILL  
WYLE MANUFACTURING DIV OF WYLE LABS  
133 CENTER ST EL SEGUNDO CALIF  
WYRKO PROJECTS INC  
FORSYTHE AVE OWEGO NY  
WYZENBEEK & STAFF INC  
223 N CALIFORNIA AVE CHICAGO 12 ILL

## X

X-ACTO INC  
48-41 VAN DAM ST LI CITY 1 N Y  
XCELITE INC  
THORN-BANK STS ORCHARD PARK NY  
X PANDO CORP  
43 15 36TH ST LONG ISLAND CITY N Y  
X RAY MFG CORP OF AMERICA  
LAKE SUCESS PARK GREAT NECK N Y  
X TRON ELECT INC  
890 71ST AVE OAKLAND CALIF

## Y

YARDNEY ELECTRIC CORP  
40 LEONARD ST NEW YORK N Y  
YARNALL WARING CO  
102 E MERMAID LANE PHILA PA  
YELLOW SPRINGS INSTRUMENT CO  
P O BOX 106 YELLOW SPRINGS OHIO  
YDKOGAWA ELECTRIC WKS INC  
40 WORTH ST NEW NEW YORK N Y  
YOLATRON INC  
DALLAS TEXAS  
YORK CO INC OTTO H  
6 CENTRAL AVE ORANGE N J  
YORK RESEARCH CORP KIP ELECTRONICS DIV  
1 RESEARCH DRIVE STAMFORD CONN  
YOUNG BROTHERS CO  
1831 COLUMBUS RD CLEVELAND 13 OHIO  
YOUNG SPRING & WIRE CORP GONSET DIV  
801 S MAIN ST BURBANK CALIF

## Z

ZACHARIAS CO ROBERT  
6045 N KEYSTONE AVE CHICAGO 46 ILL  
ZACHARIAS ELECTRONICS CORP  
P O BOX 172 LIVINGSTON N J  
ZAGORA GEAR PRODUCTS INC  
1327 S MINT ST CHARLOTTE 3 N C  
ZELL PRODUCTS CORP  
280 MAIN ST NORWALK CONN  
ZENITH ELECTRIC CO  
152 W WALTON ST CHICAGO 10 ILL  
ZENITH OPTICAL LAB  
75 MAIN ST DOBBS FERRY N Y  
ZENITH RADIO RES CORP  
4040 CAMPBELL AVE MENLO PARK CALIF  
ZERNICKOW CO O  
15 PARK ROW N Y N Y  
ZERD MFG CO  
1127 CHESTNUT ST BURBANK CALIF  
ZEUS ENG G CO INC  
625 S KINGSLEY DRIVE LA 5 CALIF  
ZIERICK MFG CORP  
BEECHWOOD & ROCKDALE AVE N ROCHELLE N Y  
ZIMNEY CORP  
160 TAYLOR ST MONROVIA CALIF  
ZINN INSTRUMENTS  
P O BOX 733 LOMITA CALIF  
ZIPPERTUBING CO  
13000 S BROADWAY LOS ANG CALIF  
ZIRCONIUM CORP OF AMER  
31501 SOLON RD SOLON OHIO  
ZOOMAR INC  
ZOPHAR MILLS INC  
112 26 ST BROOKLYN N Y  
Z & W MFG CORP  
30240 LAKELAND BLVD WICKLIFFE OHIO

# 1963 DIRECTORY

## PRODUCT FINDING INDEX

Here's How To Use This Index:

Find the product in the alphabetical list below.

Products are listed by their basic description (i.e. a wheatstone bridge will be found listed as "bridge, wheatstone"). Cross-referencing is also provided where a product may be known by a number of different names—for instance, volume control; resistor, variable; and potentiometer will be found listed separately in alphabetical order but all indicating page L98 where their manufacturers are listed.

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| Telemetering, commercial            | L61      | Transformers, flyback            | L132     | Tubes, thyratron                  | L136     | Wire, titanium                      | L137     |
| Telephone communications systems    | L61      | Transformers, HV                 | L132     | Tubes, TR                         | L136     | Wire, tungsten                      | L137     |
| Telephone systems                   | L118     | Transformers, instrument         | L132     | Tubes, transmitting               | L136     | Wire, zirconium                     | L137     |
| Telephones, portable field          | L61      | Transformers, isolation          | L132     | Tubes, traveling wave             | L136     | Wirewound strips                    | L112     |
| Telephones, sound powered           | L118     | Transformers, microwave          | L132     | Tubes, TV camera image orthicons  | L136     | Woofers                             | L119     |
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| Temperature test cabinets           | L130     | Transformers, precision matched  | L132     | Tubes, X-ray                      | L136     | Yokes, deflection                   | L81      |
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| Terminal lug swagers                | L132     |                                  |          | Tubing, non metallic              | L89      |                                     |          |

# ELECTRONIC INDUSTRIES

## 1963 DIRECTORY OF PRODUCTS & MANUFACTURERS

This is a comprehensive listing of equipment, test and measuring instruments, and components manufactured by the electronic industries. Also listed are supplementary items such as cabinets, chemicals, hardware, raw materials and services related to the electronic field. Names and addresses of manufacturers are given for over 1,500 product categories. Companies making these products or offering services in the field are arranged alphabetically. Addresses of the companies are contained in the alphabetical listing of manufacturers at the beginning of the directory. Numbers printed at the right of each column indicate the products each firm manufactures.

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| <b>AMPLIFIERS, AUDIO 100</b>                     |                                   |  |   |
| Amplifiers, decade . . . . .                     | 1                                 | ANDERSEN LAB INC . . . . .                             | 18  |
| Amplifiers, distribution . . . . .               | 2                                 | ANDREA RADIO CORP . . . . .                            | 6-7-10-16-17                              |
| Amplifiers, general purpose . . . . .            | 2                                 | ANTLAB INC . . . . .                                   | 12-15                                     |
| Amplifiers, isolation . . . . .                  | 4                                 | APPLIED CONTROL CORP . . . . .                         | 2-3-16                                    |
| Amplifiers, limiting . . . . .                   | 5                                 | APPLIED TECHNOLOGY CORP . . . . .                      | 14-15                                     |
| Amplifiers, line . . . . .                       | 6                                 | AR & DA ENGG CO . . . . .                              | 3-14                                      |
| Amplifiers, microphone . . . . .                 | 7                                 | ARKAY INTERNATIONAL INC . . . . .                      | 3-17-20                                   |
| Amplifiers, mixing . . . . .                     | 8                                 | ASTROMETRICS INC . . . . .                             | 10-11                                     |
| Amplifiers, modulator . . . . .                  | 9                                 | ATLANTIC INSTRUMENTS & ELECTRONICS INC . . . . .       | 14  |
| Amplifiers, monitoring . . . . .                 | 10                                | AUDEX CO . . . . .                                     | 10-15-17-18                               |
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| Amplifiers, narrowband . . . . .                 | 12                                | AUDIOMATION LABS . . . . .                             | 6-19                                      |
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| Amplifiers, plug-in . . . . .                    | 14                                | AUTOCRAT ELECTRONICS CO . . . . .                      | 11-17                                     |
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|  |                                   | BARKER & WILLIAMSON INC . . . . .                      | 3   |
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|  |                                   | BERGEN LABS INC . . . . .                              | 1   |
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|  |                                   | BUILDING BLOCKS ELECTRONIC CO . . . . .                | 3   |
|  |                                   | BURR BROWN RESEARCH CORP . . . . .                     | 1-4-14-18                                 |
|  |                                   | CALBEST ELECTRONICS CO . . . . .                       | 13-17-20                                  |
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|  |                                   | CAROL ELECT DIV WEECO . . . . .                        | 3   |
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|  |                                   | CENTRAL LAB DIV GLOBE UNION . . . . .                  | 7-9-14                                    |
|  |                                   | CENTRAL DYNAMICS LTD . . . . .                         | 1-2-3-4-5-6-7-8-9-10-14-15-16-17-18-19-20 |
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|  |                                   | CENTURY ELECTRONICS & INSTS INC . . . . .              | 3-14                                      |
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|  |                                   | COHU ELECTRONICS INC KIN TEL DIV . . . . .             | 5   |
|  |                                   | COLUMBIA RECORDS . . . . .                             | 2   |
|  |                                   | COLUMBUS PROCESS CO . . . . .                          | 3-12-18                                   |
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|  |                                   | CONTROL TECHNOLOGY CO . . . . .                        | 1-3-4-5-6-13-16-18                        |
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|  |                                   | COOK ELECTRIC CO DATA STOR DIV . . . . .               | 15  |
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|  |                                   | CP ELECTRONICS INC . . . . .                           | 3-11-17-19                                |
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|  |                                   | DATA SENSORS INC . . . . .                             | 2-4-6-7-8-10-14-18                        |
|  |                                   | DATA TECHNOLOGY CORP PALO ALTO . . . . .               | 5   |
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|  |                                   | DEVELCO INC . . . . .                                  | 2-3-4-6-12-14                             |
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|  |                                   | FDO CANADA LTD . . . . .                               | 3   |
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|  |                                   | ELECTRONIC ENGG CO . . . . .                           | 17-19-20                                  |
|  |                                   | ELECTRONIC INSTRUMENT CO INC . . . . .                 | 3   |
|  |                                   | ELECTRONIC INTL CO . . . . .                           | 17  |
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|  |                                   | ELGIN NATIONAL WATCH CO . . . . .                      | 1-2-3-4-5-6-12-14                         |
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| ADEC INC . . . . .                               | 3                                 |  |   |
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| AIRTRONIX DEVELOPMENT CORP . . . . .             | 3                                 |  |   |
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| ALLISON LABS INC . . . . .                       | 3-6                               |  |   |
| ALMA ENGINEERING . . . . .                       | 0                                 |  |   |
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| ALTO FONIC TAPE SERVICE INC . . . . .            | 15-19-20                          |  |   |
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| AMERICAN BOSCH ARMA CORP . . . . .               | 18                                |  |   |
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| AMERICAN MEASUREMENT & CONTROL INC . . . . .     | 3                                 |  |   |
| AMERICAN MISSILE PROD CO INC . . . . .           | 14                                |  |   |
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| AMPLIVOX LTD . . . . .                           | 7                                 |  |   |
| AMTRON INC MIDLOTHIAN . . . . .                  | 15-18                             |  |   |



# PRODUCTS & MANUFACTURERS

# Amplifiers, Audio • Amplifiers, RF-IF

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| E O ELECTRONICS INC                        | 1                            |
| EPHAD INC                                  | 16                           |
| ERIC ELECTRONICS INC                       | 3-17-19-20                   |
| ESPEY MFG & ELECTRONICS CORP               | 3                            |
| ESS GEE INC                                | 1-2-3-4-8-9-12-13-14         |
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| FISHER BERKELEY CORP                       | 6-7-16                       |
| FISHER RADIO CORP                          | 3-6-7-11-15-17-19-20         |
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| FRANKLIN SYSTEMS INC                       | 3                            |
| GAI-TRONICS CORP                           | 3-6-14-19                    |
| GATES RADIO CO                             | 5-14-16-20                   |
| GEMCO ELECTRIC CO                          | 3                            |
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| HAGAN CHEMICALS & CONTROLS INC             | 5-9-18                       |
| HALLICRAFTERS CO CHICAGO                   | 11                           |
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| INDUSTRIAL ELECTRONICS OF OMAHA INC        | 3                            |
| INDUSTRIAL ELECTRONICS CONTROLS INC        | 7                            |
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| INTERNATIONAL DATA SYSTEMS INC             | 12                           |
| INTERNATIONAL RADIO ELECTRONICS CORP       | 15-17-19-20                  |
| ITA ELECTRONICS CORP                       | 5-6-9-10                     |
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| LYNCH COMMUNICATION SYSTEMS INC            | 3-6-8-9-10-12-18             |
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| MAGNASYNC MFG CO                           | 6-7-8-10-14-15-16-17         |
| MAGNAVOX JEFFERSON CITY                    | 17-19-20                     |
| MARANTZ CO                                 |                              |
| MARCON ELECTRONICS CORP                    | 8                            |
| ROBERT J MARCY ASSOCIATES                  | 5-6-7-8-9-10-13-14-15-16     |
| MARINE ELECTRIC CORP                       | 2-3-4-6-7-16-18-19           |
| MATTERN CORPORATION                        | 3                            |
| MAXSON INSTRUMENTS                         |                              |
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| MAXSON ELECTRONICS CORP ELECTRONIC OES DIV | 1-18                         |
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| MCGOHAN INC DON                            | 3                            |
| MCINTOSH LABS INC                          | 2-3-6-15-17-18-19-20         |
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| MEAGHER ELECTRONICS CO                     | 6-7-8-15-16-17               |
| MEASUREMENT ENGG LTD                       | 6-14                         |
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| MELODY MASTER MFG CO                       | 11                           |
| METAL SPECIALTY PRODUCTS CORP              | 3                            |
| METROTEK ELECTRONICS INC                   | 2-7-10                       |
| MICROMETRICAL MFG CO                       | 12-18                        |
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| MILLIVAC INSTRUMENTS INC                   | 3-18                         |
| MILWAUKEE ELECTRONICS CORP                 | 3                            |
| MIRATEL INC NEW BRIGHTON                   | 0                            |
| MIRATEL INC ST PAUL                        | 3-7                          |
| MODEL ENGG & MFG INC                       | 3-9-18                       |
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| MOUTIC SPECIALITES CO                      | 14-15                        |

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| NORTH ATLANTIC INDUSTRY INC               | 3-4                                       |
| NORTHEAST ELECT CORP                      | 3   |
| NORTHERN ELECT INC                        | 19  |
| NORTHERN RADIO CO                         | 6-14                                      |
| NORTHERN RADIO MFG CO LTD                 | 6-7-10-12-14                              |
| NORTONICS CO INC MPLS                     | 15  |
| ONEIDA ELECTRONICS INC                    | 0   |
| ORBITRONICS INC                           | 5   |
| OTIS ELEVATOR CO DEFENSE & INDUSTRIAL DIV | 3-4-5-8-9-10-12-18                        |
| PACIFIC COMMUNICATIONS & ELECTRONICS CO   | 6-14                                      |
| PACIFIC ELECTRO MAGNETICS CO INC          | 15-18                                     |
| PACO ELECTRONICS CO INC                   | 17-19-20                                  |
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| PAMPA ELECT CORP                          | 15  |
| PAN FAX INC                               | 3-9-15                                    |
| PANTHER ELECTRONICS INC                   | 17-19-20                                  |
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| PEER INC                                  | 5-6                                       |
| PEER INC PROFESSIONAL ELECT ENG           | 18  |
| PERMA-POWER CO                            | 3   |
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| PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV | 3   |
| PILOT RADIO CORP                          | 11-17-20                                  |
| PLANETRONICS INC                          | 2-11                                      |
| PLUG IN INSTRUMENTS INC                   | 3-9-14                                    |
| PM ELECTRONICS INC                        | 6-7-14                                    |
| POWER TRONIC SYSTEMS INC                  | 1-3-4                                     |
| PRATT ALBERT                              | 3   |
| PRECISION ELECTRONICS INC                 | 3-7-15                                    |
| PRECISION SPECIALTIES INC                 | 3   |
| PRODUCTS & INDUSTRIAL ENGRG CORP          | 17-20                                     |
| PROJECTS UNLIMITED INC                    | 3-7-9-14                                  |
| PROTECTION EQUIPMENT CO INC MPLS          | 2-3-7-8-19                                |
| PULSE TECHNIQUES INC                      | 6-7                                       |
| QUAN TECH LAB INC                         | 1-3-4-14                                  |
| QUINDAR ELECTRONICS INC                   | 6   |
| RACON ELECTRIC CO                         | 3   |
| RADIAPHONE CO                             | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-16-18-19 |
| RADIATION ELECT CO DIV COMPOMETER CORP    | 19  |
| RADIATION INC PRODUCTION DIV              | 3   |
| RCA BRDST & COMM PRODS DIV CAMDEN         | 2-5-6-7-8-10-16-19-20                     |
| RCA DEFENSE ELECT PRODS CAMDEN            | 6   |
| RCA BRDST & COMM PRODS DIV MEADOW LANDS   | 2-5-6-7-8-10-16-19-20                     |
| RANGERTONE INC                            | 10-15-19                                  |
| REGENCY ELECTRONICS INC                   | 15-20                                     |
| REK O KUT COMPANY INC                     | 3-6-8-10-15-17-20                         |
| REMLER CO                                 | 3   |
| REPUBLIC ELECT INDUSTRY CORP              | 3-5-7                                     |
| RI TONE PRODS INC                         | 3-15-17                                   |
| ROBERTS ELECTRONICS INC                   | 17  |
| ROBTONICS ENTERPRISES INC                 | 1   |
| ROESCH COMMUNICATIONS DOUGLAS             | 7-16                                      |
| ROHDE & SCHWARZ                           | 9   |
| ROUGE ELECTRONICS CO                      | 8   |
| ROWE INDUSTRIES                           | 4-11                                      |
| SAGE CRAFT INC                            | 9   |
| SATURN ELECTRONICS CORP                   | 3-5                                       |
| SBD SYSTEMS                               | 3-6-10                                    |
| SCHULMERICH ELECTRONICS INC               | 2-3-7-19                                  |
| SCHLUMBERGER RIDGEFIELD INSTRUMENTS       | 18  |
| SCOTT INC M H                             | 1-3-4-6-7-10-13-17-18-19-20               |
| SECURITY DEVICES INC                      | 7   |
| SECURITY DEVICES LAB                      | 3   |
| SERVO CORP OF AMERICA                     | 8-18                                      |
| SETCHELL-CARLSON INC                      | 17  |
| SHELL ELECTRONIC MFG CORP                 | 18  |
| SHERWOOD ELECTRONIC LABS INC              | 17  |
| SHURE BROS                                | 20  |
| SIMMONS PRECISION PRODS GLENDALE          | 1   |
| SOLID STATE ELECTRONICS CO                | 8-14                                      |
| SONEX INC                                 | 3-8                                       |
| SONY CORP                                 | 7   |
| SORENSEN INDUSTRIAL ELECTRONIC CO         | 1-3-7                                     |
| SPACE SYSTEMS INC                         | 17-18                                     |
| SPEC TOOL CO                              | 3   |
| SPERTIL FARADAY INC                       | 7   |
| STANCILOFF-HOFFMAN CORP                   | 5-7                                       |
| STELMA INC                                | 6   |
| STRAND LABS INC                           | 12  |
| SUNDSTRAND DENVER                         | 3   |
| SWITCHCRAFT INC                           | 7-8                                       |
| SYSTRON DONNER CORP                       | 5   |
| TABER INSTRUMENT CORP                     | 3-12-14                                   |
| TAFFET ELECTRONICS INC                    | 3   |
| TABER INSTRUMENT CORP                     | 3   |
| AEROSPACE ELECTRONICS DIV                 | 3-12-13-14                                |
| TAMAR ELECTRONICS INC                     | 10  |
| TAPCO GROUP THOMPSON RAMO WOOLDRIDGE INC  | 14  |
| TECH-MASTER CORP                          | 17-20                                     |
| TELECTRO INDUSTRIES CORP                  | 17-20                                     |
| TELERAD MFG CORP                          | 9   |
| TELE-SIGNAL CORP                          | 6-14                                      |
| TELKOR INC                                | 9   |
| TOPPING ELECTRONICS LTD F V               | 2-5-10-16                                 |
| TRANSDATA INC                             | 18  |
| TRANSONIC INC                             | 14  |
| TROTT ELECTRONICS INC                     | 14  |
| TRUTONE ELECTRONICS INC                   | 3-17-19                                   |
| T T ELECTRONICS INC                       | 13-14                                     |
| U S RECORDING CO                          | 7   |
| ULTRAUDIO DIV OBERLINE INC                | 6-7-8-16                                  |
| ULTRAUDIO PRODUCTS                        | 6-7-8-14-16-19                            |
| ULTRONICS INC                             | 2-3-4-7-8-10-15-17                        |
| UNITED DATA CONTROL INC                   | 15  |

|  |                        |
|--|------------------------|
| UNIVERSAL MATCH CO UNIDYNAMICS DIV         | 4-14                   |
| UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT | 4-14                   |
| VALCO AMPLIFIERS INC                       | 11                     |
| VALUE ENG PROD INC                         | 0                      |
| VENNER ELECTRONICS LTD                     | 14-18                  |
| VIRING TOOL & DIE CO                       | 15                     |
| VINCO ELECTRONICS CORP                     | 3-6-7-8-11             |
| VIRGINIA ELECTRONICS CO                    | 8-14                   |
| VITRO LABORATORIES                         | 3-5                    |
| WARWICK MANUFACTURING CORP ZION            | 3-15                   |
| WARWICK MFG CORP CHICAGO                   | 17-19-20               |
| WASHINGTON TECHNOLOGICAL ASSOC INC         | 3-12                   |
| WAVELABS INC                               | 10                     |
| WEBER ELECT DIV                            | 9-14-15                |
| WESTERN APPARATUS                          | 3                      |
| WESTLAB INC                                | 3-5                    |
| WESTREX CO DIV OF LITTON SYS INC           | 6-10                   |
| WESTREX CO RECORDING EQUIP DIV LITTON SYS  | 15                     |
| WHITE INSTRUMENT LABS                      | 8-15                   |
| WICKES ENGG & CONSTRUCTION CO              | 12-14                  |
| WILCOX ELECTRIC CO INC                     | 5-6-7-8                |
| WINTRONICS INC                             | 3-11-12-16-17-18-19-20 |
| WURLITZER CO TONAWANDA                     | 6-11-17                |
| ZIMNEY CORP                                | 8                      |

## AMPLIFIERS, RF-IF 200

|                               |    |
|-------------------------------|----|
| Amplifiers, antenna           | 1  |
| Amplifiers, distribution      | 2  |
| Amplifiers, IF                | 3  |
| Amplifiers, isolation         | 4  |
| Amplifiers, keying            | 5  |
| Amplifiers, klystron          | 6  |
| Amplifiers, limiting          | 7  |
| Amplifiers, line              | 8  |
| Amplifiers, microwave         | 9  |
| Amplifiers, mixing            | 10 |
| Amplifiers, monitoring        | 11 |
| Amplifiers, narrowband (R-F)  | 12 |
| Amplifiers, noise-suppressing | 13 |
| Amplifiers, peak limiting     | 14 |
| Amplifiers, radar             | 15 |
| Amplifiers, R-F               | 16 |
| Amplifiers, single-sideband   | 17 |

|   |                                 |
|---|---------------------------------|
| AC ELECTRONICS INC                        | 3                               |
| ACF ELECTRONICS DIV RIVERDALE             | 3-8-9-10-12-15-16               |
| ACF ELECTRONICS DIV ACF INDUSTRIES INC    | 3-9-13                          |
| ADEC INC                                  | 1                               |
| ADVANCED ELECT CORP                       | 12-16                           |
| ADVANCED MEASUREMENT INST INC             | 3-12-16                         |
| AERO GEO ASTRO CORP                       | 3                               |
| AERONCA MFG CORP                          | 16                              |
| AEROSPACE ELECTRONICS INC                 | 10-16                           |
| AEROSPACE RESEARCH INC                    | 1-3-12-16                       |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC | 3-9-15-16                       |
| AIRTRON A DIV OF LITTON INDUST            | 9-15                            |
| ALERT PRODUCTS INC                        | 5-15                            |
| ALFRED ELECTRONICS                        | 9-14                            |
| ALLISON LABS INC                          | 7-15                            |
| ALMA ENGINEERING                          | 3-16-17                         |
| ALPHA CORP                                | 1-2-8-9-12-16-17                |
| ALTEC LANSING CORP                        | 11                              |
| AMELCO INC ELECT DEVICES DIV              | 16                              |
| AMERAC INC                                | 9-16                            |
| AMERICAN AIRFRAME CORP                    | 5-6-15-16-17                    |
| AMERICAN ROSCH ARMA CORP                  | 16                              |
| AMERICAN ELECT LABS INC                   | 1-2-3-9-12-15-16                |
| AMERICAN ELECT LABS MICROWAVE & PHASING   | 9-16                            |
| AMERICAN MICROWAVE & TV CORP              | 3-4-6-9-10-11-16                |
| AMP INC CAPITRON DIV                      | 6-15                            |
| AMPLIFIER CORP OF AMER                    | 10                              |
| AMTEL AMERICAN MICROWAVE & TELEVISION     | 9                               |
| AMTRON CORP                               | 16-17                           |
| ANDERSON LAB INC                          | 3-16                            |
| ANTENNA DESIGNS INC                       | 1                               |
| ANTLAB INC                                | 1-9                             |
| APPLIED MICROWAVE LAB INC                 | 9                               |
| APPLIED RESEARCH INC                      | 1-3-4-9-12-16                   |
| APPLIED TECHNOLOGY INC                    | 2-9-16                          |
| ARKAY INTERNATIONAL INC                   | 1                               |
| ARGT ELECTRONICS INC                      | 1-16                            |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD      | 6-9-15                          |
| ASTROMETRICS INC                          | 10                              |
| AVCO CORP ELECTRONICS & DRDNANCE DIV      | 15                              |
| BARKER & WILLIAMSON INC                   | 1-3-16                          |
| BELLATRE ELECTRONICS INC                  | 3-16                            |
| BELLOCK INSTRUMENT CORP                   | 3-4-5                           |
| BENDIX CORP BENDIX RADIO DIV              | 2-3-4-6-7-8-9-10-11-12-13-18-14 |
| BLACKBURN ELECTRONIC CORP                 | 3-16                            |
| BOEHM INC H O                             | 5                               |
| BORG-WARNER CONTROLS                      | 16                              |
| BRACH MFG CORP DIV GEN BRONZE CORP        | 1                               |
| BROWNING LABS INC                         | 6                               |
| BUDELMAN ELECTRONICS CORP                 | 16-17                           |
| CALIF MAGNETIC CONTROL CORP               | 1                               |
| CARDION ELECTRONICS INC                   | 15                              |
| CFNTIMEG ELECTRONICS                      | 10-16                           |





# PRODUCTS & MANUFACTURERS

# Amplifiers, Special Function

|  |                                  |
|--|----------------------------------|
| Amplifiers, power                          | 21                               |
| Amplifiers, pulse                          | 22                               |
| Amplifiers, relay                          | 23                               |
| Amplifiers, servo                          | 24                               |
| Amplifiers, standing wave                  | 25                               |
| Amplifiers, strain gage                    | 26                               |
| Amplifiers, sweep                          | 27                               |
| Amplifiers, synchro                        | 28                               |
| Amplifiers, telemetering                   | 29                               |
| Amplifiers, thyatron                       | 30                               |
| Amplifiers, transistor                     | 31                               |
| Amplifiers, ultrasonic                     | 32                               |
| Amplifiers, vibration pick-up              | 33                               |
| Cavities, tuned, wavemeter                 | 34                               |
| Amplifiers, lasers                         | 37                               |
| ARBEE ELECTRONICS CORP                     | 4-7-18-31                        |
| ARAMS INSTRUMENT CORP                      | 7                                |
| ARCO ELECTRONICS INC                       | 16                               |
| AC ELECTRONICS INC                         | 16                               |
| ACF ELECTRONICS DIV RIVERDALE              | 7-10-22                          |
| ACF ELECTRONICS DIV ACF INDUSTRIES INC     | 10-24-29                         |
| ACOUSTICA ASSOCIATES INC                   | 32                               |
| ACOUSTICA ASSOCIATES                       | 32                               |
| ACROMAG INC                                | 7-9-12-16-20-23-24-26-29         |
| AC SPARK PLUG ELECT DIV GMC                | 21-24-28                         |
| ADAGE INC                                  | 4-7-9                            |
| ADVANCE INSTRUMENT CORP                    | 24                               |
| ADVANCED ELECTRONICS INC                   | 33                               |
| ADVANCED MEASUREMENT INST INC              | 29                               |
| AERONCA MFG CORP                           | 28                               |
| AEROSPACE RESEARCH INC                     | 7-10-14-15-24-29                 |
| AIRBORNE ACCESSORIES CORP                  | 5-7-9-10-12-16-20-23-24          |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC  | 17-31                            |
| AIRCOM INC                                 | 25-34                            |
| AIRPAX ELECT INC SEMINOLE DIV              | 16-29                            |
| AIRPAX ELECTRONICS PACIFIC DIV             | 7-29-31                          |
| AIRPAX ELECTRONICS INC PASADENA            | 16-21-29                         |
| AIRTRONICS INTL CORP                       | 31                               |
| ALFRED ELECTRONICS                         | 7                                |
| ALLEGANY INSTRUMENT CO                     | 4-7-9-18-26-31                   |
| ALMA ENGINEERING                           | 2-3-7-14-18-21-29-31             |
| ALPHA CORP                                 | 21                               |
| AMELCO INC ELECT DEVICES DIV               | 9-31                             |
| AMERICAN AIRFRAME CORP                     | 2-5-7-13-19-21-24-30-31          |
| AMERICAN AVIONICS INC                      | 3-31                             |
| AMERICAN BOSCH CORP                        | 21-29                            |
| AMERICAN BOSCH ARMA CORP                   | 21                               |
| AMERICAN BRAKE SHOF CO RAYMOND ATCHLEY DIV | 4-5-7-18-24-31                   |
| AMERICAN ELCT LABS INC                     | 15                               |
| AMERICAN ELECTRONICS CO MINN               | 16-24-31                         |
| AMERICAN ELCT LABS MICROWAVE & PHASING     | 7-29                             |
| AMERICAN ELECTRONICS INC FULLERTON         | 5-24                             |
| AMERICAN ELECTRIC SWITCH DIV               | 16                               |
| AMERICAN MEASUREMENT & CONTROL BURLINGTON  | 24                               |
| AMERICAN MEASUREMENT & CONTROL INC         | 5-7-24-28                        |
| AMERICAN MICROWAVE & TV CORP               | 13                               |
| AMERICAN MISSILE PROD CO INC               | 6-26                             |
| AMERICAN OPTICAL CO INSTRUMENT DIV         | 7-9-26                           |
| AMERICAN RECTIFIERS CORP                   | 16                               |
| MFRS RICHARDSON ALLEN POWER SUPPLIES       | 16                               |
| AMERICAN RESEARCH & MFG CORP               | 21                               |
| AMPLIFIER CORP OF AMER                     | 21                               |
| AMPLIVOX LTD                               | 10-31                            |
| AMTRON INC MIDLOTHIAN                      | 10-21-24-31                      |
| AMULEX ELECTRONICS INC                     | 2-5-7-14-19-21-22-27             |
| ANALYTIC SYSTEMS CO                        | 6-7-9                            |
| ANDERSEN LAB INC                           | 5-24-32                          |
| ANLAB INC                                  | 1-5-18-30                        |
| APPALACHIAN ELECTRONIC INSTRUMENTS INC     | 20-30-31                         |
| APPLIED CONTROL CORP                       | 7-24                             |
| APPLIED DEVELOPMENT CORP MONTEREY PK       | 4-6-7                            |
| APPLIED ELECTRONICS CORP OF N J            | 7-9-29-31                        |
| APPLIED MICROWAVE LAB INC                  | 34                               |
| APPLIED TECHNOLOGY CORP                    | 4-5-7-9-20-21-23-31              |
| AR & DA ENGG CO                            | 4-6-7-16-18-20-22-23-24-26-31    |
| ARDENTE ACOUSTIC LABS LTD                  | 31                               |
| ARENBERG ULTRASONIC LABORATORY INC         | 32                               |
| ARKAY INTERNATIONAL INC                    | 31                               |
| ARMSTRONG WHITWORTH EQUIP                  | 26                               |
| ASSEMBLY PRODUCTS INC                      | 23                               |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD       | 7-16-24-31                       |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD       | 25                               |
| ASSOCIATED ENGINEERING CO MATTHEWS         | 16                               |
| ASTRODATA INC                              | 7-9                              |
| ASTROMETRICS INC                           | 3-7-29-31                        |
| ATELIERS DE MONTAGES ELECT                 | 5-7-14-15-21-22-24               |
| ATLANTIC INSTRUMENTS & ELECTRONICS INC     | 6-10-22                          |
| ATLANTIC RESEARCH CORP                     | 2                                |
| ATLAS ENG CO                               | 16                               |
| AUDEX CO                                   | 21                               |
| AUDIO INSTRUMENT CO                        | 2-15                             |
| AUSTIN ELECTRONICS DIV AUSTIN CO           | 2-4-5-6-7-9-18-20-21-22-24-28-31 |
| AUTO DATA                                  | 7                                |

|  |   |
|--|---|
| AUTOMATED CONTROLS                       | 3-5-22-32   |
| AUTOMATIC CONTROL CO                     | 7-18-29   |
| AUTOMATION DYNAMICS CORP                 | 5-23-24-29-31   |
| AVIATION INSTRUMENT MFG CORP             | 24  |
| AVIONICS INC                             | 16  |
| RABCOCK & WILCOX BAILEY METER CO         | 16  |
| BACH AURICON INC                         | 6-20-31   |
| ELECTRONICS DIV BALDWIN HAMILTON CORP    | 7-9-26  |
| BARBER & HOWARD CO                       | 7   |
| PARKER & WILLIAMSON INC                  | 7-10-14-21  |
| BARNES ENGINEERING CO                    | 1-15  |
| BASLER ELECTRIC CO                       | 16  |
| BECKMAN INST INC BERKELEY DIV            | 7-12-14-15  |
| BELOCK INSTRUMENT CORP                   | 2-4-5-7-9-10-18-27-28-31  |
| BENCO TELEVISION ASSOC LTD               | 31  |
| BENDIX CORP BENDIX RADIO DIV             | 15-31   |
| BENDIX CORP THE POINEER CENTRAL DIV      | 32  |
| BERGEN LABS INC                          | 31  |
| BERKELEY INSTRUMENT CO                   | 16  |
| BEVA LABORATORY                          | 22  |
| BIOPHYSICAL INSTRUMENTS INC              | 20  |
| B & K INSTRUMENTS INC OF BRUEL & KJAER   | 26-33   |
| BLACKBURN ELECTRONIC CORP                | 16  |
| BLACKSTONE CORP                          | 32  |
| BOONSHAFT & FUCHS INC                    | 7   |
| BORG-WARNER CONTROLS                     | 10  |
| BOY-MAR ELECTRICAL SERVICE CO            | 20  |
| BRAMCO INC SUR LEXED INC                 | 5-29  |
| BROWN ENG CO INC                         | 0-24  |
| BROWNING LABS INC                        | 25  |
| BRUNO NEW YORK INDUSTRY CORP             | 10-31   |
| BRUSH INSTRUMENTS                        | 6-7-9-14-21-24-26-31  |
| BUDELMAN ELECTRONICS CORP                | 14-21   |
| BUFFALO INSTRUMENT CORP                  | 1-6-8-19-26   |
| BULOVA WATCH CO ELECT DIV                | 16-24   |
| BURMAC ELECTRONICS CO INC                | 22  |
| BURR BROWN RESEARCH CORP                 | 4-5-6-7-8-9-12-14-21-31   |
| BUSH TRANSFORMER CORP                    | 16  |
| BYTREC CORP                              | 26  |
| CALIF MAGNETIC CONTROL CORP              | 16  |
| CALIF TECHNICAL INDUSTRY DIV TETRON INC  | 15  |
| CALIFORNIA COMPUTER PROD INC             | 5-22  |
| CALIFORNIA INSTRUMENTS CORP              | 5-6-7-8-9-12-21-24-26-31-33                                     |
| CALMAG DIV CALIF MAGNETIC CONT CORP      | 7-16  |
| CANADIAN AVIA ELECTS                     | 4-5-6-7-12-14-15-16-18-24-31                                    |
| CAROL ELECT DIV WEECO                    | 10-21   |
| CEAR ENG DIV CONTROL DATA CORP           | 24  |
| CELCO CONSTANTINE ENG LAB CO PACIFIC DIV | 27  |
| CENTRALAB DIV GLOBE UNION                | 10-31   |
| CENTRALAB DIV GLOBE UNION                | 7-31  |
| CENTRAL DYNAMICS LTD                     | 31  |
| CENTRAL ELECTRONICS INC                  | 3-31  |
| CENTRAL TRANSFORMER CO                   | 16  |
| CENTURY ELECT INST INC TULSA             | 6-31  |
| CENTURY PROJECTOR CORP                   | 20-21-31  |
| C E S ELECTRONIC PRODUCTS INC            | 5-6-7-8-9-15-26   |
| CHADWICK-HELMUTH CO                      | 19  |
| CHALCO ENGINEERING CORP                  | 3   |
| CHESAPEAKE INSTRUMENT CORP               | 31  |
| CHICAGO ELECTRONIC ENGG CO               | 16  |
| CIMRON CORP                              | 6-7-9-18-26   |
| CIRCUITDYNE CORP                         | 9-16-21-31  |
| CLEVITE ORDNANCE DIV CLEVITE CORP        | 6-7-32  |
| COAST COIL CO                            | 16  |
| COLCRAFT INC                             | 16  |
| COLUMBIA RECORDS                         | 3   |
| COLUMBIA RESEARCH LABS                   | 2-10-21-33  |
| COLUMBUS PROCESS CO                      | 31  |
| COMMERCIAL RADIO SOUND CORP              | 31  |
| COMMUNICATION ACCESSORIES CO             | 16  |
| COMMUNICATION ELECTRONIC INC             | 22-29   |
| COMMUNICATION MEASUREMENTS LABS          | 14-21-22-30-31-32   |
| COMMUNITY ENGG CORP                      | 22-29   |
| COMPTON CORP                             | 4-6-31  |
| COMPUDYNE CORP                           | 5-24-29   |
| COMPUTER CONTROL CO INC EASTERN DIV      | 4   |
| COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC  | 6   |
| COMPUTER LOGIC CORP                      | 22  |
| COMPUTER PRODUCTS INC                    | 4-7-12-23-24-31   |
| COMPUTER SYSTEMS INC                     | 4-24  |
| COMPUTER TEST CORP                       | 4-22  |
| COMPUTING DEVICES OF CANADA LTD          | 15  |
| CONSOLIDATED AIRBORNE SYSTEMS INC        | 5-6-7-24-28-29  |
| CONSOLIDATED ELECT CORP                  | 6-7-12-14-22  |
| CONTINENTAL ELECTRONIC MFG CO            | 13-14-21-22   |
| LABS LING TEMCO-VOUGHT INC               | 31  |
| CONTINENTAL MFG INC                      | 31  |
| CONTROL LOGIC INC                        | 4-10  |
| CONTROLROM LABS                          | 5-7-9-16  |
| CONTROL TECHNOLOGY CO                    | 2-3-4-5-6-7-8-9-10-12-14-15-16-18-20-21-23-24-26-28-29-30-31-33 |
| CONTRONICS INC                           | 28-29-30-31-33  |
| COOK ELECTRIC CO DATA STOR DIV           | 6-20  |
| COSMIC RADIATION LABS                    | 22  |
| COURTIER PROD DIV MODEL ENGG & MFG INC   | 24  |
| CP ELECTRONICS INC                       | 31  |
| CRANE ELECTRONICS CO                     | 31  |
| CROWN ENG DIV DATA TECH INC              | 26  |
| CUBIC CORP                               | 2-4-7-9-10-21-24-28-31  |
| ELECTRONICS DIV CURTISS WRIGHT           | 21  |
| CURTISS-WRIGHT CORP ELECTRONICS DIV      | 4-7   |
| DALLONS LABS                             | 19  |
| DALMO VICTOR CO DIV TETRON INC           | 2-5-6-7-10-12-17-21-24  |
| DALTRONICS INC                           | 16  |
| DAMON ENGINEERING INC                    | 15  |
| DANA LAB INC                             | 1-4-5-6-7-9-29-33   |

|  |   |
|--|---|
| DATA CONTROL SYSTEMS INC                     | 6-29                                      |
| DATA MASTER CORP THE                         | 24-30                                     |
| DATA TECHNOLOGY CORP PALD ALTO               | 9-31                                      |
| DATASCAN INC                                 | 18-20                                     |
| DATA TRONIX CORP                             | 7-9-14-24-29-31                           |
| DATFX CORP                                   | 31  |
| DAYSTROM INC MILITARY ELECTRONICS DIV        | 4   |
| DAYSTROM INC TRANSCIDIL DIV                  | 24  |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 20  |
| DAYSTROM TRANSISTOR CORP                     | 24  |
| DAYTON ELECT PROD CO INC                     | 2-7-19-27                                 |
| DAYTRONIC CORP                               | 6-19-26-33                                |
| DBM RESEARCH CORP                            | 6-22-29-31                                |
| DECITRON ELECTRONICS CORP                    | 16-21-22-24                               |
| DECKER CORP                                  | 2-29                                      |
| DEITZ CO S J                                 | 5-20-23-30                                |
| DELCON CORP                                  | 32  |
| DELTRON CO INC VAN NUYS                      | 16  |
| DE-TEC-TRONIC CORP                           | 5-7-20-23-30-31                           |
| DETROIT DESIGNING & ENG CO                   | 4-5-7-10-14-21-22-23-24-28-29-31          |
| DEVFLO INC                                   | 2-10-31                                   |
| DI-AN CONTROLS INC                           | 24-28                                     |
| DIATRON INC                                  | 7   |
| DIEML MFG CO                                 | 24-31                                     |
| DIFITZ CO S J                                | 5-20-23-30                                |
| DIGITROL SYSTEMS INC                         | 5-20                                      |
| DIOTRON INC                                  | 16  |
| DON BOSCO ELECT SUB OF HDWELL ELCT MOTORSC6  | 33  |
| DORSETT ELECTRONICS                          | 7-29                                      |
| DOTY ACOUSTICAL ELECTRONIC LABS              | 7-21-31                                   |
| DRESSER ELECT SIE DIV                        | 7-21                                      |
| DRESSER ELECT HST DIV                        | 16  |
| DREXEL DYNAMICS CORP                         | 4   |
| DUKANE CORP                                  | 4   |
| OYNACO INC                                   | 21  |
| DYNAIR ELECTRONICS INC                       | 14-21-31                                  |
| DYNAMETRICS CORP                             | 18-24-26                                  |
| DYNAMICS INST CO                             | 2-4-6-7-9-12-14-15-26-31                  |
| DYNAPLEX CORP                                | 2-4-6-7-9-10-14-22-26-29-31-33            |
| OYNASCIENCES CORP                            | 24-29-31                                  |
| DYNATRON LAB                                 | 7-9-22-29                                 |
| DYNATRON INST CORP ELECTR DIV                | 16  |
| LAB LINE INSTRUMENTS INC                     | 24  |
| EASTERN INDUSTRIES DIV OF L F E INC          | 10-21-26-31                               |
| EATON MFG CO DYNAMIC DIV                     | 22-24-28-31                               |
| EDO CANADA LTD                               | 31-32                                     |
| EDD CORP COLLEGE PT                          | 29  |
| EDP CORPORATION                              | 2-4-7-9-12-14-18-19-20-27                 |
| ELCOR INC                                    | 2-4-7-9-12-14-18-19-20-27                 |
| ELECT MECHANICAL RES INC                     | 29-31                                     |
| ELECTRA SCIENTIFIC CORP                      | 2-33                                      |
| ELECTRAN MFG CO                              | 16  |
| ELECTRIC EYE EQUIPMENT CO                    | 5-20-24-31                                |
| ELECTRO DEVELOPMENT CORP SEATTLE             | 6-7-16-26-29-33                           |
| ELECTRODYNAMIC INSTRUMENT CORP               | 6-21-24                                   |
| ELECTRO INSTRUMENT INC                       | 6-7-9-26-31                               |
| ELECTRO KINETICS CORP                        | 10-16-21-24                               |
| ELECTROL SPECIALTIES CO                      | 24  |
| ELECTROMATION CO                             | 24  |
| ELECTRO MECHANICAL CORP                      | 1-2-5-18-21-24-31                         |
| ELECTRO MECHANICAL RESEARCH INC              | 7-29                                      |
| ELECTRO MEDICAL ENG CO                       | 2-6-12-19-26                              |
| ELECTRONEX INDUSTRIAL LABORATORIES           | 5-7-9-16                                  |
| ELECTRO SCIENTIFIC IND INC                   | 18  |
| ELECTRO VISION LAB                           | 5-23-30                                   |
| ELECTRO WINDERS CO INC                       | 16  |
| ELECTRON OHIO INC                            | 6-16-31                                   |
| ELECTRONIC APPLICATIONS INC                  | 37  |
| ELECTRONIC COMMUNICATION EQPT CO             | 21  |
| ELECTRONIC COMMUNICATIONS                    | 24  |
| ELECTRONIC COMM & COMP DES & DEV CORP        | 2-6-11-20                                 |
| ELECTRONIC COMPUTER CO                       | 4-7-9                                     |
| ELECTRONIC CONTROL CORP                      | 20-30                                     |
| ELECTRONIC CONTROLS INC                      | 4-9-18-20-23-30-31                        |
| ELECTRONIC CONTROLS SYSTEMS INC              | 4-5-7-9-10-16-18-23-24                    |
| ELFETRONIC COUNTERS INC                      | 4   |
| ELECTRONIC CRAFTSMEN INC                     | 2-5-6-7-8-9                               |
| ELECTRONIC DESIGN & DEVELOP CO               | 6-7-20                                    |
| ELECTRONIC DEVELOPMENT CORP                  | 7-31                                      |
| ELECTRONIC ENGG CO                           | 21  |
| ELECTRONIC INTL CO                           | 21  |
| ELECTRONIC PROCESS CORP SAN CARLOS           | 9-18-24                                   |
| ELECTRONIC RESEARCH ASSOCIATES INC           | 7-16-31                                   |
| ELECTRONIC SYSTEMS ENGG CO                   | 5   |
| ELECTRONIC TRANSISTORS CORP                  | 31  |
| ELECTRONICS SYSTEMS INC                      | 15  |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 2-3-4-6-7-9-10-12-14-15-16-21-22-23-31-33 |
| ELIN DIV INTL ELECT RESCH CORP               | 21  |
| ELION INSTRUMENTS INC                        | 10-19-27                                  |
| ELLIOTT BROS LONDON LTD RADAR DIV            | 4-5-6-7-12-31                             |
| EMCEE ELECTRONICS INC                        | 5-6-7-8-24-26-31                          |
| EMERSON ELECTRIC MFG CO ELECT & AVIONICS DIV | 31  |
| ENDEVCO CORP                                 | 2-6-7-9-10-14-21-26-29-31-33              |
| ENG NORTHWEST                                | 4-5-22                                    |
| ENGINEERED ELECTRONICS CO                    | 31  |
| ENGINEERED MAGNETICS                         | 26  |
| ENSCO INC                                    | 4-7-26-31                                 |
| ENTON INC                                    | 14-21-31                                  |
| E O ELECTRONICS INC                          | 8-33                                      |
| EPSCO INC CAMBRIDGE                          | 4-11-14-15-29-31                          |
| ERWOOD INC                                   | 2-7-33                                    |
| ESPEY MFG & ELECTRONICS CORP                 | 4-7-9-10-16-21-22-26-31                   |
| ESS GEE INC                                  | 2-4-6-7-8-9-12-23-24-26-28-29-31          |
| EXACTEL INSTRUMENT CO                        | 24  |



# Amplifiers, Special Function

# PRODUCTS & MANUFACTURERS

|  |                           |  |  |                              |                                 |
|--|---------------------------|--|--|------------------------------|---------------------------------|
| FAPINON ELECTRIC                             | 21                        | JOHNSON ELECTRONICS INC                      | 16                                       | MONROE ELECTRONICS INC       | 4-7-8-9-12-14-18-20-21-26-29-31 |
| FARRAND OPTICAL CO INC                       | 7                         | JORDAN CONTROLS INC                          | 24                                       | MONTEK ASSOCIATES INC        | 5-7-14-24-31                    |
| FEDERAL MFG & ENG CORP TV SPECIALTY DIV      | 31                        | J-V-M DIVISION FIDELITONE MICROWAVE INC      | 1-                                       | MOSLER RESEARCH PROD INC     | 33                              |
| FEEDBACK CONTROLS INC                        | 4-16-24                   | KAMAN AIRCRAFT CORP                          | 21-34                                    | MUIRHEAD & CO LTD            | 24                              |
| FIDELITY AMPLIFIER CO                        | 20-21-23-30-31            | KANE ENGINEERING LABORATORIES                | 5-24-31                                  | MUIRHEAD INSTRUMENTS INC     | 11-24-33                        |
| FIDELITY INSTRUMENT CORP                     | 16                        | KEARFOTT DIV GPI LITTLE FALLS                | 20-22-26-29-31-33                        | MUTRON INC                   | 4-7-9-10-12-14-21-26-31-32      |
| FIFTH DIMENSION INC                          | 7-9-29                    | KEITHLEY INSTRUMENTS INC                     | 31                                       | NANILOA CORP                 | 20-24                           |
| FISHER RADIO CORP                            | 21                        | KELTRON CORP                                 | 2-7-8-9-15                               | NATIONAL ELECTRONICS LAB     | 7                               |
| FISHER RESEARCH LAB                          | 33                        | KENYON TRANSFORMER CO                        | 4-5-7-12-16-21-22-24-27-31               | NATIONAL SCIENTIFIC LABS INC | 22                              |
| FORWAY INDUSTRIES INC                        | 20-31-34                  | KEPCO INC                                    | 16                                       | NATIONAL ULTRASONIC CORP     | 32                              |
| FOXBOPO CO                                   | 5-6-7-16-24-29-31         | KEYSTONE PRODUCTS CO                         | 16                                       | NAVIGATION COMPUTER CORP     | 4-6-31                          |
| FRANKLIN ELECTRONICS INC                     | 7-14                      | KINELOGIC CORP                               | 16-24                                    | NEFF INSTRUMENT CORP         | 7-9                             |
| FRANKLIN SYSTEMS INC                         | 23                        | KINNELECTRONICS CORP                         | 6  | NEPTUNE ELECTRONICS CO       | 5-7-21                          |
| FREED TRANSFORMER CO                         | 16-18                     | KISTLER INSTRUMENT CORP                      | 4  | NEWCOMB AUDIO PROD CO        | 22                              |
| F X R INC WOODSIDE                           | 1                         | KLEER-TRONICS INC                            | 2-33                                     | NICHOLS & CLARK INC          | 31                              |
| FYR-FYTER ELECTRONIC & ALARM CORP            | 21-31                     | KOLLMORGEN CORP                              | 31                                       | NORBATROL ELECTRONICS CORP   | 9-16-18                         |
| GAI-TRONICS CORP                             | 31                        | KOLLSMAN INSTRUMENT CORP                     |  | NORTH ATLANTIC INDUST INC    | 31                              |
| GATES RADIO CO                               | 31                        | SUB STANDARD KOLLSMAN IND                    | 4-5-10-16-17-18-20-21-24-28              | NORTH ELECTRIC CO            | 24                              |
| GP COMPONENTS INC                            | 9                         | KROHN-HITE CORP                              | 7-21                                     | NORTHERN RADIO CO            | 29                              |
| GFMCO ELECTRIC CO                            | 5-21                      | LABLINE INC                                  | 20-23                                    | NORTHERN RADIO MFG CO LTD    | 3-31                            |
| GENERAL COMPUTERS INC                        | 4-5-6-7-8-9-12            | LAFAYETTE INSTRUMENT CO                      | 6-7-9-20                                 | NORTH HILLS ELECTRONICS INC  | 7                               |
| GENERAL DYNAMICS ELECTRONICS                 | ROCHESTER 4-6-21-22-29-31 | LANDSVERK ELECTROMETER CO                    | 14-15-22                                 | NORTRONICS DIV NORTHRUP CORP | HAWTHORNE 4-                    |
| GENERAL ELECTRIC CO POWER TUBE DEPT          | 13                        | LANGEVIN DIV OF SONOTEC INCORP               | 3  |                              |                                 |
| GENERAL ELECTRIC CO ATOM POWER EQUIP         | 22                        | LASER SYSTEMS CENTER OF LEAR SEIGLER INC     | 17-35                                    |                              |                                 |
| GENERAL ELECTRIC CO UTICA                    | 4-5-21-22-23-24           | LEACH CORP SPECIAL PRODUCTS DIV              | 6-7-31                                   |                              |                                 |
| GENERAL INSTRUMENT CORP RADIO RECEPTOR DIV   | 29                        | LEAR INC ASTRONICS DIV                       | 0  |                              |                                 |
| DEF & ENGG PRODS GRP                         | 16                        | LEAR SIEGLER INC ELECT INST DIV              | 7  |                              |                                 |
| GENERAL MAGNETICS INC BLOOMFIELD             | 29                        | LEAR SIEGLER INC POWER EQUIP DIV             | 16-24                                    |                              |                                 |
| GENERAL MAGNETICS INC MINN                   | 16                        | LEOS & NORTHRUP CO                           | 5-7-14-15-18-24                          |                              |                                 |
| GENERAL MICROWAVE CORP                       | 1-13-25-34                | LEIGH VALLEY ELECT ENGG & MFG CO             | 33                                       |                              |                                 |
| GENERAL MILLS INC MINN                       | 4-7                       | LEL INC                                      | 15-29-31                                 |                              |                                 |
| GENERAL RADIO CO                             | 7-18-21-22-31-33          | LESSELLS & ASSOCIATES INC                    | 26                                       |                              |                                 |
| GEORGE GORTON MACHINE CO                     | 5                         | LEWIS & KAUFMAN ELECTRONICS TUBE DIV         | 13                                       |                              |                                 |
| GEOTECHNICAL CORP                            | 6-7-18-26-33              | LIRASCOPE DIV GENERAL PRECISION INC          | 4-5-9-                                   |                              |                                 |
| GEOTRONIC LABS INC                           | 4-16-24-31                | LING-TEMCO VOUGHT INC ELECT DIV              | 12-21-22-24                              |                              |                                 |
| GERST & CO PAUL E                            | 16                        | LINK DIV GENERAL PRECISION INC               | 2-4-5-7-9-                               |                              |                                 |
| GERTSCH PRODUCTS INC                         | 18                        | LIQUIDOMETER CORP                            | 12-14-15-21-22-24-28-31                  |                              |                                 |
| GIBBS MFG RESEARCH CORP                      | 18-24-31                  | LITTON SYSTEMS INC APPLIED SCIENCE DIVISION  | 29                                       |                              |                                 |
| GISHOLT MACHINE CO                           | 24                        | LOENCO INC                                   | 7  |                              |                                 |
| GOOD ELECTRONICS CORP                        | 7-9-26                    | LUMATRON ELECTRONICS INC                     | 19-31                                    |                              |                                 |
| GPL DIV GENERAL PRECISION INC                | 24                        | LUMEN INC                                    | 16-31                                    |                              |                                 |
| GRAFLEX INC                                  | 31                        | LYNCH COMMUNICATION SYSTEMS INC              | 2-3-4-6-9-12-14-15-18-21-22-23-24-27-29- |                              |                                 |
| GRANGER ASSOC                                | 13                        |  | 31                                       |                              |                                 |
| GREGORY MAGNETIC INDUST INC                  | 22-31                     | MACHINERY ELECTRIFICATION INC                | 20                                       |                              |                                 |
| GULTON INDUSTRIES INC METUCHEN               | 2-3-4-5-6-                | MADIGAN ELECTRONIC CORP                      | 24-31                                    |                              |                                 |
|  | 7-8-10-15-16-24-26-29-31  | MAGNADYNE CORP                               | 2-4-5-7-10-16-21-24-26-31                |                              |                                 |
| GULTON INDUSTRIES INC ENG MAGNETICS DIV      | 16                        | MAGNASYNCF MFG CO                            | 31                                       |                              |                                 |
| GULTON INDUSTRIES INC ORTHOLOG DIV           | 3                         | MAGNETIC CIRCUIT ELEMENTS INC                | 7-10-14-16-21-24-26-29                   |                              |                                 |
| HAGAN CHEMICALS & CONTROLS INC               | 7-9-12-14-16-18-21-22-31  | MAGNETIC CONTROLS CO                         | 5-7-16-24                                |                              |                                 |
|  | 6-7-29                    | MAGNETIC INSTRUMENT CO INC                   | 7-9-24                                   |                              |                                 |
| HALEX INC                                    | 16                        | MAGNETIC RESEARCH CORP                       | 7-16-24                                  |                              |                                 |
| HALLAMORE ELECTRONICS CO                     | 7-29                      | MAGNETICO INC                                | 5-16-24-31                               |                              |                                 |
| HALLICRAFTERS PACIFIC DIV                    | 6-9-10-15-29              | MAGNETICS INC                                | 5-7-14-16-21-22-26                       |                              |                                 |
| HALLICRAFTERS CO CHICAGO                     | 3-15-29                   | MAGNETIC SYSTEMS CORP                        | 16                                       |                              |                                 |
| HAMILTON ELECTRONICS CORP                    | 21-31                     | MALLORY ELECT CO                             | 5-7-8-9-10-18-26-31                      |                              |                                 |
| HAMNER ELECTRONICS CO INC                    | 14-22                     | MANSON LABORATORIES INC                      | 2-13-14-21-31                            |                              |                                 |
| HARREL INC                                   | 5-7-9-16-18-24-26-31      | MARCH DYNAMICS INC                           | 34                                       |                              |                                 |
| HAYS CORP                                    | 24                        | MARCON ELECTRONICS CORP                      | 29                                       |                              |                                 |
| HEATH CO SUB OF DAYSTROM INC B HARBOR        | 4                         | MARINE ELECTRIC CORP                         | 21-31                                    |                              |                                 |
| HEATH CO DIV OF DAYSTROM INC ST JOS          | 4-14-24-31                | MARS LAND ENGG LTD                           | 12-24                                    |                              |                                 |
| HELIPOT DIV BECKMAN INST FULLERTON           | 24                        | MASER OPTICS INC                             | 22                                       |                              |                                 |
| HENRY & MILLER INDUSTRIES INC                | 24                        | MAXSON ELECTRONICS CORP N Y                  | 15                                       |                              |                                 |
| HENSCHEL CORP                                | 24-28-31                  | MAXSON INSTRUMENTS                           | 15                                       |                              |                                 |
| HEWLETT PACKARD CO                           | 31-34                     | DIV MAXSON ELECTRONICS CORP                  | 15                                       |                              |                                 |
| HEYER INDUSTRIES INCORPORATED                | 16-19                     | MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 3-7-8-14-15-22                           |                              |                                 |
| LAB OF MARQUETTE CO                          | 5-23                      | MAYBERRY ELECTRONICS CO                      | 7-24-31                                  |                              |                                 |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 6-11                      | MCGOHAN INC DON                              | 21                                       |                              |                                 |
| HOGAN FAXIMILE CORP                          | 6-11                      | MCKENNA LABORATORIES                         | 32                                       |                              |                                 |
| HONEYWELL CONTROLS LTD                       | 23-24                     | MCMARTIN INDUSTRIES INC                      | 31                                       |                              |                                 |
| HOOPER ELECTRIC CO                           | 24                        | MEASUREMENT ENGG LTD                         | 3-7-20-31                                |                              |                                 |
| HOOPER ELECTRONICS CO                        | 29                        | MEASUREMENT SYSTEMS INC                      | 1-24                                     |                              |                                 |
| HOUSTON INSTRUMENT CORP                      | 7                         | MEDCRAFT ELECTRONIC CORP                     | 5-9-26                                   |                              |                                 |
| HOWARD INSTRUMENT CO                         | 22-31                     | MEDISTOR INST CO                             | 7-18-19-25-31                            |                              |                                 |
| HRB SINGER INC                               | 15-32                     | MEDTRONIC INC                                | 29                                       |                              |                                 |
| HUGHES & PHILLIPS                            | 3                         | MELARS                                       | 13-17-21-22-23-29-34                     |                              |                                 |
| HUNT ELECTRONICS                             | 30                        | MELCOR ELECT CORP                            | 2-3-4-7-9-10-24-31                       |                              |                                 |
| HURLETRON INCORPORATED ELECTRIC EYE EQP DIV  | 5-20-24-31                | MELROY ELECTRONIC MFG CO                     | 21                                       |                              |                                 |
| HUYCK SYSTEMS CO DV OF HUYCK CORP            | 9-24                      | MICRODOT INC MAGNETICS DIV                   | 7  |                              |                                 |
| H W ELECTRONICS INC                          | 4-31                      | MICRODOT GEE PROD INC                        | 7  |                              |                                 |
| HYCON MFG CO                                 | 24                        | MICROWAVE INSTRUMENT CO                      | 16                                       |                              |                                 |
| HYDROPOISE INC SUB BROOKS INST CO            | 22                        | MICROMETRIC MFG CO                           | 18-20-23-33                              |                              |                                 |
| HYSON MFG CO PASADENA                        | 5-24                      | MICRO METRICS INC                            | 4-5-24-28                                |                              |                                 |
| IMPERIAL ELECT INC                           | 4-7-9-12                  | MIDWESTERN INC                               | 4-9-12-14-15-16-22-27-28-32              |                              |                                 |
| INDUCTOP ENGG INC                            | 16                        | MIDWESTERN INSTRUMENTS                       | 6-7-24-26-29                             |                              |                                 |
| INDUSTRIAL CONTROL CO                        | 5-7-18-24-28              | MILGO ELECT CORP                             | 7-24                                     |                              |                                 |
| INDUSTRIAL ELECTRONICS INC                   | 6-20-26-31                | MILLEN MFG CO JAMES                          | 19-27                                    |                              |                                 |
| INDUSTRIAL TEST EQUIPMENT CO                 | 18-21                     | MILLIVAC INSTRUMENTS INC                     | 7-31                                     |                              |                                 |
| INFRARED INDUSTRIES INC WESTERN DIV          | 1-2-5-                    | MILRO CONTROLS CO INC                        | 16                                       |                              |                                 |
|  | 10-12-20-31               | MILWAUKEE ELECTRONICS CORP                   | 10-16-24                                 |                              |                                 |
| INSTRON ENGG CORP                            | 12-26                     | MINNEAPOLIS-HONEYWELL HEILAND DIV            | 6-9-12-                                  |                              |                                 |
| INSTRUMENT LABS CORPORATION                  | 31                        |  | 14-21-26-31-33                           |                              |                                 |
| INSTRUMENTS FOR INDUSTRY INC                 | 2-14-15-21-22-            | MINNEAPOLIS-HONEYWELL BOSTON DIV             | 31                                       |                              |                                 |
|  | 29-31                     | MINNEAPOLIS-HONEYWELL FALL RIVER DIV         | 4-5                                      |                              |                                 |
| INTERELECTRONICS CORP                        | 2-3-4-5-7-10-15-16-       | MINNEAPOLIS-HONEYWELL APPARATUS CONTROLS DIV | 5-23-24-31                               |                              |                                 |
|  | 18-21-31-32-33            | MINNEAPOLIS-HONEYWELL ORDANCE DIV            | 22-32                                    |                              |                                 |
| INTERNATIONAL DATA SYSTEMS INC               | 2-5-6-7-14-               | MINNEAPOLIS-HONEYWELL AERO DIV               | 1-4-5-6-7-9-                             |                              |                                 |
|  | 22-24-26-29-31-33         |  | 10-11-12-14-15-16-17-18-20-21-           |                              |                                 |
| INTERNATIONAL RESEARCH & DEVELOPMENT CORP    | 5-6-33                    |  | 22-23-24-26-28-29-31-33                  |                              |                                 |
| INTERSTATE ELECTRONICS CORP                  | 7                         | MINNEAPOLIS-HONEYWELL BROWN INST DIV         | 7-16-                                    |                              |                                 |
| ITA ELECTRONICS CORP                         | 13                        |  | 24                                       |                              |                                 |
| I TEL INC                                    | 15                        | MIRATEL INC NEW BRIGHTON                     | 0  |                              |                                 |
| ITT FEDERAL LABS NUTLEY                      | 17                        | MODEL ENGG & MFG INC                         | 2-5-6-7-9-10-12-14-15-                   |                              |                                 |
| ITT KELLOGG COMM SYSTEMS DEPT                | 4-5-13                    |  | 18-19-21-22-23-24-28-31-34               |                              |                                 |
| JACK & HEINTZ DIV SIEGLER CORP               | 21                        |  |  |                              |                                 |
| JAMES ELECTRIC INC                           | 31                        |  |  |                              |                                 |
| JANSEN ELECT MFG CO INC                      | 7                         |  |  |                              |                                 |
| JARVIS ELECTRONICS CORP                      | 2-3-5-7-8-16-15-19-       |  |  |                              |                                 |
|  | 20-21-24-26-28            |  |  |                              |                                 |
| JERROLD ELECTRONICS CORP                     | 15-19-27-31               |  |  |                              |                                 |
| JOHNSON CO E F                               | 14                        |  |  |                              |                                 |

For Company Addresses, See Alphabetical Listing of Electronic Mfrs.

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# PRODUCTS & MANUFACTURERS

|   |                               |
|---|-------------------------------|
| RESE ENGG INC                                   | 22                            |
| RFS ENGINEERING CO                              | 8-9-14-22-31                  |
| RHG ELECTRONICS LAB INC                         | 3-14-15-19-21-22-29           |
| RICH ELECTRONICS INC                            | 6-32                          |
| RIKER INDUSTRIES INC                            | 22-29                         |
| RIL ELECTRONICS CORP                            | 7-16                          |
| RISCO   | 21-29                         |
| RI TONE PRDGS INC                               | 31                            |
| RIXON ELECTRONICS INC                           | 10-21-31                      |
| R M S ASSOCIATES INC                            | 6-9-12-19-27-32               |
| RBDOTMICS ENTERPRISES INC                       | 31                            |
| RBDOTMICS ENTERPRISES INC                       | 20                            |
| ROHDE & SCHWARZ                                 | 21                            |
| ROUGE ELECTRONICS CO                            | 29                            |
| ROWE INDUSTRIES                                 | 31                            |
| R S ELECTRONICS CORP                            | 15-22                         |
| RYTRON CD INC                                   | 16                            |
| SANGAM ELECTRIC CO                              | 16                            |
| SANGAM MICROSDNICS INC                          | 30                            |
| SARTRON INC                                     | 16                            |
| SBD SYSTEMS                                     | 7-16-21-31                    |
| SCHAEVITZ ENGG                                  | 18-24                         |
| SCHULMERICH ELECTRONICS INC                     | 25-31                         |
| SCHLUMBERGER RIDGEFIELD INSTRUMENTS             | 7-9-31                        |
| SCDTT INC H H                                   | 8-18-19-21-23-32-33           |
| SECTRON INC                                     | 5-7-10-24-26-31               |
| SENECA FALLS MACHINE CO                         | 24                            |
| SERVD CNTRL DIV DILGEAR CO                      | 24                            |
| SERVD CORP OF AMERICA                           | 1-22-24                       |
| SERVD DYNAMICS CORP                             | 24-28                         |
| SERVOMECHANISMS INC EL SEGUNDO                  | 4-5-14-16-21-24-29-31         |
| SERVD TEK PRDCTS CO                             | 16-24                         |
| SIERRA ELECTRONIC DIV PHILCO CORP               | 13-21                         |
| SIGMA INSTRUMENTS INC                           | 5-7-9-10-12-14-16-18-20-22-23 |
| SIMMONDS PRECISION PRDGS GLENDALE               | 22-24-27-31                   |
| SINGER METRICS DIV SINGER MFG CO                | 7                             |
| SINGER METRICS SENSITIVE RES DIV                | 20                            |
| SOLA ELECT CO SOLA TRANSFORMER DIV              | 16                            |
| SOLID STATE ELECTRONICS CO                      | 4-7-9-10-22-29-31             |
| SONEX INC                                       | 7-10-21-29                    |
| SORENSEN INDUSTRIAL ELECTRONIC CO               | 3-5-7-22-23-31                |
| SPACE CNTRL CORP                                | 21                            |
| SPACE INSTRUMENTATION CORP                      | 2-6-10-31-33                  |
| SPACDNICS & PORTABLE ELECTRIC TOOLS INC         | 29                            |
| SPARTON ELECTRONICS                             | 5-7-8-9-14-16-21-22-23        |
| SPECIAL INSTRUMENTS LABRATORY INC               | 24                            |
| SPECIALTIES INC CHARLDTTESVILLE                 | 5-20-24-31                    |
| SPEC TOOL CO                                    | 6-24-31                       |
| SPECTROLAB DIV TEXTRON ELECTRONICS INC          | 20                            |
| SPENCER-KENNEDY LABS INC                        | 31                            |
| SPERRY ELECTRONIC TUBE DIV SPERRY RAND CORP     | 13-22                         |
| SPERRY FARRAGUT CO DIV SPERRY RAND CORP         | 4-9-12-24-31                  |
| SPERRY GYROSCOPE CO DIV SPERRY RAND CORP        | 16-24                         |
| SPERRY ELECTRONIC TUBE DIV SPERRY RAND CORP     | 13-17                         |
| SPERRY MICROWAVE ELECT INC                      | 1-17-25-34                    |
| SPERRY PHOENIX CO DV                            | 24                            |
| SPERRY UTAH CO DV SPERRY RAND CORP              | 4-5-6-10-12                   |
| STANCOR ELECTRONICS INC                         | 16                            |
| STANDARD INSTRUMENT CORP                        | 20                            |
| STANDARD PRODUCT INC SUB ELECTR COMM INC        | 11                            |
| STANDARD WINDING CO DIV OF OVITRON CORP         | 5-16-31                       |
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| Antennas, amateur              | 2  |
| Antennas, broadcasting AM      | 3  |
| Antennas, broadcasting FM & TV | 4  |
| Antennas, citizens band        | 5  |
| Antennas, direction finding    | 6  |
| Antennas, ferrite core         | 7  |
| Antennas, ground plane         | 8  |
| Antennas, home all-wave        | 9  |
| Antennas, helical              | 10 |
| Antennas, indoor, FM & TV      | 11 |
| Antennas, loop                 | 12 |
| Antennas, loop-core            | 13 |
| Antennas, marine               | 14 |
| Antennas, master community     | 15 |
| Antennas, microwave            | 16 |
| Antennas, mobile               | 17 |
| Antennas, parabolic            | 18 |
| Antennas, radar, ground        | 19 |
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| Antennas, radar, surface       | 21 |
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 PEARCE SIMPSON INC MARINE & COMM DIVISION 14-17  
 PEERLESS PRODUCTS INDUSTRIES 11-23-24  
 PHAOSTRON INSTRUMENT & ELECTRONIC CO 1  
 PHILCO CORP PHILA 1-6-14-16-18-19-20-21-26-27-28-29-30-31-32-33  
 PHILCO CORP SPACE DIV 28  
 PHILCO CORP COMMUNICATIONS & WEAPONS DIV 1-6-14-16-18-19-20-21-26-27-28-29-30-31-32-33  
 PHILCO CORP G & I DIV 1-20  
 PHILMORE MFG CO INC 9  
 PICKARD & BURNS INC SUB GORHAM CORP 12-13  
 PLAS TRON CORP 8-17-30-32  
 POLARAD ELECTRONICS CORP 1-16-18-34  
 PREMAX PRODUCTS DIV CHISHOLM RYDER CO 2-5-8-9-14-17-33

PRDELIN INC 4-8-16-17-18-19-21-25-26-28-30-31-32-33-34  
 PRDDUCTS & INDUSTRIAL ENGRG CORP 11-13  
 PROJECTS UNLIMITED INC 14-23  
 PYE CANADA LTD 31-33  
 Q L C CORP 7  
 QUANTATRON INC 1-10-16-20  
 RACAL ELECTRONICS LTD 10-14-30-31-32-33  
 RADATRON INC 16  
 RADIATION ENGG LABS 16-19-20-21-30-31-32-33  
 RADIATION INC 1-10-12-16-19-28  
 RADIATRONICS INC 1-10-14-16-17-18-19-20-21-27-28-30-31-34  
 RADIO ACTIVITIES INC 1-2-3-5-6-9-14-16-17-30-31-32-33  
 RCA BRODST & COMM PRODS DIV CAMDEN 3-4-16-17-18-27-30-31-34  
 RCA BRODST & COMM PRODS DIV MEADOW LANDS 3-4-16-17-18-27-30-31-34  
 RADID SPECIALTY MFG CO 31  
 RADIDN CORP 11  
 RADID T V PRODUCTS CORP 7  
 RAYMOND ENGINEERING LABORATORY INC 28  
 RAYPAR INC 13  
 RAYTHEON CO 16-19-21  
 REEVES INSTRUMENT CORP 19-20  
 REGENCY ELECTRONICS INC 17-33  
 REGO INSULATED WIRE CO 11-23  
 REMANCO INC 16  
 RENFREW ELECTRIC CO LIMITED 17  
 REPUBLIC AVIATION CORP 1-16-18-19-20  
 R F PRODUCTS INC DIV AMPHENOL BORG 1-17  
 RICH ELECTRONICS INC 4-11-31  
 RMS ENG INC 7  
 ROBERTS R O 16-20  
 ROBINS INDUSTRIES CORP 11  
 ROHDE & SCHWARZ 3-4-6-12-25  
 ROHN MFG CO 3  
 RDRR AIRCRAFT CORP 18-19-21-26-28-29-34  
 ROWE INDUSTRIES 1-5-17  
 S & A ELECTRONICS 2-23-24-32-33  
 SANDERS ASSOCIATES 1-16-19-20-21  
 SAVOY ELECTRONICS INC FT LAUDERDALE 14-17  
 SAXTON PRODUCTS INC 7-11  
 SCALA RADIO CO 4-8-14-15-18-22-23-24-25-28-30-31-32-33  
 SCIENTIFIC ATLANTA INC 16-18-28-34  
 SERCO ELECT RESEARCH CORP 0  
 SERVO CORP OF AMERICA 6-14-17-18-30-31-32-33  
 SIMMONDS PRECISION PRODS TARRYTOWN 32-33  
 SKYRON CORPORATION 1-2-8-10-11-12-14  
 SMALLWOOD LTD S G 7-12  
 SNYDER MFG CO 5-11-17  
 SONAR RADIO CORP 8-14  
 SORENSEN INDUSTRIAL ELECTRONIC CO 2-6-8-17  
 SPARTAN ELECTRONICS 1-7-32  
 SPASORS INC SUB SILICON TRANSISTOR 1-16-20  
 SPERRY MICROWAVE ELECT INC 1-16-19-20-21-27-34  
 SPICO ELECTRONICS INC 11-29  
 SPINACRAFT INC 18  
 SPIRLING PRODUCTS CO 4-29  
 ST JOE MACHINES INC 2-3-17  
 STAINLESS INC 3  
 THE STANDARD PRODUCTS CO 7  
 STANDARD WINDING CO DIV OF DVITRON CORP 12-13-23-24  
 STATES ELECTRONICS CORP BLUDWORTH MARINE DIV 12-14  
 STEPPER MOTOR DIV LAND AIR INC 6-16  
 STEWART WARNER ELECT DIV STEWART-WARNER CORP 12-16-32-33  
 STODDART AIRCRAFT RADIO CO 12-16-32-33  
 STONE & SMITH INC 19  
 SURFACE CONDUCTION INC 15  
 SYLVANIA ELECTRIC PRDPS INC WALTHAM LABS 1-6-7-8-16-18-19-20-21-34  
 SYSTEMS INC 6  
 TAMAR ELECTRONICS INC 1-8-10-16-20-27-30  
 TAPCO GROUP THOMPSON RAMO WOODRIDGE INC 16  
 TECHNICAL APPLIANCE CORP 1-10-15-16-18-19-20-21-23-24-26-28-30-31-32-33-34  
 TELCD ELECTRONICS MFG COMPANY 5-8-9-17-23-24-32-34  
 TELECOMTRDL CORPORATION 16  
 TELERAD DIV OF THE LIDNEL CORP 16-18-19-20-21-34  
 TELERAD MFG CORP 1-4-6-8-10-14-16-18-19-20-21-27-30-31-32-33  
 TFLKOR INC 4-11-32-33  
 TENATRONICS LTD 5-17-29  
 TENNALAB 25-31-33  
 TENNA MFG CO 5-8-11-17-23-24  
 TEXTRON CORP 12  
 THOMAS MOLD & DIE CO 29  
 TONGREN CD C W 18-20-21-34  
 TOWER COMMUNICATIONS CO 34  
 TOWER CONSTRUCTION CO 3-4-16-34  
 TRANSCO PRODUCTS INC 8-10-16-27-28-30-31-32-33  
 TRG INC SYOSSET 1-16-18-19-20-27-34  
 TRG INCORPORATED BOSTON 1-16-18-19-20-27  
 TRICRAFT PRODUCTS CORP 5-9-11-23-24-32-33-34  
 TRILSCH INC JDHN D 34  
 TRIO MFG CO 23-24-32-33  
 TRU BEAM PROD 23-24  
 TURBO MACHINE CO 16-27  
 U S DIELECTRIC INC 18-19-20  
 UNIVERSAL MATCH CO UNDYNAMICS DIV 16  
 UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT 2  
 UNIVERSAL PRODUCTS ENGG CO 16  
 VANGUARD ELECTRONIC LABS 2-5  
 VERSA-TRONICS 17  
 VERSA-TRONICS 2-5-15-30-31-32-33

# PRODUCTS & MANUFACTURERS



# PRODUCTS & MANUFACTURERS

# Antennas • Antenna Accessories

|  |                             |
|--|-----------------------------|
| VICTOR RF MICROWAVE CO                   | 16                          |
| VIDEO INDUSTRIES CD                      | 23-24-33                    |
| WABER ELECTRONICS INC                    | 11                          |
| WALSCO ELECTRONICS MFG CO                | 12-13-23-24                 |
| WARD PRODUCTS CORP                       | 2-3-4-5-8-11-14-17-23-24-29 |
| WASHINGTON TECHNOLOGICAL ASSOC INC       | 32-33                       |
| WAVEGUIDE INC                            | 1-8-16-18-19-20-21-27       |
| WAVELINE INC                             | 16-20-21                    |
| WERSTER MFG                              | 14-17                       |
| WESTERN COIL & ELECTRICAL CO             | 2                           |
| WESTINGHOUSE ELECTRIC CO DIV AIR ARM DIV | 20                          |
| WHITE & SON JAMES L                      | 5-14-15-17                  |
| WILCOX ELECTRIC CO INC                   | 1-8-12-19-20-30-31-32-33    |
| WILEY ELECTRONIC PROD CO                 | 16-19-20-21                 |
| WIND TURBINE CO                          | 2-3-25-26-30-31-32-33-34    |
| WINEGARD CO                              | 9-15-23-24-32-33            |
| YOUNG SPRING & WIRE CORP GONSET DIV      | 2-8-17-23-25-29-30-31-32-33 |
| ZIMNEY CORP                              | 28                          |
| Z & W MFG CORP                           | 1                           |

## ANTENNA ACCESSORIES 600

|                                |    |
|--------------------------------|----|
| Antenna, heaters               | 1  |
| Antenna, insulators            | 2  |
| Antenna, isolation units       | 3  |
| Antenna, mounts                | 4  |
| Antennas, erection accessories | 5  |
| Antennas, feed system          | 6  |
| Antennas, radome               | 7  |
| Antennas, reflectors           | 8  |
| Antennas, towers & supports    | 9  |
| Antenna tuning units           | 10 |
| Baluns                         | 11 |
| Clamps, ground                 | 12 |
| Coupling & phasing units       | 13 |
| Diplexers                      | 14 |
| Dummy loads                    | 15 |
| Duplexers                      | 16 |
| Lenses, R-F                    | 17 |
| Lightning arresters            | 18 |
| Masts                          | 19 |
| Monitors, R-F power            | 20 |
| Multi-set couplers             | 21 |
| Rods, ground                   | 22 |
| Rotators, Antenna              | 23 |
| Spreaders, feeders             | 24 |
| Springs, grounding             | 25 |
| Switching equipment            | 26 |
| Tower lighting                 | 27 |
| Tower and supports             | 28 |
| Tuning units                   | 29 |

|  |  |
|--|--|
| ABALON PRECASUON MFG CORP                  | 4-5                                    |
| ADAMS RUSSELL CO INC                       | 3-6-11-13-16-21-26                     |
| ADEC INC                                   | 2-4                                    |
| ADVANCED STRUCTURES                        | 4-5-7-8-9                              |
| AFRMOTER CO                                | 28                                     |
| AEROFLEX LABORATORIES INC                  | 4                                      |
| AERO GEO ASTRON CORP                       | 4-6-8-17-23                            |
| AEROLITE ELECTRONICS CORP                  | 18-21-24                               |
| AERONCA MFG CORP                           | 4-7-8-9                                |
| AEROSPACE ELECTRONICS INC                  | 10-20-29                               |
| AEROSPACE RESEARCH INC                     | 10-13-20-21-29                         |
| AINSLIE CORP                               | 1-4-5-8-9-11-14-16-17-23-28            |
| AIRBORNE ACCESSORIES CORP                  | 23-26-29                               |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC  | 20                                     |
| AIRTEC INC                                 | 15                                     |
| AIRTRON A DIV OF LITTON INDUST             | 6-14-15-16-18                          |
| ALERT PRODUCTS INC                         | 13                                     |
| ALFORD MFG CO                              | 14-16-26                               |
| ALLIED RESEARCH & ENG CO                   | 8                                      |
| ALL PRODUCTS CO COMMUNICATION PROD DIV     | 2-3-5-6-8-9-11-12-13-14-16-18-19-24-27 |
| ALPAR MFG CORP                             | 8-9-19-28                              |
| ALPHA CORP                                 | 4-5-6-8-9-14-15-16-23-29               |
| AMATON ELECTRONIC HARDWARE CO INC          | 12                                     |
| AMERIC INC                                 | 4                                      |
| AMERICAN BRAKE SHOE CO RAYMOND ATCHLEY DIV | 23                                     |
| AMERICAN ELECT LABS INC                    | 4-26                                   |
| AMERICAN ELECT LABS MICROWAVE & PHASING    | 14                                     |
| AMERICAN ELECTRONICS INC FULLERTON         | 23                                     |
| AMERICAN MACH & FOUNDRY CO NEW YORK        | 8-9-23                                 |
| AMPHENOL CANADA LTD                        | 1-2-3-4-5-6-7-8-9-10                   |
| AMY ACEVES & KING                          | 21                                     |
| ELECTRONIC SPECIALTY CO ANCHOR METALS DIV  | 4-28                                   |
| ANDERSON AIRCRAFT CO                       | 8                                      |
| ANDREW ANTENNA CORP                        | 1-2-4-6-7-8-10-13-14-16-21-22-26-29    |
| ANDREW CALIF CORP                          | 1-4-6-7-8-14-15-16-19-23-26            |
| ANDREW CORP                                | 4-5-6-7-8-22-23-26                     |
| ANDREWS TOWER INC                          | 9-28                                   |

|   |                              |
|---|------------------------------|
| ANTENNA & RADOME RESEARCH ASSOC             | 15                           |
| ANTENNACRAFT CO                             | 2-4-19                       |
| ANTENNA PRODUCTS CO DIV OF ALL PROD CO      | 4-5-6-9-19-23-28             |
| ANTENNA SPECIALISTS CO                      | 19                           |
| ANTENNA SYSTEMS INC                         | 0                            |
| ANTLAB INC                                  | 4-5-9                        |
| APPARATUS DEVELOPMENT CO                    | 11-23                        |
| APPLIED RESEARCH INC                        | 14-21                        |
| ARCH GEAR WORKS INC                         | 10-29                        |
| ARDE ASSOC ENGRG DIV                        | 9                            |
| A R F PRODUCTS INC RIVER FOREST             | 14                           |
| A T ELECTRONICS INC                         | 6-13                         |
| ATELERS DE MONTAGES ELECT                   | 15                           |
| ATKINS & MERRILL INC                        | 7-8                          |
| ATLAS TRANSFORMER CO                        | 3                            |
| AVCO CORP ELECTRONICS & ORDNANCE DIV        | 6-10                         |
| AVCO CORP ORDNANCE DIV RICHMOND             | 4-6                          |
| AVIEL ELECTRONICS INC                       | 13-15                        |
| BARKER & WILLIAMSON INC                     | 10-15-19-20-22-26-29         |
| BELOCK INSTRUMENT CORP                      | 4                            |
| BELZ INDUSTRIES DIV EL TRONICS INC          | 4-6-8-10-15-21-26-29         |
| BENCO TELEVISION ASSOC LTD                  | 21                           |
| BENDIX CORP BENDIX RADIO DIV                | 6-8-10-11-16                 |
| BERGER BROS CO SPECIAL PRODS DIV            | 19                           |
| BERNARD FRANKLIN CO INC                     | 19                           |
| BIRDAIR STRUCTURES INC                      | 7-28                         |
| BISHOP ENGINEERING CO INC                   | 9-19                         |
| BLACKBURN ELECTRONIC CORP                   | 18                           |
| BLACO MFG CO                                | 12                           |
| BLAINE ELECTRONICS INC                      | 8-23                         |
| BLOSS ANTENNA ELECTRONICS CORP              | 6                            |
| BLAW-KNOX CO/BLAW-KNOX EQUIP DIV            | 9                            |
| BOGART MFG CORP                             | 15-16-26                     |
| BORE ENGG CORP                              | 21                           |
| BRACH MFG CORP DIV GEN BRONZE CORP          | 11-18-21                     |
| BRAUN TOOL & INSTRUMENT CO INC              | 25                           |
| BROOKS & PERKINS INC                        | 19                           |
| BUDD STANLEY CO                             | 15-16                        |
| BUDELMAN ELECTRONICS CORP                   | 14-16                        |
| BUHL OPTICAL CO                             | 17                           |
| CADRE INDUSTRIES CORP                       | 10                           |
| CALIF TECHNICAL INDUST DIV TEXTRON INC      | 20                           |
| CANADIAN MARCONI CO                         | 10-11-29                     |
| CANOGA ELECT CORP                           | 6-7-8-10-16                  |
| CASWELL ELECTRONICS CORP                    | 15-26                        |
| C B C ELECTRONICS CO                        | 13-21                        |
| CENTRALAB DIV GLOBE UNION                   | 2-18-24-26                   |
| CFI CORP                                    | 2                            |
| CHANNEL MASTER CORP                         | 4-5-9-10-12-13-21-22-23      |
| CHU ASSOCIATES                              | 6-7-8-11-17-19-23            |
| CLEAR BEAM ANTENNA CORP                     | 2-4-5-9-13-19-22             |
| COAZ DEVICES                                | 6-7-15-20                    |
| COLCRAFT INC                                | 11                           |
| COLLINS RADIO CO OF CANADA LTD              | 6-10                         |
| COLLINS RADIO CO CEDAR RAPIDS               | 21                           |
| COLUMBIA PROD CO                            | 4                            |
| COMMUNICATION ASSOCIATES INC                | 10                           |
| COMMUNICATIONS PRODUCTS CO                  | 4-6                          |
| COMPONENTS FOR RESEARCH INC                 | 2                            |
| COMPUDYNE CORP                              | 6                            |
| CONSOLIDATED WIRE & ASSOCIATED COS          | 2-18                         |
| CONTINENTAL ELECTRONIC MFG CO               | 2                            |
| LABS LING TEMCO-VOUGHT INC                  | 6-10-11-13-15-26-29          |
| COOK TECHNOLOGICAL CENTER DIV               | 26                           |
| CORNELL DUBILIER ELECTRONICS DIV FUQUAY SPS | 23                           |
| COX & CO                                    | 1                            |
| CRAIG SYSTEMS INC                           | 9-19-28                      |
| CROWN CONTROLS CORP                         | 15-21-23                     |
| CUBIC CORP                                  | 4-6-8-9-14-15-16-23          |
| CUNNINGHAM SON & CO INC JAMES HONEYE FALLS  | 26                           |
| CUSH CRAFT                                  | 18                           |
| DAISLEY CO INC RAY                          | 4-11                         |
| DALE ELECTRONICS INC COLUMBUS               | 18-19                        |
| DALMO VICTOR CO DIV TEXTRON INC             | 4-6-7-8-9-11                 |
| DAYTON AIRCRAFT PRODUCTS INC                | 18-19                        |
| DBM RESEARCH CORP                           | 8-17                         |
| DECIBEL PRODUCTS INC                        | 4-7-14-16                    |
| DECITRON ELECTRONICS CORP                   | 4-7-8-20-21-29               |
| DECO ELECTRONICS INC                        | 3-11-14-16-29                |
| DELTA ELECTRONICS INC ALEXANDRIA            | 10                           |
| DEMORNAV RONARDI CORP                       | 15                           |
| DERO ELECTRONICS                            | 11                           |
| DIAMOND ANTENNA & MICROWAVE CORP            | 6-7-8-10-13-14-15-16-17-29   |
| DIELECTRIC PRODUCTS ENGG CORAYMOND          | 8-15-26                      |
| DIELECTRIC PRODUCTS ENGG CO BRIDGETON       | 1-4-6-9                      |
| DIGITRAN CO DIV ENDEVCO                     | 6-9                          |
| DITTMORE FREIMUTH CORP                      | 4-26                         |
| DOSSERT MFG CORP                            | 12-22                        |
| DOUGLAS MICROWAVE CO                        | 6-10-14-15-16-20-21-23-26-29 |
| DOW KEY CO INC                              | 26                           |
| DRESSER-IDECO CO                            | 4-9-19-28                    |
| EBY SALES CO                                | 21                           |
| ECLIPSE-PIONEER DIV BENDIX CORP             | 4                            |
| EDO CORP COLLEGE PT                         | 19                           |
| EITEL-MC CULLOUGH INC SAN CARLOS            | 15                           |
| ELECTRO FLEX HEAT INC                       | 1                            |
| ELECTRO IMPULSE LAB INC                     | 15-20                        |
| ELECTRO INTERNATIONAL INC                   | 10-20                        |
| ELECTROMAGNETIC TECHCORP                    | 14                           |
| ELECTRO MECHANICAL CORP                     | 10-26                        |
| ELECTRO PRODUCTS INC                        | 5                            |
| ELECTRO SOLID CONTROLS INC                  | 13                           |
| ELECTRONANICS CORPORATION                   | 7-9-15                       |
| ELECTRONIC SPECIALTY CO                     | 15-16                        |
| TECHNICRAFT DIVISION                        | 15-16                        |
| ELECTRONICS OF CLEARFIELD INC               | 21                           |

|  |                                       |
|--|---------------------------------------|
| ELION INSTRUMENTS INC                        | 14-16                                 |
| ELM MFG CO INC                               | 4                                     |
| EMFRSON & CUMING INC WESTERN DIV             | 8-17                                  |
| EMERSON ELECTRIC MFG CO ELECT & AVIONICS DIV | 6-7-23                                |
| EMERSON PLASTICS CORP                        | 2-7                                   |
| EMPIRE DEVICES PRODUCTS CORP                 | 11                                    |
| ENERTRAN INC                                 | 13-29                                 |
| ENTRON INC                                   | 11-21                                 |
| EVEN KNIGHT CORP                             | 6-14-26                               |
| F-2 WAY TOWERS INC                           | 4-5-9-19-23-27-28                     |
| FAE INSTRUMENT CORP                          | 26                                    |
| FARINON ELECTRIC                             | 16-20                                 |
| FILMOHM CORP                                 | 15                                    |
| FINNEY CO                                    | 4-5-12-21-22                          |
| FORWAY INDUSTRIES INC                        | 27                                    |
| FRENCHY RADIO MFG CO                         | 0                                     |
| FREQUENCY ENGG LABS                          | 14-15-23                              |
| FUGLE MILLER LABS INC                        | 11                                    |
| F X R INC WOODSIDE                           | 6                                     |
| GABRIEL ELECTRONICS DIV GABRIEL CO           | 1-4-7-8-23                            |
| GARDE MFG CO                                 | 18                                    |
| GARLOCK ELECTRONIC PRODUCTS PRODS PALMYRA    | 2                                     |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 2-4-5-9-11-12-13-18-19-21-22-26-28    |
| GENERAL COIL PRODUCTS CORP                   | 11                                    |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 26                                    |
| GENRAL ELECTRIC CO POWER TUBF DEPT           | 16                                    |
| GENERAL ELECTRIC CO INSULATOR DEPT           | 2                                     |
| GENERAL ELECTRIC CO ORDNANCE DEPT            | 4                                     |
| GENERAL ELECTRONIC LABS INC                  | 4-6-9-10-21                           |
| GENERAL ELECTRONIC LAB INC                   | 7-8                                   |
| GENERAL MAGNETICS INC MINN                   | 13                                    |
| GENERAL MICROWAVE CORP                       | 11-14-15-16-20-21                     |
| GLADDING MCBEAM & CO LOS ANG                 | 2-7                                   |
| GLADDING MCBEAM & CO MONROVIA                | 7-10                                  |
| GLASPLY CORP                                 | 7-8-19                                |
| GOLDING MFG CO                               | 4                                     |
| GRANGER ASSOC                                | 11                                    |
| GREAT FALLS PRODUCTS CO INC                  | 4                                     |
| GREMAR MFG CO                                | 15                                    |
| GUIDE MFG CO                                 | 4-11-14-15-16-17-20-21-26             |
| HALLICRAFTERS CO CHICAGO                     | 4-6-7-8-10-11-13-17-20-21-22-23-26-29 |
| HAZELTINE ELECTRONICS DIV/HAZELTINE CORP     | 4-6-7-8-9                             |
| HEATH CO SUB OF DAYSTROM INC                 | 11                                    |
| HEXCEL PRODUCTS INC EASTERN DIV              | 7                                     |
| HI LO MFG CORP                               | 2-4-5-19                              |
| HOUSTON FEARLESS CORP WESTWOOD DIV           | 4-8-23                                |
| HOWARD INDUSTRIES INC LOYD SCRUGGS DIV       | 23                                    |
| HUGHES & PHILLIPS                            | 27                                    |
| HY GAIN ANTENNA PRODUCTS CO                  | 2-4-6-9-10-11-13-18-23                |
| IE MFG                                       | 2-3-4-5-8-9-12-19-21-22-25-26-28      |
| ILLUMITRONIC ENGG CO                         | 11                                    |
| INSTRUMENTS FOR INDUSTRY INC                 | 21                                    |
| IRVAN FERROMAGNETICS CORP                    | 17                                    |
| ISOLANTITE MFG CORP                          | 2-24                                  |
| ITA ELECTRONICS CORP                         | 11-29                                 |
| I TEL INC                                    | 11-13-14-15-16                        |
| I-T-E CIRCUIT BREAKER CO                     | 4-6-17-19                             |
| JAMPRO ANTENNA CO                            | 9-10-11-28                            |
| JAN HARDWARE MFG CO                          | 13                                    |
| JARVIS ELECTRONICS CORP                      | 26-29                                 |
| JAVEX ELECTRONICS                            | 2-4-5-13-21-26                        |
| JFD ELECTRONIC CORP                          | 2-3-4-5-6-10-12-13-14-18-19-21-22-29  |
| JFD ELECTRONICS SOUTHERN INC                 | 4-5-8-10-11-12-13-18-19-21-22         |
| J & G MACHINE CO INC                         | 4-5-22                                |
| JOCLIN MFG CO                                | 2                                     |
| JOHNSON CO E F                               | 2-10-23-24-29                         |
| JONES ELECTRONIC CO INC M C                  | 15-20-29                              |
| JONTIZ MFG CO INC                            | 9-28                                  |
| J-V-M DIVISION FIDELITONE MICROWAVE INC      | 6                                     |
| KALPA SCIENTIFIC LABORATORIES INC            | 26                                    |
| KANE ENGINEERING LABORATORIES                | 15-16                                 |
| KENWOOD ENGG CO                              | 4-5-19                                |
| KINETICS CORP                                | 26                                    |
| KLINE IRON & STEEL CO                        | 9-28                                  |
| KPT MFG CO                                   | 4-9                                   |
| KTV TOWER COMMUNICATION EQUIP CO             | 28                                    |
| K W ENGINEERING WORKS                        | 0-4-10-29                             |
| LABORATORY FOR ELECTRONICS INC               | 14-15-16-17                           |
| LAONIA MALLEABLE IRON CO INC                 | 5-9-12-28                             |
| LAMINAIR INC                                 | 7-8                                   |
| LANCF ANTENNA MFG CORP                       | 2-4-9-19                              |
| LAND AIR INSTRUMENT & ELECT DIV              | 13-14                                 |
| LAPP INSULATOR CO RADIO SPECIALTIES DIV      | 2                                     |
| LA POINTE INDUSTRIES INC                     | 4-6-7-8                               |
| LEVOLOR LORENTZEN INC H K LORENTZEN DIV      | 19                                    |
| LITTON INDUSTRIES MARYLAND DIV               | 6-10-13-14-16-23                      |
| LUDWIG HONOLD MFG CO                         | 4-5                                   |
| LUHRS & CO C H                               | 13-16-21-26                           |
| MAJESTIC EXTRUDERS INC                       | 2                                     |
| MARCH DYNAMICS INC                           | 16-23                                 |
| MARCON ELECTRONICS CORP                      | 19                                    |
| MASTER MOBILE MOUNTS INC                     | 4-5-6-10-11-13-20-29                  |
| MATHIS CO G E                                | 9                                     |
| MAXSON ELECTRONICS CORP OLD FORGE            | 10                                    |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 20                                    |
| MAYSTEEL PRODUCT INC                         | 9                                     |
| MCMILLAN COMPANIES                           | 7-17                                  |
| MEASUREMENT ENGG LTD                         | 10-24-29                              |
| MEASUREMENT SYSTEMS INC                      | 4-23                                  |
| MECTRON CO N PLAINFIELD                      | 11-26                                 |
| MELABS                                       | 6-14-16-20-21                         |
| MERIDIAN METALCRAFT INC                      | 6-11-13-14-15-16-17-20-21             |
| METAL SPECIALTY PRODUCTS CORP                | 12-15-19-29                           |



|   |                       |
|---|-----------------------|
| MFTAVAC INC                               | 14                    |
| MEYER MANUFACTURING                       | 28                    |
| MICROFLECT CO                             | 4-8-9-28              |
| MICRONETICS INC                           | 6-17                  |
| MICROWAVE ASSOCIATES INC                  | 14-15-16              |
| MICROWAVE ELECTRONIC TUBE CO INC          | 16                    |
| MICROWAVE PRODUCTS INC                    | 15-16                 |
| MID-WEST SPRING CO                        | 25                    |
| MILLEN MFG CO JAMES                       | 11                    |
| MILLER CO J W                             | 11                    |
| MODEL ENGG & MFG INC                      | 6-16-26-29            |
| MOORE ASSOCIATES INC                      | 26                    |
| MORAN PRODUCTS CO                         | 23                    |
| MOSLEY ELECTRONICS INC                    | 11-13-19-21           |
| MULTRONICS INC                            | 6-10-13-14-15-16-26   |
| MUNSTON ELECTRONIC MFG CORP               | 19-21                 |
| NATIONAL BERYLLIA CORP                    | 2-7                   |
| NATL RADIO CO INC                         | 2-24                  |
| NATIONAL TEL TRONICS CORP                 | 2                     |
| NEICO MICROWAVE CO                        | 6-13-14-15-16-23-26   |
| NEPTUNE ELECTRONICS CO                    | 15-21                 |
| NEVADA AIR PRODUCTS CO                    | 2-10                  |
| NEWCOMB SPRING CORP VALLEY STR            | 25                    |
| NORRICH PLASTICS CORP                     | 4-22                  |
| NORTHERN PRECISION LABORATORIES           | 26                    |
| NORTHROP CORP                             | 4-9-23                |
| NRK MICROWAVE DIV COOK ELECT CO           | 15-16                 |
| OHMITE MFG CO                             | 15                    |
| ORION ELECTRONICS CORP                    | 21                    |
| PACIFIC AUTOMATION PRODUCTS               | 19                    |
| PALCO ENG CO                              | 15                    |
| PALOMAR EQUIP CO                          | 6-11                  |
| PARABAM INC                               | 7                     |
| PEARCE SIMPSON INC MARINE & COMM DIVISION | 4-5-12                |
| PEGASUS LABS INC                          | 23-29                 |
| PERMALI INC                               | 2                     |
| PHILCO CORP SIERRA ELECTRONIC DIV         | 15-20                 |
| PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV | 23                    |
| PICKARD & BURNS INC SUB GORHAM CORP       | 13                    |
| PIONEER INDUSTRIES INC                    | 28                    |
| PLAS TRON CORP                            | 2-4-13                |
| PORCELAIN PRODUCTS CO                     | 2-22                  |
| POWER TRONIC SYSTEMS INC                  | 4                     |
| PRD ELECTRONICS INC                       | 15                    |
| PREMAX PRODUCTS DIV CHISHOLM RYDER CO     | 2-4-                  |
| PRESTOLE CORP                             | 12                    |
| PRODELIN INC                              | 2-4-6-7-8-12          |
| PROJECTS UNLIMITED INC                    | 11-15                 |
| QUANTATRON INC                            | 6-10-26-29            |
| RADIAPHONE CO                             | 3-4-6-14-20-26        |
| RADIATION ENGG LABS                       | 6                     |
| RADIATION INC                             | 6                     |
| RADIATRONICS INC                          | 4-6-8-9-16-17-23-28   |
| RCA BRDCT & COMM PRODS DIV CAMDEN         | 1-8-9-                |
| RCA BRDCT & COMM PRODS DIV MEADOW LANDS   | 27-28-29              |
| RCA BRDCT & COMM PRODS DIV MEADOW LANDS   | 1-                    |
| RAYPAR INC                                | 8-9-27-28-29          |
| REEVES INSTRUMENT CORP                    | 15                    |
| REMFINGTON RAND UNIVAC ST PAUL            | 4-23                  |
| REPUBLIC AVIATION CORP                    | 13                    |
| RICH ELECTRONICS INC                      | 8                     |
| RIXON ELECTRONICS INC                     | 11-13                 |
| ROBERTS R O                               | 16                    |
| ROHOE & SCHWARZ                           | 11-13-15-23           |
| ROHN MFG CO                               | 9-19-27               |
| ROHR AIRCRAFT CORP                        | 8                     |
| ROSTAN CORP                               | 9-19-28               |
| ROWE INDUSTRIES                           | 4-18                  |
| SAGE LABORATORIES INC                     | 6-13-23               |
| SATELLITE CORP OF AMERICA                 | 7-8-9-19-28           |
| SAXTON PRODUCTS INC                       | 11-12-18              |
| SAYRE ELECTRONICS                         | 2-24                  |
| SCALE RADIO CO                            | 1-6-11                |
| SCIENTIFIC ATLANTA INC                    | 4-6-8-9-23            |
| SEABORD PACIFIC DIV ASSOC SPRING          | 25                    |
| SEAELECTRO CORP                           | 15                    |
| SECODE CORP                               | 16                    |
| SECO ELECTRONICS INC                      | 25                    |
| SERVO CORP OF AMERICA                     | 4-5-7-10              |
| SERVWELL PRODUCTS CO                      | 12-22-25              |
| SIERRA ELECTRONIC DIV PHILCO CORP         | 15-20                 |
| SILICONE INSULATION INC                   | 2-7                   |
| SIVERS LAR                                | 26                    |
| SKYRON CORPORATION                        | 4-5-12-25-26          |
| SONEX INC                                 | 15                    |
| SPASORS INC SUB SILICON TRANSISTOR        | 6                     |
| SPAULDING PRODUCTS CO                     | 28                    |
| SPERRY MICROWAVE ELECT INC                | 6-8-14-15-16-17-      |
| STAINLESS INC                             | 4-9-19-27-28          |
| STATES CO                                 | 15                    |
| STEWART MFG CO D M                        | 3                     |
| SURFACE CONDUCTION INC                    | 6                     |
| SYLVANIA ELECTRIC PRODUCTS SALEM          | 27                    |
| SYLVANIA ELECTRIC PRODS INC WALTHAM LABS  | 4-                    |
| TABET MFG CO                              | 6-8-14-16-            |
| TAFFET ELECTRONICS INC                    | 27                    |
| TAMAR ELECTRONICS INC                     | 12-15-19-22-29        |
| TECHNICAL APPLIANCE CORP                  | 3-6-7-13-20           |
| TECHNICRAFT DIV                           | 1-4-5-6-7-8-9-11-     |
| TELCO ELECTRONICS MFG COMPANY             | 21                    |
| TELERAD MFG CORP                          | 15-16                 |
| TELEX/AEMCO DIV OF TELEX INC              | 4-5-9-12-13-          |
| TELKOR INC                                | 18-19-21-28           |
| TEMPCO TV PROD CO                         | 4-7-11-13-14-16-17-26 |
| THOMAS MOLD & DIE CO                      | 13-21                 |
| THOR CERAMICS INC                         | 4-5-9-12-19-22        |
| TORNGREN CO C W                           | 9                     |
| TOWER COMMUNICATIONS CO                   | 2                     |
| TOWER CONSTRUCTION CO                     | 8                     |
|   | 27-28                 |

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|--|-----------------------------|
| TRAK ELECTRONICS COMPANY INC             | 3-10-26                     |
| TRANSCO PRODUCTS INC                     | 15                          |
| TRANSDATA INC                            | 15                          |
| TRG INCORPORATED BOSTON                  | 7-8                         |
| TRICRAFT PRODUCTS CORP                   | 2-4-5-19                    |
| TRI-EX TOWER CORP                        | 5-8-10-19-27                |
| TRILSCH INC JOHN D                       | 9-27                        |
| TRU CONNECTOR CORP                       | 15                          |
| TURBO MACHINE CO                         | 15                          |
| U S DIELECTRIC INC                       | 2-7-8-15                    |
| UCINITE CO DIV UNITED CARR FASTENER CORP | 3-                          |
| UNIVERSAL PRODUCTS ENGG CO               | 4-26                        |
| UNIVOX CORP LOS ANG                      | 28                          |
| UTILITIES SERVICE CO                     | 11-26                       |
| VIDAIRE ELECTRONICS MFG CORP             | 12-22                       |
| VULCAN-TV MAST & TOWER CO INC            | 11-21                       |
| WABER ELECTRONICS INC                    | 3-9-12-19-22                |
| WALSICO ELECTRONICS MFG CO               | 11-13-21                    |
| WARD PRODUCTS CORP                       | 21                          |
| WAVEGUIDE INC                            | 2-4-19-26                   |
| WAVELINE INC                             | 6-10-15                     |
| WEINSCHEL ENGG                           | 6-14-15-16-21-26            |
| WELEX ELECTRONICS CORP                   | 15                          |
| WERNER CO INC R D                        | 10                          |
| WESTERN COIL & ELECTRICAL CO             | 5-9-19-27-28                |
| WESTLAKE PLASTICS CO                     | 2-5-9-19-19                 |
| WESTREX CO DIV OF LITTON SYS INC         | 2                           |
| WILEY ELECTRONIC PROD CO                 | 10                          |
| WILTRON CO                               | 6-17                        |
| WIND TURBINE CO                          | 13                          |
| WINEGARD CO                              | 2-4-5-6-8-9-15-19-23-24-26- |
| WINPOWER MFG CO                          | 13-21                       |
| WORKMAN ELECT PROD INC                   | 28                          |
|  | 11-15                       |

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|--|----------------|
| C & D BATTERIES DIV ELECTRIC AUTOLITE CO     | 2              |
| C & D BATTERIES DIV ELECT AUTOLITE CO        | 14-15          |
| CENTRAL COIL CORP                            | 14             |
| CENTRAL-DYNAMICS LTD                         | 14-15          |
| CENTROL ENG CO                               | 14             |
| CHATHAM ELECTRONICS DIV-TUNG-SOL ELECTRIC    | 15             |
| CHRISTIE ELECTRIC CORP                       | 14-16          |
| COOK BATTERIES                               |                |
| COOK CO FRANK R                              | 8-9-10         |
| COOK ELECT CO WIRECOM DIV                    | 14-15          |
| CTS OF CANADA LTD                            | 14             |
| DAISLEY CO INC RAY                           | 18             |
| DALES CO FRANKLIN                            | 15             |
| DAYTON ELECT PROD CO INC                     | 14-15          |
| DYNAMIC INSTRUMENT CORP                      | 14-16          |
| ELECT STORAGE BATTERY MISSILE BATTERY DIV    | 10             |
| ELECT STORAGE BATTERY CO DIV EXIDE IND       | 2              |
| ELECTRAMATIC INC                             | 14             |
| ELECTRIC AUTOLITE CO PENNSBURG               | 14-15          |
| ELECTRIC AUTOLITE CO VINCENNES               | 2              |
| ELECTRIC STORAGE BATTERY CO EXIDE IND DIV    | 1-2-5-8-10-12  |
| ELECTRIC STORAGE BATTERY CO                  | 2              |
| ELECTRIC STORAGE BATTERY CO RALEIGH          | 7-9-10-        |
| ELECTRO DEVELOPMENT CORP SEATTLE             | 14-15          |
| ELECTRODYNAMIC INSTRUMENT CORP               | 14             |
| ELECTRO MECHANICAL CORP                      | 14-15          |
| ELECTRON ARC DIV IONICS INC                  | 13-14-15-17    |
| ELECTRONIC BATTERIES INC                     | 2              |
| ELECTRONIC COMPONENTS CORP                   | 14-15          |
| ELECTRONIC INSTRUMENT CO INC                 | 14-16          |
| ELECTRONIC MEASUREMENTS CORP N Y             | 14             |
| ELECTRONIC RESEARCH ASSOCIATES INC           | 15             |
| ELECTRONICS BATTERIES INC                    | 14             |
| ENGINEERED MAGNETICS                         | 14             |
| FPPLEY LAB INC                               | 12             |
| ESPEY MFG & ELECTRONICS CORP                 | 14-15-16       |
| FANSTEEL METALLURGICAL CORP                  | 14             |
| FOX PRODUCTS CO                              | 14-16          |
| FYR-FYTER ELECTRONIC & ALARM CORP            | 14             |
| GATES ELECTRONIC CO                          | 14             |
| GENERAL ELECTRIC CO ORDNANCE DEPT            | 1              |
| GENERAL ELECT CO LOW VOLT SWITCHGEAR DIV     | 14             |
| GENERAL RAILWAY SIGNAL CO                    | 14-15          |
| GENERAL SCIENTIFIC EQUIP CO                  | 16             |
| GORDON ENTERPRISES                           | 4-5-8-9-10-14  |
| GRAY GAINER ELECTRONICS                      | 14             |
| GREEN RECTIFIER CO                           | 14-15          |
| GULTON INDUSTRIES INC METUCHEN               | 4-5            |
| HAMILTON STANDARD ELECTRONICS DEPT           | 14-16          |
| HARRISON LABS                                | 14-15          |
| HAYDON DIV GENERAL TIME CORP                 | 16             |
| HEATH CO SUB OF DAYSTROM INC                 | 14-16          |
| HEATH CO DIV OF DAYSTROM INC                 | 14             |
| HEYER INDUSTRIES INCORPORATED                |                |
| LAB OF MARQUETTE CORP                        | 14-16          |
| HICKOK ELECTRICAL INSTRUMENT CO              | 16             |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 3761 S HILL ST |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 2621 S HILL ST |
| HUGHES TREITLER MFG CORP                     | 11             |
| IE MFG                                       | 13-18          |
| INDUSTRIAL ELECTRONIC HARDWARE CORP          | 18             |
| INTERNATIONAL RECTIFIER CORP                 | 11             |
| IONICS INC ELECTRON ARC DIV                  | 13-14-15-17    |
| ITT FEDERAL LABS NUTLEY                      | 11             |
| KEARFOTT DIV GPI INC CLEVELAND               | 14-15          |
| KEYSTONE ELECTRONICS CORP N Y                | 18             |
| KLEER-TRONICS INC                            | 14             |
| LAI 1 & E DIV                                | 14             |
| LAKE SHORE ELECTRIC CORP                     | 14             |
| LAMARCHE MFG CO                              | 14             |
| LECLANCHE S A                                | 1-2-4-5-12     |
| LELANO AIRBORNE PRODUCTS                     | 14-15          |
| LUMEN INC                                    | 14-15          |
| MALLORY ELECT CO                             | 15             |
| MARATHON BATTERY CO                          | 1              |
| MARINE ELECTRIC CORP                         | 14-15-16       |
| MEASUREMENT ENGG LTD                         | 14             |
| METEOR PRODUCTION ENGRG INC                  | 2-14           |
| MID-EASTERN ELECTRONICS INC                  | 14-15          |
| MINNEAPOLIS-HONEYWELL ORDNANCE DIV           | 1              |
| MODEL RECTIFIER CORP                         | 14             |
| MOLDED INSULATION CO PHILA                   | 16             |
| MORSE INSTRUMENT CO                          | 14             |
| MUCKLE MFG CO                                | 18             |
| MUIRHEAD & CO LTD                            | 12             |
| MUIRHEAD INSTRUMENTS INC                     | 12             |
| NICAD DIV GOULD NATIONAL BATTERIES INC       | 4-5            |
| NICAD DIV GOULD NATL BATTERIES INC           | 5-10           |
| NORTH ELECTRIC CO                            | 14             |
| NORTHERN ELECT INC                           | 14             |
| ONAN DV OF STUDEBAKER PACKARD CORP           | 14             |
| ONEIDA ELECTRONICS INC                       | 14-15          |
| OPAD ELECTRIC CO                             | 14-15-16       |
| PACO ELECTRONICS CO INC                      | 15             |
| PENN KEYSTONE CORP                           | 16             |
| PIONEER GEN-E-MOTOR CORP                     | 14             |
| POWERDYNE DIVISION                           | 14-15          |
| POWER SOURCES DIV TELECOMPUTING CORPORATION  | 8-9-10         |
| PRL ELECTRONICS INC                          | 14-15          |
| PRODUCTION ELECTRONICS INC                   | 14-15          |
| QUALITY STAMPING CO                          | 7              |
| QUICK CHARGE DIV LINE SCALE CO INC           | 14             |
| RADIATION RESEARCH CORP WESTBURY             | 6              |
| RCA ELECTRN TUBE DIV INDIANAPLS              | 1-3-4          |
| RCA ELECTRN TUBE DIV MARION                  | 1-3-4          |
| RCA ELECTRN TUBE DIV HARRISON                | 1-3-4          |
| RCA ELECTRN TUBE DIV WOODBRIDGE              | 1-3-4          |
| RCA ELECT TUBE DIV CINN                      | 1-3-4          |
| RCA ELECTRN TUBE DIV LANCASTER               | 1-3-4          |
| RADIO SPECIALTY MFG CO                       | 14             |
| RAMMYR MFG CO                                | 14             |

**BATTERIES, CHARGERS & ACCESSORIES 700**

|                                   |    |
|-----------------------------------|----|
| Batteries, dry cell               | 1  |
| Batteries, lead-acid              | 2  |
| Batteries, mercury                | 3  |
| Batteries, nickel alkaline        | 4  |
| Batteries, nickel cadmium         | 5  |
| Batteries, nuclear                | 6  |
| Batteries, rechargeable, dry cell | 7  |
| Batteries, silver                 | 8  |
| Batteries, silver cadmium         | 9  |
| Batteries, silver zinc            | 10 |
| Batteries, solar                  | 11 |
| Batteries, standard cell          | 12 |
| Battery adapters                  | 13 |
| Battery chargers                  | 14 |
| Battery charging regulators       | 15 |
| Battery testers                   | 16 |
| Fuel cells                        | 17 |
| HOLDERS, battery                  | 18 |

|  |           |
|--|-----------|
| ACCURATE ELECTRONICS CO CHICAGO          | 14-15     |
| ACME BATTERY CORP                        | 1         |
| ACME ELECTRIC CORP                       | 14        |
| ACME MODEL ENGG CO                       | 18        |
| AERO GFO ASTRO CORP                      | 11        |
| AEROSPACE ELECTRONICS INC                | 17        |
| AEROTRONIC ASSOCIATES INC                | 16        |
| AGA CORP OF AMERICA                      | 2-7       |
| ALKALINE BATTERY DIV                     | 5         |
| ALL AMERICAN ENGG CO                     | 14        |
| AMELCO INC ELECT DEVICES DIV             | 11        |
| AMERICAN AIRFRAME CORP                   | 14-15-16  |
| AMERICAN ELECTRIC CABLE CO               | 14        |
| AMERICAN ELECTRONICS CO MINN             | 14-15     |
| AMERICAN ELECTRONICS INC FULLERTON       | 14        |
| AMERICAN RECTIFIERS CORP                 |           |
| MFRS RICHARDSON ALLEN POWER SUPPLIES     | 14        |
| ANCHOR PLASTICS CO                       | 18        |
| APPLIED CONTROL CORP                     | 14        |
| APPLIED TECHNOLOGY CORP                  | 14        |
| AR & DA ENGG CO                          | 14        |
| ARISTO CRAFT DISTINCTIVE MINIATURES      | 2-14-18   |
| ASSEMBLY PRODUCTS INC                    | 15        |
| ATLEE CORP                               | 18        |
| AUGAT BROS                               | 18        |
| AUTOMATIC CONTROL CO                     | 14        |
| AUTOMATIC SWITCH CO                      | 14        |
| AUTO TEST INC CHICAGO                    | 14-16     |
| BACH AURICON INC                         | 5-7-14    |
| BACH-SIMPSON LTD                         | 16        |
| BARKER & WILLIAMSON INC                  | 14        |
| BARNETT INST CO                          | 16        |
| BASLER ELECTRIC CO                       | 14        |
| BERGEN LABS INC                          | 14-15     |
| BRAUN TOOL & INSTRUMENT CO INC           | 18        |
| BRIGHT STAR BATTERY                      | 1-12-16   |
| BURGESS BATTERY CO                       | 1-3-5     |
| BURGESS BATTERY CO DIV SERVEL CANADA LTO | 1         |
| BURMAC ELECTRONICS CO                    | 14        |
| BURMAC ELECTRONICS CO INC                | 14        |
| BUTCHER CO L H                           | 14        |
| CADRE INDUSTRIES CORP                    | 5-14      |
| CAMBRIDGE THERMIONIC CORP                | 18        |
| CANADIAN RESEARCH INSTITUTE              | 14-15     |
| CARBONE CORP                             | 1-9-10-12 |
| CAROL ELECT DIV WEECO INC                | 14        |
| CATALYST RESEARCH CORP                   | 1-10      |

# PRODUCTS & MANUFACTURERS

# Batteries, Chargers & Accessories • Capacitors, Fixed

|                                       |                |
|---------------------------------------|----------------|
| RAPID ELECTRIC CO BROOKFIELD          | 14             |
| RAY-O VAC INC WILLIAMSPORT            | 1              |
| RAY-O-VAC CO MADISON                  | 1-3            |
| RAYTHEON COMPANY INDUSTRIAL OPERATION | 14             |
| READY POWER CO                        | 14             |
| REGCO INC                             | 10-14          |
| REPUBLIC AVIATION CORP                | 14-16          |
| RFS ENGINEERING CO                    | 14-15          |
| RICHARDSON ALLEN CORP                 | 14-15          |
| SUB STANDARD KOLLSMAN IND             | 14             |
| SARATOGA PLASTICS INC                 | 18             |
| SATELLITE CORP OF AMERICA             | 14             |
| SCHAUER MFG CORP                      | 14             |
| SCHRACK ELECTRICAL SALES CORP         | 14             |
| SECURITY DEVICES LAB                  | 18             |
| SEL REX CORP                          | 14             |
| SERVICE INSTRUMENTS CORP WESTGATE DR  | 14-16-18       |
| SERVICE INSTRUMENT CORP OFFICIAL RD   | 16             |
| F W SHRODER CO                        | 14             |
| SHURITE METERS                        | 16             |
| SIGMA INSTRUMENTS INC                 | 15             |
| SOLA ELECT CO SOLA TRANSFORMER DIV    | 14             |
| SONOTONE CORP ELMFORD                 | 5-14           |
| SONOTONE CORP OLD SPRING              | 1              |
| SORENSEN INDUSTRIAL ELECTRONIC CO     | 14             |
| SPACE CONTROL CORP                    | 14             |
| SPECTROLAB DIV TETRON ELECTRONICS INC | 11             |
| SPERTI FARADAY INC                    | 14-15          |
| ST JOE MACHINES INC                   | 14             |
| SULZER LABORATORIES INC               | 14-15          |
| TECHNICAL APPARATUS BUILDERS          | 14             |
| TETROMATIC                            | 14             |
| TELCOMPUTING CORP POWER SOURCES DIV   | 8-9-10         |
| TERADO CO                             | 14             |
| TIPPRONIC INC                         | 14             |
| TRACERLAB INC WALTHAM                 | 6              |
| TROXLER ELECTRONICS LAB INC           | 14-15          |
| TWINCO INC                            | 14-15          |
| U S RUBBER CO                         | 1              |
| ULTRONICS INC                         | 14-15          |
| UNION CARBIDE CONSUMER PROD N Y       | 1-3-5-7-8      |
| UNION CARBIDE BENNINGTON              | 12-14-16-17-18 |
| UNION CARBIDE CONSUMER PROD CHARLOTTE | 1-3-5-7-17     |
| VAP AIR DIV VAPOR CORP                | 14             |
| VERCO INC                             | 16             |
| WATERMAN PRODUCTS CO                  | 14             |
| WESTERN COIL & ELECTRICAL CO          | 13             |
| WICKES ENGG & CONSTRUCTION CO         | 15             |
| WINPOWER MFG CO                       | 14             |
| WURLITZER CO TONAWANDA                | 10             |
| YARDNEY ELECTRIC CORP                 | 5-8-9-10-14-17 |

## CAPACITORS, FIXED 800

|                                     |    |
|-------------------------------------|----|
| Capacitors, bathub                  | 1  |
| Capacitors, button                  | 2  |
| Capacitors, ceramic                 | 3  |
| Capacitors, composition             | 4  |
| Capacitors, disc                    | 5  |
| Capacitors, electrolytic dry        | 6  |
| Capacitors, electrolytic wet        | 7  |
| Capacitors, feed-through            | 8  |
| Capacitors, film                    | 9  |
| Capacitors, gas-filled              | 10 |
| Capacitors, glass                   | 11 |
| Capacitors, high temperature        | 12 |
| Capacitors, high voltage            | 13 |
| Capacitors, mica                    | 14 |
| Capacitors, mylar dielectric        | 15 |
| Capacitors, oil                     | 16 |
| Capacitors, paper metalized         | 17 |
| Capacitors, plastic dielectric      | 18 |
| Capacitors, plug-in                 | 19 |
| Capacitors, polystyrene insulated   | 20 |
| Capacitors, porcelain               | 21 |
| Capacitors, printed circuit         | 22 |
| Capacitors, pulse forming network   | 23 |
| Capacitors, silicone-filled         | 24 |
| Capacitors, silvered mica           | 25 |
| Capacitors, tantalum                | 26 |
| Capacitors, teflon dielectric       | 27 |
| Capacitors, temperature compensated | 28 |
| Capacitors, transmitting            | 29 |
| Capacitors, vacuum                  | 30 |

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| ALLEN-BRADLEY CO                             | 3-8-12-22-28                               |
| AMELCO INC ELECT DEVICES DIV                 | 22   |
| AMERICAN CAPACITOR CO INC                    | 3-5-12-13-28                               |
| AMERICAN LAVA CORP SUBS MINN MINING MFG      | 3-8  |
| AMP INC CAPITRON DIV                         | 8-13                                       |
| AMP INCORPORATED HARRISBURG                  | 9-12-23                                    |
| ARCO ELECT INC                               | 1-12-13-15-18-19-20-27-28                  |
| ARROW RADIO CO                               | 1-8-15-16                                  |
| ASTRON CORP                                  | 0  |
| AUTOMATION COMPONENTS INC                    | 3-5-13-22-28                               |
| AVNET CORP LOS ANG                           | 15-17-26                                   |
| AXEL ELECTRONICS INC                         | 8-13-23-24-27                              |
| BALCO RESEARCH LABS CAPACITOR DIV            | 1-8-9-12-13-15-18-19-20-22-23-26-27-28-30  |
| BARBCO INC                                   | 6-26                                       |
| BENDIX CORP/SCINTILLA DIV                    | 3-12-14-25                                 |
| THE BENDIX CORP CINCINNATI DIV               | 20   |
| BRITISH RADIO ELECTRONICS LTD                | 6-25                                       |
| BURMAC ELECTRONICS CO                        | 13-23                                      |
| BURMAC ELECTRONICS CO INC                    | 13-16-23-24-27                             |
| CALLINS INDUSTRIES INC                       | 6  |
| CAPCON INC                                   | 1-8-9-13-16-17-18-20-22-24-27              |
| CAPTRONICS INC                               | 1-9-10-12-13-15-16-18-20-23-24-27-29       |
| CAROLINA COMPONENTS INC                      | 6-7-26                                     |
| CENTRALAB DIV GLOBE UNION                    | 2-3-5-8-13-20-22-28-29                     |
| HOPKINS ST                                   | 28-29                                      |
| CENTRALAB DIV GLOBE UNION 32 ST              | 3  |
| CENTRALAB DIV GLOBE UNION                    | 3-8-12-13-22-27-28-29                      |
| BREMEN ST                                    | 28-29                                      |
| CHEM ELECTRO RESEARCH INC                    | 3-8-12-22                                  |
| CHEMTRONIC CORP                              | 6  |
| CHICAGO CONDENSER CORP                       | 1-8-9-12-13-15-16-17-18-19-20-22-23-24-27  |
| COLUMBUS ELECTRONICS CORP                    | 10   |
| COMPONENTS INC                               | 6-19-22-26                                 |
| COMPONENT RESEARCH CO INC                    | 3-11-15-20                                 |
| CONDENSER PROD DIV NEW HAVEN CLOCK & WATCH 3 | 1-9-12-13-15-16-18-20-23-24-27             |
| CONTINENTAL ELECTRONIC MFG CO                | 16   |
| LABS LING TEMCO-VOUGHT INC                   | 16   |
| CORNELL-DUBILIER ELECTRIC CORP VENICE        | 1-8-9-12-13-15-16-17-18-20-23              |
| CDRNELL-DUBILIER ELECT DIV NORWOOD           | 26   |
| CORNELL-DUBILIER ELECTRIC CORP N BEDFORD     | 1-2-3-8-9-12-13-15-16-17-18-20-23-24-28-29 |
| CORNELL-DUBILIER ELECTRONICS DIV SANFORD PLT | 27   |
| 1-6-9-12-13-15-17-18-19-20-22-27             | 14-25                                      |
| CORNELL DUBILIER ELECTR DIV PROVIDENCE       | 14-25                                      |
| CORNING GLASS WORKS CORNING                  | 11-12-13-29                                |
| CORNING GLASS WORKS RALEIGH                  | 9-11-12-13-22-29                           |
| CORSON ELECTRIC MFG CORP E HAMPTON           | 12-13-14-15-18-20-23-27                    |
| CORSON ELECTRIC MFG CORP                     | 9-13-15-17-18-20-23-27                     |
| COSMIC RADIO CORP                            | 6-17                                       |
| DALE ELECTRONICS INC COLUMBUS                | 3-12-13-28                                 |
| DEARBORN ELECTRONIC LABS INC                 | 1-8-9-12-13-15-16-18-20-21-23-24-27-28     |
| DEVCO DIV R E PHELONCO INC                   | 15   |
| DILECTRON DIV BESTRAN CORP                   | 2-3-5-8-13-19-22-28                        |
| DOLINKO & WILKENS INC                        | 30   |
| DOUBLE E PRODUCTS CO                         | 1-8-9-12-13-15-16-17-18-27                 |
| DUMONT AIRPLANE & MARINE INSTRUMENT INC      | 6-12-15-16-17-20-24                        |
| EFCON INCORP SUB GENERAL INST                | 1-9-11-12-13-15-16-18-20-26-27-28          |
| ELECTRA MFG CO INDEPENDENCE                  | 6-26                                       |
| ELECTRA MFG CO KANSAS CITY                   | 26   |
| ELECTRICAL SPECIALTY CO LOS ANG              | 6-16                                       |
| ELECTRICAL SPECIALTY CO SAN FRAN             | 6-16                                       |
| ELECTRICAL UTILITIES CO                      | 1-9-13-15-16-17-27                         |
| ELECTRO CAPACITORS CO                        | 6-26                                       |
| ELECTRO-CERAMICS INC NEW HAVEN               | 3  |
| ELECTRO MOTIVE MFG CO INC                    | 9-12-13-14-15-18-25                        |
| ELECTRO SCIENTIFIC IND INC                   | 12-13-14-19-25-28-30                       |
| ELECTRON PRODS DIV MARSHALL IND MONROVIA     | 1-8-9-12-13-15-16-17-18-19-20-22-24-27     |
| ENFLO CORP                                   | 18-27                                      |
| EPIC INC                                     | 13   |
| ERIE ELECTRONICS DIV                         | 2-3-4-5-8-9-12-13-14-22-25-26-28           |
| ELECTRONICS DIV ERIE RESISTOR CORP           | 3-4-8-13-14-18-25                          |
| ERIE RESISTOR CORP                           | 2-3-5-8-12-13-14-22-25-26-28               |
| ESPEY MFG & ELECTRONICS CORP                 | 9-12-13-15-16-17-20-23-27                  |
| ESSEX ELECTRONICS OF CANADA LTD              | 3  |
| FANSTEEF METALLURGICAL CORP                  | 6-7-8-12-26                                |
| FARADAYE ELECT CORP                          | 0  |
| JOHN E FAST CO DIV VICTOREEN INST CO         | 1-8-9-12-13-15-16-17-18-20-22-24-26-28-29  |
| FILM CAPACITORS INC                          | 1-9-12-13-15-17-27                         |
| FILMOHM CORP                                 | 14   |
| FILTRON CO                                   | 1-8-9-12-13-15-16-17-18-20-23-24-27        |
| FILTRON CO INC WESTERN DIV                   | 8-13-16-23                                 |
| FRYLING ELECT PROD INC                       | 3-5-8-18-28                                |
| GENERAL CAPACITOR CO                         | 12-13-14-15-16-18-20-23-24-27-28           |
| GENERAL ELECTRIC CAPACITOR DEPT              | 6-7-12-13-26                               |
| GENERAL INSTRUMENT CO                        | 6-7-14-15-17-26                            |

|   |   |
|---|---|
| GENERAL INSTRUMENT CORP CAPACITOR DIV       | 1-6-8-9-12-13-14-15-16-17-18-19-20-22-24-25-26-27-29            |
| GENERAL INSTRUMENT CORP CAPACITOR DIV       | 6-14  |
| GENERAL PRODUCTS CORP                       | 17-20   |
| GENERAL RADIO CO                            | 14-15-17-19-20-25   |
| GENISTRON INC HENSENVILLE                   | 1-8-9-12-13-15-16-17-18-19-20-23-26                             |
| GEOTRONIC LABS INC                          | 9-15-20-27  |
| GIRARD-HOPKINS                              | 15-16-17  |
| GLADDING MCBEAM & CO LOS ANG                | 3-21  |
| GLP ELECTRONICS INC                         | 6-26  |
| GOOD ALL ELECTRIC MFG CO OGALLALA           | 3-9-11-16   |
| GOOD-ALL ELECTRIC MFG CO ALLIANCE           | 3-15-18-22-24   |
| THE GUDEMAN CO CHICAGO                      | 1-8-9-12-13-15-16-17-18-20-23-24-27-28                          |
| GUDEMAN CO OF CALIF                         | 9-15-17-18-24   |
| GULTON INDUSTRIES INC METUCHEN              | 3-11-12-26-28   |
| HALEX INC                                   | 9   |
| HALLETT MFG CO                              | 8   |
| HI-O DIV AEROVOX CORP                       | 3-4-5-8-12-13-22  |
| HOPKINS ENG CO                              | 1-8-9-12-13-15-16-17-18-20-22-23-24-27                          |
| ILLINOIS CONDENSER CO                       | 1-6-15-16-18-20-22  |
| INDUSTRIAL CONDENSER CORP                   | 1-6-15-16-18-20-22  |
| INTELLUX INC                                | 9   |
| INTERNATIONAL ELECT INDUSTRY                | 6-7-22-26   |
| INTL ELECTRONIC INDUSTRIES                  | 6-7-8-26  |
| ITT COMPONENTS DIV CLIFTON                  | 17-26   |
| ITT FEDERAL LABS NUTLEY                     | 3-9-12-22-26  |
| JARVIS ELECTRONICS CORP                     | 9-20  |
| JEFFERS ELECTRONICS DIV SPEER CARBON CO     | 4   |
| JENNINGS RADIO MFG CORP SAN JOSE            | 30  |
| JFD ELECTRONIC CORP                         | 28  |
| JOHNSTON FOIL MFG CO                        | 4   |
| KEMET CO DIV UNION CARBIDE CORP             | 26  |
| KEMET CO DIV OF UNION CARBIDE CORP          | 26  |
| LAPP INSULATOR CO RADIO SPECIALTIES DIV     | 10  |
| LA ROSE & ASSOC INC W T                     | 8   |
| LECLANCHE S A                               | 2-3-5-6-7-8-9-13-15-16-17-18-20-26                              |
| LEEDS & NORTHRUP CO                         | 25  |
| LINE MATERIAL INDUSTRIES                    | 0   |
| MAIDA DEVELOPMENT CO                        | 3-5-8-12-13-22-28   |
| P R MALLORY & CO INC                        | 1-6-7-12-13   |
| MALLORY & CO INC P R                        | 6-7-12-13   |
| MALLORY CAPACITOR CO DIV P R MALLORY CO INC | 16  |
| MALLORY CAPACITOR CO DIV P R MALLORY CO INC | 7   |
| MALLORY CAPACITOR CO DIV PR MALLORY CO INC  | 26  |
| MALLORY CAPACITOR CO                        | 26  |
| M E C INC                                   | 7   |
| METAVAC INC                                 | 9-25  |
| METCOM INC                                  | 10  |
| METROPOLITAN TELECOMMUNICATIONS CORP        | 3   |
| COIL WINDERS DIV                            | 13-29   |
| MILLEN MFG CO JAMES                         | 25  |
| MOREY CORP                                  | 3-12-22-28  |
| MUCON CORP                                  | 14  |
| MUIRHEAD & CO LTD                           | 14-17   |
| MUIRHEAD INSTRUMENTS INC                    | 3   |
| MUTER CO                                    | 6-15-26   |
| NASHVILLE ELECTRONICS INC                   | 17  |
| NATIONAL VACUUM PLATERS INC                 | 15-16-17  |
| NEPTUNE ELECTRONICS CO                      | 6-15-20   |
| NUCLEAR CORP OF AMER PHOENIX                | 5-11-12   |
| NUCLEONIC PROD CO                           | 3-22  |
| NU-LINE INDUSTRIES                          | 2-7-13  |
| NYTRONICS INC BERKELEY HTS                  | 13  |
| NYTRONICS INC LEXINGTON                     | 7-26  |
| OHIO BRASS CO                               | 7-26  |
| OHWHITE MFG CO                              | 3-26  |
| ONONDAGA ELECTRONICS DIV SPEER CARBON CO    | 15  |
| PAKTRON DIV ILL TOOL WORKS                  | 6-22  |
| PLANET MFG CORP                             | 1-8-9-12-13-15-16-18-20-22-23-24-27                             |
| PLASTIC CAPACITORS INC                      | 1-8-9-12-13-15-16-17-18-24-27                                   |
| POTTER CO THE                               | 4-8-11-12-13-17   |
| POTTER CO THE                               | 1-9-12-13-15-16-18-19-20-22-24-27                               |
| PRECISION CAPACITORS INC                    | 4   |
| QUALITY COMPONENTS INC                      | 9-15-18-27  |
| RADIATION RESEARCH CORP WESTBURY            | 26  |
| RADIO CONDENSER CO LTD                      | 9-15-18-20-22-26  |
| RCA SEMICOND & MTL DIV NEEDHAM HTS          | 26  |
| RADIO CORP OF AMERICA SCHEWVILLE            | 26  |
| RCA SEMICOND & MTL DIV FINDLAY              | 26  |
| RCA SEMICOND & MTL DIV MOUNTAINTOP          | 26  |
| RADIO FREQUENCY CO                          | 29  |
| RADIO INDUSTRIES TRW ELECTRONICS            | 3   |
| RADIO MATERIALS CO DIV PR MALLORY & CO INC  | 3-5-13-19-22-28   |
| RF INTERONICS INC                           | 1-8-9-12-13-15-16-17-18-19-22-23-24-27-28-29                    |
| RISCO                                       | 14  |
| SAFE-T-MIKE CORP                            | 6   |
| SAN FERNANDO ELECTRIC MFG CO                | 1-3-7-8-9-12-13-15-16-17-18-19-20-22-24-27                      |
| SANGAMO ELECTRIC CO                         | 1-2-4-5-6-7-8-9-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-29 |
| SCINTILLA DIV BENDIX CORP                   | 3-12-14-25  |
| SEMICON INC                                 | 9   |
| SEMITRONICS CORP                            | 5-15  |
| SKOTTIE ELECTRONICS INC                     | 3-5-12-13-22-28   |
| SOLAR MFG CORP                              | 2   |
| SOLAR VOLT CO INC                           | 23  |



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|---|--|
| SOUTHERN ELECTRONICS CORP               | 1-12-13-15-18-19-20-22-27-28   |
| SPRAGUE ELECTRIC CO N ADAMS             | 1-2-3-5-6-7-8-9-12-13-14-15-16-17-18-19-20-22-23-24-25-26-27-28                  |
| STACKPOLE CARBON CO ST MARYS            | 4  |
| STANDARD PRESSED STEEL CO               | 6-7-26   |
| SYNCO CORP ELECT DIV                    | 6-22   |
| TRANSITOR ELECTRONICS INC               | 26   |
| TELEGRAPH CONDENSER CO                  | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30 |
| TEXAS CAPACITOR CO DIV K-C-K CORP       | 1-9-12-13-15-16-18-22-23-24-27   |
| TEXAS INSTRUMENT SEMICON-COMPONENTS DIV | 0  |
| TI TAL INC                              | 6-7-12-26  |
| U S CAPACITOR CORPORATION               | 3  |
| US SMCOR                                | 26   |
| US SEMICONDUCTOR PRODUCTS               | 6-7-8  |
| UNDERWOOD ELECTRIC & MFG CO INC         | D  |
| UNITED ELECTRONIC MFG CORP              | 6-22   |
| UNIVERSAL CONDENSER CO                  | 1-8-9-11-12-13-15-16-17-18-20-22-23-24-27-28                                     |
| VITRAMON INC                            | 2-3-8-21   |
| WESCO ELECTRIC & MFG CO                 | 1-9-12-13-15-16-17-18-19-20-22-23-24-27-28-29                                    |
| WESTINGHOUSE ELECT CORP APPARATUS DIV   | 7-12-13  |
| WESTLAKE PLASTICS CO                    | 20   |
| WINDSOR ELECTRONICS INC                 | 16   |

**CAPACITORS, VARIABLE 900**

|                                     |    |
|-------------------------------------|----|
| Capacitors, air                     | 1  |
| Capacitors, ceramic trimmer         | 2  |
| Capacitors, gas filled              | 3  |
| Capacitors, glass trimmer           | 4  |
| Capacitors, high temperature        | 5  |
| Capacitors, mica trimmer            | 6  |
| Capacitors, miniature               | 7  |
| Capacitors, oil filled              | 8  |
| Capacitors, piston                  | 9  |
| Capacitors, plastic                 | 10 |
| Capacitors, printed circuit         | 11 |
| Capacitors, semiconductor           | 12 |
| Capacitors, temperature compensated | 13 |
| Capacitors, transmitter tuning      | 14 |
| Capacitors, vacuum                  | 15 |

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|---|-------------------------|
| AEROVOX CORP HQ DIVISION                | 2                       |
| AETNA ELECTRONICS CORP                  | 14                      |
| AIRCRAFT RADIO CORP                     | 1                       |
| AIR O TRONICS ENG CO                    | 2                       |
| ALL STAR PRODUCTS INC                   | 1                       |
| ARCO ELECT INC                          | 10                      |
| ATLEE CORP                              | 4                       |
| AUTOMATION COMPONENTS INC               | 2                       |
| BARKER & WILLIAMSON INC                 | 14                      |
| BENDIX CORP SEMICONDUCTORS DIV          | 12                      |
| BIRD & SONS LTD SYDNEY S                | 1-6-14                  |
| BRITISH RADIO ELECTRONICS LTO           | 1-13                    |
| BUD RADIO INC                           | 1-14                    |
| CAMBRIDGE THERMIONIC CORP               | 2-11                    |
| CAPTRONICS INC                          | 5-8-10-14               |
| CARDWELL CONDENSER CORP                 | 1-7                     |
| CENTRALAB DIV GLOBE UNION               | 2-7                     |
| CENTRALAB DIV GLOBE UNION INC           | 11-12                   |
| CENTRALAB DIV GLOBE UNION               | 2                       |
| CENTRALAB DIV GLOBE UNION               | 2-7-11-12               |
| COLUMBUS ELECTRONICS CORP               | 3                       |
| COMPONENT RESEARCH CO INC               | 1-2-4-5-7-8-9-10        |
| CONTINENTAL DEVICE CORP                 | 12                      |
| CONTINENTAL ELECTRONIC MFG CO           |                         |
| LABS LING TEMCO-VOUGHT INC              | 8-14                    |
| CORNING GLASS WORKS CORNING             | 4-5-7                   |
| CULBERTSON PRODUCTS INC                 | 1-7                     |
| DITTMORE FREIMUTH CORP                  | 1                       |
| ELECTRON RESEARCH INC                   | 12                      |
| ELPAC INC                               | 7-8-10-11               |
| ENGLISH ELECTRIC VALVE CO LTD           | 15                      |
| ERIE ELECTRONICS DIV                    | 2-4-5-7-11-12-13        |
| ERIE RESISTOR OF CANADA LTD             | 2-10-13                 |
| ELECTRONICS DIV ERIE RESISTOR CORP      | 2-7                     |
| ERIE RESISTOR CORP                      | 2-4-5-9-10-11-13        |
| FRYING ELECT PROD INC                   | 2-10-13                 |
| GARY WELLS CO                           | 1                       |
| GENERAL ELECTRIC CO CAPACITOR DEPT      | 7-8-10-12               |
| ELPAC INC                               | 7-8-10-11               |
| GENERAL INSTRUMENT CORP NEWARK          | 1-8-12-14               |
| GENERAL INSTRUMENT CORP F W SICKLES DIV | 1                       |
| GENERAL RADIO CO                        | 1                       |
| GENISTROM INC                           | 7-8-10-13               |
| GLADDING MCBREAM & CO LOS ANG           | 2                       |
| GOMBOS INC CO JOHN                      | 1                       |
| HAMMARLUND MFG CO INC MARS HILL         | 1-14                    |
| HI-Q DIV AEROVOX CORP                   | 7-11-13                 |
| INTERNATIONAL RECTIFIER CORP            | 12                      |
| ITT FEDERAL LABS NUTLEY                 | 7-12                    |
| JACKSON BROS LONDON LTD                 | 1-7-9-10-11-14          |
| JANVIS ELECTRONICS CORP                 | 7                       |
| JENNINGS RADIO MFG CORP SAN JOSE        | 15                      |
| JFO ELECTRONIC CORP                     | 2-3-4-5-7-9-10-11-13-14 |
| JOHANSON MFG CO                         | 1-2-4-5-7-9-11-14       |
| JOHNSON CO E F                          | 1-7                     |
| JOHNSON CO E F                          | 1-7-9-11-13-14          |

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| LAPP INSULATOR CO RADIO SPECIALTIES DIV    | 3-14           |
| LA POINTE INDUSTRIES INC                   | 14             |
| LFEDS & NORTHROP CO                        | 1              |
| MAIDA DEVELOPMENT CO                       | 2              |
| MEASUREMENTS DIV MC GRAW-EDISON CO         | 1              |
| M E C INC                                  | 7              |
| METAL SPECIALTY PRODUCTS CORP              | 1              |
| MICROMOLO PRODUCTS CORP                    | 10             |
| MILLEN MFG CO JAMES                        | 1-2            |
| MUIRHEAD & CO LTD                          | 1-6            |
| MUIRHEAD & CO LTD                          | 1              |
| MUIRHEAD INSTRUMENTS INC                   | 1              |
| NATL RADIO CO INC                          | 1-14           |
| OAK MFG CO                                 | 1              |
| THE POTTER CO                              | 5-7-8-10-11    |
| POWER COMPONENTS INC                       | 12             |
| PRECISION CAPACITORS INC                   | 10             |
| RADIO COND CO SUB THOMPSON RAMO WOOLDRIDGE | 1-5-7-11-13-14 |
| RADIO CONDENSER CO LTD                     | 1-7-10-11      |
| RADIO CONDENSER CO WATSEKA                 | 1-10           |
| RADIO CONDENSER CO HOOPESTOWN              | 1-10           |
| RADIO FREQUENCY CO                         | 14             |
| SARKES TARZIAN INC                         | 1-7            |
| SICKLES F W DIV GIC                        | 1              |
| SOUTHERN ELECTRONICS CORP                  | 10-11          |
| TAFFET ELECTRONICS INC                     | 1              |
| TELECHROME MFG CORP                        | 1-2-4-7-9-14   |
| TELEGRAPH CONDENSER CO                     | 2              |
| TRANSITRON ELECTRONIC CORP                 | 12             |
| VACAP CORP                                 | 15             |
| WARREN COMPONENTS DIV EL-TRONICS INC       | 12             |
| WESTINGHOUSE ELECT CORP APPARATUS DIV      | 8              |

**CHASSIS, ACCESSORIES, FUSES 1000**

|                           |    |
|---------------------------|----|
| Adapters, crystal         | 1  |
| Adapters, lamp socket     | 2  |
| Adapters, plug            | 3  |
| Adapters, test            | 4  |
| Adapters, tube socket     | 5  |
| Binding posts             | 6  |
| Chassis, metal            | 7  |
| Chassis, non-metal        | 8  |
| Fuse clips                | 9  |
| Fuse holders              | 10 |
| Fuses, cartridge          | 11 |
| Fuses, indicating         | 12 |
| Fuses, instrument         | 13 |
| Fuse panels               | 14 |
| Fuses, plug               | 15 |
| Fuses, special-purpose    | 16 |
| Jacks                     | 17 |
| Jumpers                   | 18 |
| Lugs                      | 19 |
| Sockets, adapter          | 20 |
| Sockets, coil             | 21 |
| Sockets, crystal          | 22 |
| Sockets, relay            | 23 |
| Sockets, subminiature     | 24 |
| Sockets, transistor       | 25 |
| Sockets, tube             | 26 |
| Sockets, turret           | 27 |
| Solder                    | 31 |
| Spaghettis                | 28 |
| Straps, ground            | 29 |
| Tapes, pressure sensitive | 30 |

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|--|-----------------|
| ABALON PRECASUON MFG CORP              | 7               |
| ACCURATE ELECTRONICS CORP ELYRIA       | 6-10-14-17-21   |
| ACME MODEL ENGG CO                     | 7               |
| ADC PRODUCTS DIV OF MAGNETIC CONTROLS  | 17              |
| AEROLITE ELECTRONICS CORP              | 6-9-10-17-18    |
| AEROVOX CORP                           | 26              |
| AIRCRAFT & FLECT SPEC                  | 4-10-16-29      |
| AIR O TRONICS ENG CO                   | 4-6-17          |
| ALCON METAL PRODUCTS INC               | 5-6-18-19-26-29 |
| ALOEN PRODUCTS CO                      | 4-7-10-17-18-26 |
| ALDEN SYSTEMS CO                       | 10              |
| ALLEN-BRADLEY CO                       | 9               |
| ALLIED CONTROL CO INC                  | 23              |
| ALPHA METALS INC                       | 31              |
| ALPITEC INC                            | 7               |
| AMATON ELECTRONIC HARDWARE CO INC      | 9-10-17-19      |
| AMCO ENG CO                            | 7-14            |
| AMERICAN ALUMINUM CO                   | 7               |
| AMERICAN ELECTRIC CABLE CO             | 18              |
| AMERICAN ELECT INC TALLER & COOPER DIV | 7               |
| AMERICAN ELECTRIC SWITCH DIV           | 14              |
| AMPHENOL CONNECTOR                     | 23-24-26        |
| ANCHOR SPFC MFG CO                     | 3-4-7-8-14      |
| APPLIED DEVELOPMENT CORP MONTEREY PK   | 7               |
| APPLIED TECHNOLOGY CORP                | 7               |

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|---|--|
| ARROW MACHINIST & FABRICATORS               | 7  |
| ARTISAN METAL WORKS CO                      | 7  |
| ASSOCIATED ENG CORP BROOLINE                | 18   |
| ATLAS CONNECTORS CORP                       | 22-23-25-26-27                                 |
| ATLEE CORP                                  | 9  |
| AUBURN MFG CO                               | 30   |
| AUDID ACCESSORIES                           | 17   |
| AUGAT BROS                                  | 17-22-23-26                                    |
| AUTO PRODUCTS MFG                           | 13   |
| AVCO CORP ORNANCE DIV RICHMOND              | 7  |
| BARNES DEVELOPMENT CO                       | 3-4-5-23-24-25-26                              |
| BARRY CONTROLS DIV OF BARRY WRIGHT CORP     | 7  |
| W A BEAUCHATNE & SONS INC                   | 4-5-17   |
| BELFUSE INC                                 | 9-10-11-12-13-14-16                            |
| BELMONT SMELTING & REFINING WORKS           | 31   |
| BERNARD FRANKLIN CO INC                     | 7  |
| BOW SOLOER PRODUCTS CO                      | 31   |
| BRAND REX DIV AMER ENKA CORP GARDENA        | 28   |
| BRAND REX DIV AMER ENKA CORP N WINOHAM      | 28   |
| BRAUN TOOL & INSTRUMENT CO INC              | 9  |
| BROOKS & PERKINS INC                        | 7-14   |
| BROWN ENG CO INC                            | 0  |
| BUD RADIO INC                               | 7  |
| BURGHMASTER CORP                            | 7  |
| BUSSMANN MFG CO DIV MCGRAW EDISON           | 9-10-11-12-13-14-15-16                         |
| BY-BUK CO                                   | 30   |
| CALCOR SPACE FACILITY INC                   | 7  |
| CALIFORNIA CHASSIS CO                       | 7  |
| CAMBRIDGE THERMIONIC CORP                   | 17   |
| CANNON ELECTRIC CO PHOENIX                  | 20-23  |
| CARTER PARTS CO                             | 17   |
| C B C ELECTRONICS CO                        | 3-5-20   |
| CENTURY LIGHTING INC N Y                    | 2-7-17-18                                      |
| CHEMVALLEY ELECTRONICS CORP                 | 31   |
| CHEMPLAST INC                               | 28   |
| CHISHOLM INDUST LTD                         | 7  |
| CINCH MFG CO CINCH JONES DIV                | 9-10-17-18-22-23-24-25-26-27                   |
| CIRCUIT STRUCTURES LAB                      | 7  |
| COLUMBIA METAL BOX CO                       | 7  |
| CONN HARD RUBBER CO                         | 30   |
| CONNECTOR CORP                              | 3-5-10-19-23-26                                |
| CONSOLIDATED MOLDED PRODUCTS CORP           | 10-17-18-23-26                                 |
| CRAIG SYSTEMS INC                           | 7  |
| CROWN INC                                   | 7  |
| CROWN CONTROLS CORP                         | 1-10   |
| CUTLER METAL PRODUCTS CO                    | 7  |
| DAHLSTROM METALLIC DOOR CO                  | 7  |
| DAISLEY CO INC RAY                          | 7  |
| DALE ELECTRONICS INC COLUMBUS               | 29   |
| DALWELD CO INC                              | 31   |
| DANTE ELECTRIC MFG CO                       | 9  |
| DAYSTROM INC MILITARY ELECTRONICS DIV       | 7  |
| DELTA ELECT CO                              | 7-9-10-29                                      |
| DIE TECH CORP                               | 7-9-10-19                                      |
| DITTMORE FREIMUTH CORP                      | 16   |
| DOLIN METAL PRODUCTS INC                    | 7  |
| DONMAR PRODUCTS INC                         | 3-17   |
| DONNELLY MFG CO                             | 7  |
| DOSSERT MFG CORP                            | 16-19-29                                       |
| DRAKE MFG CO                                | 24   |
| DYNALECTRON CORP MATTERN DIV                | 7  |
| EAGLE ELECTRIC MFG CO INC                   | 2-3-10-11-15-20-29                             |
| EASTERN TECHNICAL ASSOC INC                 | 7-8-14   |
| EBY SALES CO                                | 3-4-5-6-10-17-20-22-23-24-25-26-27             |
| EDO CANADA LTD                              | 7  |
| EISLER TRANSFORMER CO INC                   | 7-14   |
| EITEL-MC CULLOUGH INC SAN CARLOS            | 26   |
| ELECTRALAB PRINTED ELECT CORP NEEOHAM       | 7  |
| ELECTRO CHEMICAL ENGRAVING CO INC           | 7  |
| ELECTRO PRODUCTS INC                        | 3-4-7-9  |
| ELECTRO RACK INC                            | 7  |
| ELECTROSPACE CORP                           | 6  |
| ELECTRO SPACE FAB INC                       | 7  |
| ELECTRONIC CONNECTORS INC                   | 3-6-17-20-24                                   |
| ELECTRONIC TECHNOLOGY RESEARCH INC          | 24-26  |
| ELECTRONIC TRAINING AIDS CO                 | 20   |
| ELECTRONICS DEVELOPMENT INC STATE COLLEGE   | 31   |
| ELJAY CORP                                  | 7  |
| ELZEE METAL PRODUCTS CO                     | 7  |
| ENFLO CORP                                  | 26-30  |
| ERWOOD INC                                  | 7  |
| ESPEY MFG & ELECTRONICS CORP                | 7  |
| EUGENE ENGINEERING CO INC                   | 7-8  |
| EUTECTIC WELDING ALLOYS CORP                | 31   |
| FAIRMOUNT CHEMICAL CO INC                   | 31   |
| FALSTROM CO                                 | 7  |
| FARWELL METAL FABRICATING                   | 7  |
| FEDERAL SCREW PRODUCTS INC                  | 6-9-10-19                                      |
| FEINER & SONS P                             | 7-8  |
| FORMICA METAL PROD CO                       | 7  |
| FORWAY INDUSTRIES INC                       | 4-5-7-20                                       |
| FRONTIER ELECT CO                           | 1  |
| GARDE MFG CO                                | 10   |
| GARLOCK ELECTRONIC PRODUCTS PROOS PALMYRA   | 24-25-26-28                                    |
| GASSER METAL PRODUCTS                       | 7-14   |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV | 3-4-5-6-9-10-17-26-28-29-30-31                 |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS   | 3-4-5-6-7-8-9-10-17-18-19-20-25-26-28-29-30-31 |
| GEER MACHINE WORKS INC                      | 7  |
| GENERAL ELECT CO WIRING DEVICE DEPT         | 10-11-15                                       |
| GENERAL METAL PROD CO                       | 7  |
| DIV OF PLANETRONICS INC                     | 7  |
| GENERAL MICROWAVE CORP                      | 1  |
| GENERAL PLASTICS CORP                       | 26-30  |
| GENERAL RADIO CO                            | 6-17   |
| GOLDING MFG CO                              | 7-14   |
| GRAPHICS INC KEARNY                         | 8  |



**PRODUCTS & MANUFACTURERS**

**Chassis, Accessories, Fuses • Chemicals, Coatings & Related Products**

|   |                                |
|---|--------------------------------|
| GRAYHILL MOLDTRONICS INC                  | 26                             |
| GREAT FALLS PRODUCTS CO INC               | 7                              |
| GREEN RECTIFIER CO                        | 7                              |
| HALLETT MFG CO                            | 18                             |
| HAMMER ELECTRONICS CO INC                 | 7                              |
| HANDEE HOUSEHOLD PRODUCTS                 | 7                              |
| HARRIS MFG CO INC                         | 7-8-10                         |
| HELDOR MFG CORP                           | 7-17                           |
| HFLER CO GFRAID K                         | 7                              |
| HENRY & MILLER INDUSTRIES INC             | 7-9                            |
| HI-SPEED EQUIPMENT CO                     | 7-8                            |
| HOBSON BROS                               | 19                             |
| HOFFMAN ENG CORP                          | 14                             |
| HUGHES AIRCRAFT CO ELECT PROD DIV         | 23                             |
| HUGHES TREITLER MFG CORP                  | 7                              |
| IDEAL INDUSTRIES INC SYCAMORE             | 7-8                            |
| IE MFG                                    | 3-4-7-9-10-17-18               |
| INDUSTRIAL ELECTRONIC HARDWARE CORP       | 5-6-10-14-20-22-23-24-25-26-27 |
| INDUSTRIAL METALS ALLOY CO INC            | 31                             |
| INSO ELECT PROD INC                       | 28                             |
| INSTRUMENTS FOR INDUSTRY INC              | 26                             |
| INTERLAKE STAMPING CORP                   | 7                              |
| INTERNATIONAL ELECTRIC INDUSTRIES INC     | 3-4-18-29                      |
| INTL ELECTRIC INDUSTRIES INC N Y          | 17                             |
| JETTRON PRODUCTS                          | 2-5-20-24-25-26                |
| JOCLIN MFG CO                             | 30                             |
| JOHNSON CO E F                            | 6-17-22-26                     |
| JONES ELECTRONICS HIRAM                   | 17                             |
| KESTER SOLDER CO CHICAGO                  | 31                             |
| KESTER SOLDER CO NEWARK                   | 31                             |
| KEYSTONE ELECTRONICS CORP N Y             | 6-14-17-18-19                  |
| KIBBY INSTRUMENT CO                       | 7-18-19                        |
| KOLTON ELECTRIC MFG CO                    | 9-10-14-19                     |
| KORRY MANUF CO                            | 24                             |
| KULKA ELEC CORP                           | 2-3-10-18-19-29                |
| LABELLE INDUSTRIES INC                    | 7                              |
| LABORATORY FOR ELECTRONICS INC            | 5-7-8                          |
| LAI I & E DIV                             | 7-8                            |
| LAND AIR INSTRUMENT & ELECT DIV           | 7                              |
| LEACH & GARNER CO INDUSTRIAL DIVISION     | 31                             |
| LEITCH HUARD CORP                         | 7                              |
| LINK DIV GENERAL PRECISION INC            | 7-8                            |
| LITTELFUSE INC                            | 16                             |
| LITTON INDUSTRIES ELECTRON TUBE DIVISION  | 21-26                          |
| LIVINGSTON ELECT CORP                     | 24-26                          |
| LMB                                       | 7                              |
| LUDWIG HONOLO MFG CO                      | 7-14                           |
| LYN TRON INC                              | 19-24                          |
| LYNCH COMMUNICATION SYSTEMS INC           | 7                              |
| LYNCH MFG CO R H                          | 7                              |
| MADIGAN CORP                              | 7-8                            |
| MALKIN-ILLTON CO                          | 7                              |
| MANDEX MFG CO INC                         | 5-17-24-26                     |
| MARYLAND CERAMIC & STEATITE CO INC        | 19                             |
| MASTERITE INDUSTRIES INC                  | 7                              |
| MAYSTEEL PRODUCT INC                      | 7                              |
| MEASUREMENT ENGG LTD                      | 7                              |
| METAL CRAFT INC                           | 7                              |
| METAL FABRICATORS CORP                    | 7                              |
| METAL SPECIALTY PRODUCTS CORP             | 5-7-20                         |
| METHODE MFG CORP                          | 22-23-24-25-26                 |
| METHODE MFG CO                            | 5-19-20-22-23-24-25-26-29      |
| MICROELECTRON INC                         | 10-11-13-16                    |
| MIO-CONTINENT ENGINEERING                 | 7                              |
| MIDWEST METAL PRODUCTS INC                | 7                              |
| MILLEN MFG CO JAMES                       | 1-6-20-21-22-23-24-26          |
| MILLITEST CORP                            | 4                              |
| MINI-MOLD INC                             | 25                             |
| MINNEAPOLIS-HONEYWELL AERO DIV            | 7-8                            |
| MINNESOTA MINING & MFG CO HUTCHINSON      | 30                             |
| MOBIL ELECTRONICS MFG CO                  | 7                              |
| MORSE CO FRANK W                          | 2                              |
| MUCKLE MFG CO                             | 7                              |
| MULTICORE SOLDERS LTD                     | 31                             |
| MUNSTON ELECTRONIC MFG CORP               | 1-23                           |
| NATL RADIO CO INC                         | 6-22-26                        |
| NATIONAL TEL TRONICS CORP                 | 4-5-6-8-10-14-17-19-29         |
| NEVADA AIR PRODUCTS CO                    | 7                              |
| NEW YORK SOLDER CO                        | 31                             |
| NICHOLS PRODUCTS CO                       | 1                              |
| NORRICH PLASTICS CORP                     | 6-17                           |
| NU-LINE INDUSTRIES                        | 17                             |
| OK ELECTRONICS CORP                       | 12-13-16-22-23-25-26-27        |
| OLYMPIC PRODUCTS CO INC                   | 7                              |
| PEEBLES & CO LTD BRUCE                    | 7                              |
| PERMOFLUX CORP                            | 3-4                            |
| PIFER INDUSTRIES INC                      | 7                              |
| PLUG IN INSTRUMENTS INC                   | 7                              |
| POMONA ELECTRONICS CO INC                 | 3-4-5-18-20-25                 |
| PREMIER METAL PRODUCTS CO                 | 7                              |
| PRESTO ELECTRONIC METAL PROD CO INC       | 7-19                           |
| PROJECTS UNLIMITED INC                    | 7                              |
| PYLE-NATIONAL CO                          | 17-18                          |
| PYLON CO INC                              | 24                             |
| RADIAPHONE CO                             | 7                              |
| RADIO SPECIALTY MFG CO                    | 7                              |
| RAYTHEON CO INDUSTRIAL COMPONENTS DIV     | 6-10-17                        |
| REMINGTON CORP                            | 17                             |
| REMLER CO                                 | 26                             |
| REPUBLIC FLOW METERS CO                   | 7                              |
| REFUTER INC                               | 7                              |
| RIESTER & THESMACHER CO                   | 7                              |
| ROBERTSON ELEC CO INC                     | 7                              |
| ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA | 30                             |
| ROSS METALS CO MILTON                     | 22-23-24-25                    |
| SAGE LABORATORIES INC                     | 1                              |
| SATELLITE CORP OF AMERICA                 | 8                              |
| SCHMITT MFG CO                            | 2-7-14                         |
| SEAELECTRO CORP                           | 3-4-17-19-20-24-25             |

|  |                                      |
|--|--------------------------------------|
| SEAELECTRO CORP                          | 3-17-24-25                           |
| SERVOMECHANISMS INC EL SEGUNDO           | 7                                    |
| SHAMBRAN & CO W S CULVER CITY            | 28                                   |
| SIGHTMASTER CORP                         | 11-12-13-16                          |
| SITTLER CORP                             | 18-29                                |
| C SJOBERG & SON                          | 7                                    |
| SKYRON CORPORATION                       | 9-10-17-18-19-20-22-23-25-29         |
| SLOAN CO THE                             | 2                                    |
| SMITH INC HERMAN H                       | 6-9-17-19-22-26                      |
| THE SOLARTRON ELECTRONIC GROUP LTD       | 7                                    |
| SONEX INC                                | 7                                    |
| SORENSEN INDUSTRIAL ELECTRONIC CO        | 25                                   |
| SPENCE CORP ADAM                         | 28                                   |
| SPERTI FARADAY INC                       | 7-8-14                               |
| STAMPFORD METAL SPECIALTY CO             | 7                                    |
| THE STANDARDO PRODUCTS CO                | 7                                    |
| STAVER CO                                | 10                                   |
| STEINEN MFG CO WM                        | 6-7                                  |
| STONE CITY PRODUCTS CO                   | 9                                    |
| STONE & SMITH INC                        | 7                                    |
| SUCKLE ELECTRONICS CO                    | 7                                    |
| SUN ENG INC OF ST PETERSBURG             | 7-8                                  |
| SPENCER ELECTRIC CO                      | 3-6                                  |
| SWITCHCRAFT INC                          | 3-17                                 |
| SYLVANIA ELECTRIC PROD INC PARTS DIV     | 2-3-4-5-9-10-17-20-23-24-25-26-27-29 |
| TAFFET ELECTRONICS INC                   | 5-7-20                               |
| TAURUS CORP                              | 17-25                                |
| TECHICRAFT CO                            | 6                                    |
| TELKOR INC                               | 7                                    |
| TEMPLET INDUSTRIES INC                   | 7                                    |
| THOR CERAMICS INC                        | 6-26-28                              |
| THORSEN CORP L S                         | 7-14                                 |
| TITCHENER CO E H                         | 7                                    |
| TOPPING ELECTRONICS LTD F V              | 7                                    |
| TROTT ELECTRONICS INC                    | 7-14                                 |
| TRU CONNECTOR CORP                       | 1-3-6-17-29                          |
| TURBO MACHINE CO                         | 13                                   |
| U S RUBBER CO                            | 30                                   |
| UCINITE CO DIV UNITED CARR FASTENER CORP | 2-3-4-5-6-9-10-17-18-19              |
| UNIVERSAL RELAY CORP                     | 23                                   |
| UTILITY METAL PRODUCTS CO INC            | 7                                    |
| VARFLEX CORP                             | 28                                   |
| VECTOR ELECTRONIC CO                     | 3-4-5-7-14-20-25-27                  |
| WABER ELECTRONICS INC                    | 7                                    |
| WALOOM ELECTRONICS INC                   | 19-22-25-26                          |
| WALSCO ELECTRONICS MFG CO                | 4-5-19-20-26-28-31                   |
| WANG LARS INC                            | 7                                    |
| WASHINGTON TECHNOLOGICAL ASSOC INC       | 7                                    |
| WELTRONIC CO                             | 7                                    |
| WESTERN DEVICES INC                      | 7                                    |
| WESTERN DEVICES INC                      | 7                                    |
| WICKES ENGG & CONSTRUCTION CO            | 7                                    |
| WILCOX ELECTRIC CO INC                   | 7                                    |
| WYCO METAL PRODUCTS                      | 7                                    |
| X PANDO CORP                             | 1-3                                  |
| ZERO MFG CO                              | 7                                    |
| ZIMNEY CORP                              | 7                                    |

|                                    |    |
|------------------------------------|----|
| Paint, resistive . . . . .         | 34 |
| Phosphors . . . . .                | 35 |
| Pitch . . . . .                    | 36 |
| Plastic, conductive . . . . .      | 37 |
| Plastics, non-conductive . . . . . | 38 |
| Resins, encapsulating . . . . .    | 39 |
| Rubber, conductive . . . . .       | 40 |
| Silicones . . . . .                | 41 |
| Silverpaste . . . . .              | 42 |
| Solder Resist . . . . .            | 43 |
| Solvents . . . . .                 | 44 |
| Varnish . . . . .                  | 45 |
| Wax . . . . .                      | 46 |

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| ACE ELECTRIC MFG CO                        | 3-44                                     |
| AC ELECTRONICS INC                         | 23                                       |
| ACETO CHEMICAL CO INC                      | 7-9                                      |
| ACHESON COLLOIDS CO                        | 15-18-20-21-32-34                        |
| ACME WIRE CO                               | 17-19-21-24-31-45                        |
| ACOUSTICA ASSOCIATES                       | 5  |
| ACRON LAB                                  | 30                                       |
| ACTON LAB                                  | 4  |
| ALBEROX CORP                               | 5-8                                      |
| ALCONOX INC                                | 4  |
| ALERT SUPPLY CO                            | 4-14                                     |
| ALITE DIV U S STONWARE CO                  | 5-7-8-32                                 |
| ALLACO PRODUCTS                            | 1-5-15-37-38-39-42                       |
| ALLIED CHEMICAL CORP GENERAL CHEM DIV      | 1-6-7-8-9-44                             |
| ALL-STATE WELDING ALLOYS CO                | 27                                       |
| ALPHA METALS INC                           | 27                                       |
| AMBROIO CO                                 | 1-3-21-23-28-31                          |
| AMCHEM PRODUCTS INC                        | 1-5-8-15-19-21                           |
| AMERICAN FELDMUEHLER CORP                  | 4  |
| AMERICAN LAVA CORP SUBS MINN MINING MFG    | 4  |
| AMERICAN PRODUCTS MFG CO                   | 1-5-8-9-16-24-31-38                      |
| AMERICAN SEALANTS CO                       | 1  |
| AMERICAN SILVER CO                         | 27                                       |
| AMERICAN SOLDER & FLUX CO                  | 27                                       |
| ANCHOR PLASTICS CO                         | 38                                       |
| ARLIN MFG CO                               | 38                                       |
| ARMSTRONG CORK CO                          | 1-19                                     |
| ASSOCIATED ENG & MFG CORP                  | 9-16-35                                  |
| ATKINSON LAB INC                           | 0  |
| ATLAS MINERAL PRODUCTS CO                  | 3-21-39                                  |
| ATOMIC ACCESSORIES INC                     | 12                                       |
| BABBITT CHEMICAL CO                        | 37-38                                    |
| BACON INDUSTRIES                           | 1-19-21-39                               |
| BAKER CHEMICAL CO J T                      | 2-5-6-7-8-11-12-17-24-28-37-38-41-44     |
| BARCO CHEMICAL PRODUCTS CO                 | 5-7-14-41-44                             |
| BARIUM & CHEMICALS INC                     | 5-6-7-9-10                               |
| BARIUM CHEMICALS INC                       | 4-6-7-8-9-10-11                          |
| BARNFY CHENEY CO                           | 34                                       |
| BARRETT VARNISH CO                         | 3-21-23-25-26-31-33-45                   |
| BARTA GRIFFIN CO                           | 30                                       |
| BEE CHEMICAL CO                            | 1-15-21-25-26-31-33                      |
| BELDING CORTICELLI INDUST INC              | 21                                       |
| BELFUSE INC                                | 15                                       |
| BELMONT SMELTING & REFINING WORKS          | 27                                       |
| BIGGS CO CARL H                            | 1-3-15-16-18-19-20-21-23-24-37-38-39     |
| BIO-RAD LABS                               | 12                                       |
| BIOS LABS INC                              | 5-6-7-9-10-11-12-13-16-21-24-28-32-35-41 |
| BIWAX CORP                                 | 1-19-39-46                               |
| BLACK LIGHT PRODUCTS INC CHICAGO           | 16-30                                    |
| BLACKSTONE CORP                            | 27                                       |
| BLOOMINGDALE RUBBER CC                     | 1-5-18-38                                |
| BOMYTE CO                                  | 38                                       |
| BONNY MFG CORP                             | 38                                       |
| THE BORDEN CO CHEMICAL DIV ANDOVER         | 19                                       |
| BORDEN CHEMICAL CO PHILA                   | 1-3-9-10-17-19                           |
| BOW SOLDER PRODUCTS CC                     | 27                                       |
| BRUSH BERYLLIUM CO                         | 4  |
| CAIG LABS INC                              | 14-32                                    |
| CANADIAN RADIUM URANIUM DV CANRAD PRES IND | 9-10-12-16-22-35                         |
| CANNON MFG CO INC L J                      | 30                                       |
| CARAD CORP                                 | 5-7-44                                   |
| CARBOLINE CO                               | 1-3-15-18-19-21-34                       |
| CATALIN CORP OF AMERICA                    | 1-2                                      |
| CENTRALAB DIV GLOBE UNION                  | 4  |
| CERAMCO INC CHEMISTS                       | 1-3-4-5-14-15-18-19-21-24-32-44          |
| CHEMICAL COMMERCE                          | 7-11                                     |
| CHEMICAL DEVELOPMENT CORP                  | 1-3-5-15-19-37-38-39-42                  |
| CHEMICAL ELECTRONIC MFG                    | 14                                       |
| CHEMPLAST INC                              | 38                                       |
| CHOMERICS INC                              | 1-2-3-5-8-15-19-20-21-24-32-37-38-39-45  |
| CITY CHEMICAL CORP                         | 5-6-7-8-28-44-46                         |
| CITY MARKING DEVICES CORP                  | 30                                       |
| CITRARKSON LABORATORIES INC                | 1-2-5-7-8-13-14-21-28-44-45-46           |
| COAST PRO-SFAL & MFG CO                    | 1-18-20-24-39-41                         |
| COREHN INC                                 | 5  |
| COLMAN ELECTRONIC PRODUCTS INC             | 1-3-5-14-21                              |
| COLUMBIA TECHNICAL CORP                    | 15-16-18-19-20-21-23                     |
| COMMER PLASTICS & SUPPLY CO                | 1  |
| COMMERCIAL RESINS DIV INTERPLASTICS CORP   | 2-19-21-24-38-39-45                      |
| CONAP INC                                  | 1-3-15-19-20-37-38-39                    |
| CONN HARD RUBBER CO                        | 1-40-41                                  |
| CONNECTICUT VALLEY CHEMICALS INC           | 27                                       |
| COOPER CO D C                              | 5-21-44-46                               |

**CHEMICALS, COATINGS & RELATED PRODUCTS 1100**

|                                      |    |
|--------------------------------------|----|
| Adhesives . . . . .                  | 1  |
| Binders, liquid . . . . .            | 2  |
| Cement . . . . .                     | 3  |
| Ceramics, high temperature . . . . . | 4  |
| Chemicals, cleaning . . . . .        | 5  |
| Chemicals, dehumidifying . . . . .   | 6  |
| Chemicals, electroplating . . . . .  | 7  |
| Chemicals, etching . . . . .         | 8  |
| Chemicals, luminescent . . . . .     | 9  |
| Chemicals, photosensitive . . . . .  | 10 |
| Chemicals, photosensitive . . . . .  | 11 |
| Chemicals, radioactive . . . . .     | 12 |
| Chemicals, wire stripper . . . . .   | 13 |
| Cleaners, contact . . . . .          | 14 |
| Coatings, conductive . . . . .       | 15 |
| Coatings, fluorescent . . . . .      | 16 |
| Coatings, fungicidal . . . . .       | 17 |
| Coatings, high temperature . . . . . | 18 |
| Coatings, insulating . . . . .       | 19 |
| Coatings, printed circuit . . . . .  | 20 |
| Coating, protective . . . . .        | 21 |
| Coatings, radioactive . . . . .      | 22 |
| Coil dope . . . . .                  | 23 |
| Compounds, waterproofing . . . . .   | 24 |
| Enamels . . . . .                    | 25 |
| Finishes, winkle . . . . .           | 26 |
| Flux, brazing & soldering . . . . .  | 27 |
| Fungicides . . . . .                 | 28 |
| Greases, vacuum . . . . .            | 29 |
| Ink, marking . . . . .               | 30 |
| Lacquer . . . . .                    | 31 |
| Lubricants . . . . .                 | 32 |
| Paint, metallic . . . . .            | 33 |

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| COORS PORCELAIN CO                          | 4-18                           |
| CORODO CHEMICAL CORP                        | 37                             |
| CRYSTAL-X CORP                              | 37-38                          |
| CRYS TECH INC                               | 5                              |
| DALWELD CO INC                              | 27                             |
| DAVIDOFF CHARLES                            | 8-20                           |
| DAVIES SUPPLY & MFG CO                      | 5-7-8-19-21-34                 |
| DAVISON CHEMICAL CO                         | 5                              |
| DBM RESEARCH CORP                           | 1-4-6-18-19-20-21              |
| DECIMETER PRODUCTS CO                       | 27                             |
| DEMENT LABS                                 | 9-10-16-22-35                  |
| DERBY LUMINESCENTS LTD OF LONDON ENG        | 9-10-                          |
| C/O UNITED MINERAL & CHEMICAL CORP          | 11-35                          |
| DEWEY & ALMY CHEMICAL CO                    | 0                              |
| DIAMONITE PRODUCTS MFG CO                   | 4                              |
| DILECTRIX CORP                              | 18-19-21-37-38                 |
| DIXON CRUCIBLE CO JOSEPH                    | 18-21-32-33                    |
| DODGE FIBERS CORP                           | 19-37-38                       |
| DORE CO JOHN                                | 37-38                          |
| DOSSERT MFG CORP                            | 15                             |
| DOW CORNING CORP                            | 1-2-18-19-20-21-24-25-29-      |
|   | 32-39-41-45                    |
| DURAMIC PRODUCTS INC                        | 1-3-4-18                       |
| DUREZ PLASTIC DIV-HOOKER CHEMICAL CORP      | 21                             |
| DYNAMONICS CORPORATION                      | 5                              |
| EASTERN CHEMICAL CORP                       | 5-6-7-11-13                    |
| ELECTRICAL SPECIALTY CO LOS ANG             | 13-19-20-                      |
|   | 39-41-45-46                    |
| ELECTRICAL SPECIALTY CO SAN FRAN            | 13-19-20-                      |
|   | 39-41-45-46                    |
| ELECTRO CHEMICAL ENGG & MFG CO              | 3-21                           |
| ELECTRO CHEMICAL DIV REPUBLIC FOIL INC      | 8                              |
| ELECTROFLOR INC                             | 9                              |
| ELECTROMAGNETIC PROBE CO                    | 39                             |
| ELECTRO-THERMO CERAMICS INC                 | 3-4                            |
| ELECTRONANITICS CORPORATION                 | 1-4-15-16-17-18-               |
|   | 19-20-21-22-37                 |
| ELECTRONIC CHEMICAL CORP                    | 5-14-32                        |
| EMERSON & CUMING INC                        | 1-2-3-4-15-18-19-20-           |
|   | 21-37-38-39-40-41-42-44        |
| EMERSON & CUMING INC WESTERN DIV            | 0                              |
| ENFLO CORP                                  | 19                             |
| ENGELHARD INDUSTRIES INC                    | 7-21-27                        |
| ENGINEERED PLASTICS INC                     | 19-21-38                       |
| ENTHONE INC                                 | 5-7-8-13-14-20-21-44-46        |
| EPOXYLITE CORP THE                          | 1-18-19-20-21-24-34-38-        |
|   | 39                             |
| EPOXY PRODUCTS DIV JOS WALDMAN & SONS       | 1-15-                          |
|   | 19-37-38-39-42                 |
| ERIE ELECTRONICS DIV                        | 4                              |
| EUTECTIC WELDING ALLOYS CORP                | 5-27-42-43                     |
| FAIRMOUNT CHEMICAL CO INC                   | 27                             |
| FARRELOO CO                                 | 5-27-43                        |
| AMERICAN SMELTING REFINING CO               | 7                              |
| FENVAL INC                                  | 1                              |
| FIDELITY CHEMICAL PRODUCTS CORP             | 5-8-13-21-                     |
|   | 44                             |
| FINNELL SYSTEM INC                          | 5-46                           |
| FISHER SCIENTIFIC CO FAIR LAWN              | 6-7-8-11-                      |
|   | 14-29-30-44-46                 |
| FLOXROCK CO                                 | 38-39                          |
| FLOOR PRODUCTS INC                          | 16-18-21-25-30-33-34           |
| THE FLUOROCARBON CO                         | 19-21-38                       |
| FLUORON LABS INC                            | 38                             |
| FORMICA CORP                                | 38                             |
| FULLER CO H B LINDEN                        | 1-2-3-15-19-20-21-25-          |
|   | 33-34-38-39-44                 |
| FULLER CO H B CHICAGO                       | 1-3-17-19-20-21-34-            |
|   | 39                             |
| GARLOCK ELECTRONIC PRODUCTS PRODS PALMYRA   | 38                             |
| GATES & CO GEO W                            | 8                              |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV | 1-2-3-5-10-13-14-17-18-19-20-  |
|   | 21-23-24-25-26-27-31-32-33-34- |
|   | 38-39-41-42-44-45-46           |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS   | 1-2-3-5-6-13-14-15-17-18-19-   |
|   | 20-21-23-24-25-26-27-28-31-32- |
|   | 33-34-39-41-42-44-45-46        |
| GENERAL BOX CO                              | 38                             |
| GENERAL CERAMICS DIV IND GENERAL CORP       | 4                              |
| GENERAL ELECTRIC COMPANY CHEM MATERIAL DEPT | 19-38                          |
| GENERAL ELECTRIC CO WATERFORD               | 1-2-18-19-20-                  |
|   | 21-24-29-32-39-41-45           |
| GENERAL FORMULATIONS INC                    | 1-20-21-25-31                  |
| GENERAL MILLS INC CHEMICAL DIV              | 1-39                           |
| GENERAL PLASTICS CORP                       | 15-18-19-21                    |
| GLADDING MCBEAM & CO LOS ANG                | 4                              |
| GLYCO CHEMICALS DIV C L HUISKING & CO INC   | 7-46                           |
| GRAFO COLLOIDS CORP                         | 15-18-21-32                    |
| GREEN RECTIFIER CO                          | 1-39                           |
| GREINER CO EMIL                             | 5                              |
| GULFON INDUSTRIES INC METUCHEN              | 4-18-21                        |
| HALEX CORP DETROIT                          | 37-38                          |
| HANDY & HARMAN BRIDGEPORT                   | 27-33-42                       |
| HANDY & HARMON EL MONTE                     | 15-20-27-33-42                 |
| HARDMAN CO H V                              | 1-39                           |
| HARPER LEADER INC                           | 18                             |
| HARRISON PAINT & VARNISH CO                 | 19-21-25-45                    |
| HARWALD CO INC                              | 3-5-15-32                      |
| HAYNES LABS INC C W                         | 1-3-15-16-17-18-19-20-         |
|   | 21-23-24-25-26-31-33-34-39     |
| HI PURITY METALS INC                        | 5                              |
| HI TEST CHEMICAL CORP                       | 19-21-24-36-46                 |
| HOOVER CHEMICAL CORPORATION                 | 5-32-44                        |
| HUGHSON CHEM CO DIV LORO MFG CO             | 1-21                           |
| HUNT CO PHILIP A                            | 8                              |
| HURON INDUSTRIES                            | 15-32                          |
| HYCOL CORP OLEAN                            | 1-15-19-20-37-38               |
| HYCOL OF CALIF DIV                          | 1-15-17-18-19-20-24-37-        |
|   | 38-39-41-43-45                 |
| INCELOID CO INC                             | 31                             |
| INDIUM CORP OF AMERICA                      | 7-27                           |

|  |                                  |
|--|----------------------------------|
| INJECTORALL CO                               | 1-5-14-19-32                     |
| INSL X PRODUCTS CORP                         | 1-2-3-15-16-17-18-19-            |
|  | 20-21-23-24-25-26-28-31-33-34-   |
|  | 35-39-40-41-44-45-46             |
| IRVAN FERROMAGNETICS CORP                    | 4                                |
| ISOICHEM RESINS CO                           | 1-2-3-5-13-15-18-19-20-          |
|  | 21-24-32-37-38-39-40-41-42-44-   |
|  | 46                               |
| ISOCYANATE PRODUCTS INC                      | 38-39                            |
| ISOMET CORP                                  | 9-35                             |
| JAMES PLATING WORKS INC                      | 15                               |
| JOCLIN MFG CO                                | 18-19-21-41                      |
| JOHNSON MFG CO INC                           | 5-27                             |
| KANO LABS                                    | 5-21-24-32-41-44                 |
| KEMET CO DIV OF UNION CARBIDE CORP           | 41                               |
| KERRCO PRODUCTS                              | 21                               |
| KERSSILK PRODUCTS INC                        | 17-20-25-31-33-34-43             |
| KESSLER CHEMICAL CO INC                      | 0                                |
| KOPPERS CO INC                               | 1-8-21-24-25-32-36-38-39         |
| KRESSLIT PROD INC                            | 33-34                            |
| KRYLON INC                                   | 5-14-16-17-19-21-24-25-30-31-32- |
|  | 33-41-45                         |
| LABORATORY EQUIPMENT CORP                    | 4-18                             |
| LABORATORY FOR ELECTRONICS INC               | 16-17-18-19-                     |
|  | 20-21-24-26-27-30-31-39-43       |
| THE LAKE CHEMICAL CO                         | 3-27-43                          |
| LAMINATED SHEET PRODUCTS CORP                | 38                               |
| LEDAL INC                                    | 4                                |
| LEED INSULATOR CORP                          | 5                                |
| LEFFINGWELL CHEMICAL CO                      | 38                               |
| LEITCH HUARD CORP                            | 26-27-31-33-34                   |
| LEVEY LABS HAROLD A                          | 1-5-8-9-16-24-31-38              |
| LIBBEY OWENS FORD GLASS CO LIBERTY MIRROR DV | 15                               |
| LOCKREY CO                                   | 32                               |
| LONDON CHEMICAL CO INC                       | 5-7-8-13-20-21-27-               |
|  | 31-43-44                         |
| L & R MFG CO                                 | 5-14                             |
| LUMINOUS PROCESSES INC                       | 9-10-12-16-22-35                 |
| MAAS & WALDSTEIN CO                          | 1-3-25-26-31-33-34-45            |
| MACDERMID INCORPORATED                       | 5-7-8-14-20-21-46                |
| MAHONEY TELETRONIC LABS INC                  | 31                               |
| MAJESTIC EXTRUDERS INC                       | 38                               |
| MAJESTIC EXTRUDERS INC                       | 38                               |
| MALLINCKRODT CHEMICAL WORKS ST LOUIS         | 5-6-                             |
|  | 7-8-9-10-11-28-44                |
| MALLINCKRODT CHEMICAL WORKS JERSEY CITY      | 5-                               |
|  | 6-7-8-9-10-11-12-28-32-35-44     |
| MANUFACTURERS CHEMICAL CO INC                | 1-2-23-21-40                     |
| MARBLETTE CORP                               | 1-2-3-15-17-18-19-20-21-24-      |
|  | 31-37-38-39-43-45                |
| MARCONI CHEMICAL DIV BORG-WARNER CORP        | 1                                |
| MARKAL COMPANY                               | 18-21-30                         |
| MATERIALS FOR ELECTRONICS CO                 | 4-11-15-33-37-                   |
|  | 42                               |
| MAY RESEARCH INC                             | 20-21                            |
| MERIT SHORT WAVE DIATHERMY CO                | 3                                |
| MERIX CHEMICAL CO                            | 5-6-14-15-21-32-37-46            |
| METACHFM RESINS CORP MEREKO PRODS DIV        | 5-13-                            |
|  | 15-18-19-20-21-24-30-34-37-38-   |
|  | 39-44-46                         |
| METAL HYDRIDES INCORP                        | 6                                |
| METAL BOTHERMIT CORP                         | 7-8-20-21-25-26-28-31-           |
|  | 34                               |
| METALECTRO LAB                               | 33                               |
| METALLIZING CO OF LOS ANG INC                | 15-18-19-20-                     |
|  | 21                               |
| METAVAC INC                                  | 15-19-21                         |
| METZ REFINING CO                             | 15-42                            |
| MICRO-CIRCUITS CO                            | 15-19-21-33-34-37-40-42-         |
|  | 44                               |
| MICRONICS CORP OF AMERICA                    | 40-41                            |
| MIO-CONTINENT ENGINEERING                    | 1                                |
| MIOLAND INDUSTRIAL FINISHES CO               | 4-15-18-19-                      |
|  | 20-21-25-31-33-34-41-44-45       |
| MILRUH CO                                    | 21                               |
| MILLEN MFG CO JAMES                          | 4-19-23                          |
| MILLER CORP HARRY                            | 5-7-21-32                        |
| MINNEAPOLIS-HONEYWELL CERAMIC LAB            | 4                                |
| MINNEAPOLIS-HONEYWELL ORANGE DIV             | 1-39                             |
| MINN MINING MFG CO CHEMICAL DIV              | 2-19-20-21-                      |
|  | 29-32-38-39                      |
| MINNESOTA MINING & MFG CO ST PAUL            | 1-4-19-                          |
|  | 21-38-39-45                      |
| MINOR RUBBER CO                              | 40-41                            |
| MOLOED FIBER GLASS CO                        | 38                               |
| MONA INDUSTRIES INC                          | 5-8-44                           |
| MOORE CORP JOHN B                            | 44                               |
| MOORE & CO SAMUEL                            | 19                               |
| MORNINGSTAR PAISLEY FACTORIES                | 1-2                              |
| MOTOROLA INC SOLIO STATE SYSTEMS DIV         | 4-7-8-                           |
|  | 12-15-20-37                      |
| MOYEN CO C P                                 | 1-3-23-25-31-44                  |
| NATIONAL ENGG PRODUCTS INC                   | 1-19-24-32-38-39                 |
| NATIONAL METALLIZING CORP                    | 15                               |
| NATL RADIAIC INC                             | 9-10-11-12-22                    |
| NATIONAL ULTRASONIC CORP                     | 44                               |
| NEUSES INC P K                               | 14-30                            |
| NITINE INC                                   | 5-7-8-14-44                      |
| NOPCO CHEMICAL CO                            | 2-5-46                           |
| NOPCO CHEMICAL CANAOGA LTD                   | 5-32                             |
| NORRICK PLASTICS CORP                        | 38-39                            |
| NORTON CO NEW PRODS DEPT                     | 4-18-19-21                       |
| NUCLEONIC CORP OF AMERICA                    | 12                               |
| NU STEEL CO                                  | 5                                |
| PARK ELECTROCHEMICAL CORP                    | 1                                |
| PENETONE CO                                  | 5-8-14-21-44-46                  |
| PETTINOS GRAPHITE CORP                       | 15                               |
| PHILLIPS PROCESS CO                          | 30                               |
| PHYSICAL SCIENCES CORP                       | 4-18-19                          |
| PILOT CHEMICALS INC                          | 10-35                            |
| PLASTICS & RESINS DIV SHELL CHEMICAL CO      | 1-                               |
|  | 38-39                            |
| POLY KOTE INC                                | 15-18-19-20-21                   |
| POLYMER CORP                                 | 38                               |
| PROMCOR INCORP                               | 30                               |
| PRESSITE DIV AMER MARIETTA                   | 1-24                             |

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|--|-------------------------|
| PROTECTIVE COATINGS CORP                     | 21                      |
| Q-MAX CORP                                   | 31                      |
| QUIETROLE CO                                 | 5-14-32                 |
| RADAR RELAY INC                              | 19                      |
| RADIATION RESEARCH CORP WESTBURY             | 19                      |
| RAM CHEMICALS INC                            | 1-5-21-25-31-32         |
| RANDOLPH PRODUCTS CO                         | 1-3-15-17-18-21-25-26-  |
|  | 31-33-34-44-45          |
| RAPID ELECTROPLATING PROCESS INC             | 7                       |
| RAYBESTOS-MANHATTAN INC PASSAIC              | 1-21-41                 |
| RAYBESTOS-MANHATTAN INC PLASTIC PRODUCTS DIV | 38                      |
| REICHHOLD CHEMICALS INC                      | 39                      |
| REID ENTERPRISES                             | 38                      |
| REILLY TAR & CHEMICAL CORP                   | 21-24-36                |
| REPUBLIC RUBBER DIV LEE RUBBER & TIRE CORP   | 40                      |
| RIEGLER PAPER CORP                           | 1-18-19-20-21           |
| ROBERTSON ELEC CO INC                        | 19-21-39                |
| ROBERTS TOLEDO RUBBER CO                     | 40                      |
| ROSENTHAL ISOLATORION GMBH OF SELB W GERMA   | 9-10-11-12              |
| ROSS METALS CO MILTON                        | 39                      |
| ROSTONE CORP                                 | 38                      |
| RUBBER & ASBESTOS CORP                       | 1-39                    |
| RURY CHEMICAL CO                             | 27                      |
| RUST-LICK INC                                | 5                       |
| SAUERISEN CEMENTS CO                         | 1-2-3-15-18-19-21-23    |
| SAXONBURG CERAMICS INC                       | 39                      |
| SAYRE ELECTRONICS                            | 4                       |
| SCHENETADY CHEMICALS INC                     | 19-25-39-45             |
| SEAL PEEI INC                                | 7-21-24                 |
| SEL REX CORP                                 | 7-20-21                 |
| SEMI-ALLOYS INC                              | 27-35-42                |
| SEMICON OF CALIF INC                         | 1-3-4-18-19             |
| SEMI ELEMENTS INC                            | 9-10-11-37              |
| SHAMBAN & CO W S CULVER CITY                 | 38                      |
| SHIPLEY CO INC                               | 1-5-8-14-15-20-21-33    |
| SIFCO METACHEMICAL INC                       | 7                       |
| SILCOCKS MILLER CO                           | 16                      |
| SINGLETON CO                                 | 7-18-21                 |
| SOLAR VOLT CO INC                            | 39                      |
| SOUTHERN PLASTICS CO                         | 38                      |
| SPECIAL CHEMICALS CORP                       | 5-27                    |
| STEWART MFG CO D M                           | 4                       |
| STONHARD CO INC                              | 24                      |
| STROBLITE CO INC                             | 9-10-16                 |
| SUNSHINE SCIENTIFIC INSTRUMENT               | 15-34                   |
| SUPEREX ELECTRONICS CORP                     | 14                      |
| SUPERIOR FLUX & MFG CO                       | 27                      |
| SYLVANIA ELECTRIC PRODUCTS IPSWICH           | 18-19                   |
| SYLVANIA ELECT PRODS CHEM & METALLURG DIV    | 9-10-16-35              |
| SYLVANIA ELECT PRODS CHEM & METALLURG DIV    | 2-9-10-11-33            |
| SYNTHANE CORP                                | 37-38                   |
| TECHNICAL CERAMICS & LAVA CORP               | 4                       |
| TECHNIC INC                                  | 7                       |
| TECHNICRAFT CO                               | 38-39                   |
| TECT INC                                     | 5-44                    |
| THERMAL DYNAMICS CORP                        | 18-21                   |
| THOR CERAMICS INC                            | 39                      |
| TICKLE ENGG WORKS ARTHUR                     | 18-21                   |
| TOPPER MFG CO INC                            | 37-38-39-40             |
| TRACERLAB INC RICHMOND                       | 9-12                    |
| TRA-CON RESIN SYSTEMS DIV                    | 1-3-15-19-24-37-        |
|  | 38-39-42                |
| TRANCOA CHEMICAL CORP                        | 45                      |
| TRAN SONICS                                  | 3                       |
| TRINITY EQUIPMENT CORP                       | 18                      |
| U B S CHEMICAL CORP                          | 1-3                     |
| U S RADIUM CORP HOLLYWOOD                    | 9-12-16-22-26-35        |
| U S RUBBER CO                                | 1-15-21-24-28-40-46     |
| ULTRASONIC INDUSTRIES INC                    | 5-44                    |
| UNION CARBIDE CORP SILICONES DIV             | 3-15-18-                |
|  | 19-24-32-37-38-39-40-41 |
| UNION CARBIDE PLASTICS CO                    | 39                      |
| UNIVERSAL SHELLAC & SUPPLY CO                | 3-45                    |
| VECTOR MANUFACTURING CO HOUSTON              | 15-19                   |
| VITRO CHEMICAL CO                            | 4-12                    |
| VITRO LABORATORIES                           | 18-20-21                |
| VORAC CO                                     | 1-15-18-21              |
| WALDOM ELECTRONICS INC                       | 25-31                   |
| WALSCO ELECTRONICS MFG CO                    | 3-5-14-17-19-20-        |
|  | 23-25-32-33-41-44       |
| WATSCO INC                                   | 32                      |
| WESTERN COATING CO                           | 7-21-24-38              |
| WESTERN GOLD & PLATINUM CO                   | 4                       |
| WESTINGHOUSE ELECTRIC CORP BENOLITE MICARTA  | 17-19-21-25-39-44-45    |
| WESTLAKE PLASTICS CO                         | 37-38                   |
| WINZEN RESEARCH INC                          | 4                       |
| WISCONSIN PORCELAIN CO                       | 4                       |
| WORKMAN ELECT PROD INC                       | 5                       |
| WYE INDUSTRIES                               | 5-13-14-44              |
| X PANDO CORP                                 | 21-24-39                |
| ZENITH OPTICAL LAB                           | 15                      |
| ZOPHAR MILLS INC                             | 24-36-46                |

|                                    |   |
|------------------------------------|---|
| <b>COMMUNICATIONS SYSTEMS 1200</b> |   |
| Aircraft                           | 1 |
| Airport                            | 2 |
| Amateur                            | 3 |
| Carrier Current                    | 4 |
| Citizens bands                     | 5 |
| Civil defense                      | 6 |
| Facsimile                          | 7 |
| FM                                 | 8 |
| Frequency shift                    | 9 |



# PRODUCTS & MANUFACTURERS

# Communications Systems & Accessories

|                            |    |
|----------------------------|----|
| Handsets                   | 10 |
| Headphones, crystal        | 11 |
| Headphones, dynamic        | 12 |
| Headphones, hearing aid    | 13 |
| Headphones, magnetic       | 14 |
| Induction loops            | 15 |
| Infrared                   | 16 |
| Intercommunicating system  | 17 |
| Marine                     | 18 |
| Microwave                  | 19 |
| Mobile                     | 20 |
| Multiplex                  | 21 |
| Portable                   | 22 |
| Receiver, fixed            | 23 |
| Receiver, mobile           | 24 |
| Selective paging           | 25 |
| Single sideband            | 26 |
| Sonar                      | 27 |
| Speech scrambling          | 28 |
| Telemetry commercial       | 29 |
| Telephone                  | 30 |
| Telephones, portable field | 31 |
| Teletypewriter             | 32 |
| Transceivers, lifeboat     | 33 |
| Transceivers, UHF          | 34 |
| Transceivers, VHF          | 35 |
| Transmitters, fixed        | 36 |
| Transmitters, mobile       | 37 |
| TV systems, closed-circuit | 38 |
| Walkie-talkie              | 39 |
| Radar                      | 40 |

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|---|---|
| ACCURATE ELECTRONICS CORP ELYRIA            | 5   |
| ACF ELECTRONICS DIV RIVERDALE               | 8-19-21-23-24                                   |
| ACR ELECTRONICS CORP                        | 16-37   |
| AC SPARK PLUG ELECT DIV GMC                 | 25  |
| ADCRAFTERS CO                               | 17  |
| AOEC INC                                    | 10-12-14-17                                     |
| ADLER ELECTRONICS INC                       | 19-22-24-26-31-32-37                            |
| ADMIRAL CORP                                | 19-38   |
| ADVANCED ELECT CORP                         | 29  |
| AEROFLEX LABORATORIES INC                   | 7   |
| AERO GEO ASTRO CORP                         | 1-19  |
| AERONAUTICAL COMM EQUIP CO                  | 1-2-23-36                                       |
| AERONAUTICAL ELECTRONICS INC                | 2-6-8-26-35-37                                  |
| AERONAUTICAL & INST DV ROBERTSHAW FULTON CO |   |
| AEROSPACE ELECTRONICS INC                   | 17-23-24-33-34                                  |
| AEROSPACE RESEARCH INC                      | 23  |
| AGA CORP OF AMERICA                         | 5-6-10-18                                       |
| AIRBORNE ELECT CO                           | 5-18-23   |
| AIRCRAFT RADIO CORP                         | 1-17-34-35                                      |
| AIR ELECTRONICS CO                          | 1   |
| AIRGUIDE INSTRUMENT CO                      | 17  |
| ALCAR INSTRUMENTS INC                       | 27  |
| ALERT PRODUCTS INC                          | 28  |
| ALPHA CORP                                  | 2-4-6-7-8-9-17-18-19-20-21-22-23-24-26-28-29-32 |
| ALTEC LANSING CORP                          | 6-8-21-30                                       |
| ALTO FONIC TAPE SERVICE INC                 | 8   |
| AMERICAN AIRFRAME CORP                      | 10-17-18-34-35                                  |
| AMERICAN AVIONICS INC                       | 17  |
| AMERICAN ELECTRONICS CO MINEOLA             | 0   |
| AMERICAN ELECT LABS MICROWAVE & PHASING     | 19  |
| AMERICAN GELOSO ELECT INC                   | 3-17  |
| AMERICAN MICROWAVE & TV CORP                | 2-7-19-38                                       |
| AMERICAN TRANSFORMER DIV RADIO ENG LABS     | 1-18-34-35                                      |
| AMPLIVOX LTD                                | 12-13-14-15-17-20-22-31                         |
| AMTEL AMERICAN MICROWAVE & TELEVISION       | 19-38   |
| ANALYTIC SYSTEMS CO                         | 29  |
| ANDREA RADIO CORP                           | 1-17-20-22-24                                   |
| ANTREX CORP                                 | 1-2-6-17-20-22-25-30-31                         |
| APPARATUS DEVELOPMENT CO                    | 8   |
| APPLIED CONTROL CORP                        | 25  |
| APPLIED ELECTRONICS CO SUB                  | 5-18  |
| APPLIED TECHNOLOGY INC                      | 19  |
| ARKAY INTERNATIONAL INC                     | 5-17  |
| ARNOUX CORP                                 | 29  |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD        | 4-15-17   |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD        | 19-29   |
| ASTROMARINE PRODUCT CORP                    | 18-20-23-24                                     |
| ATELIERS DE MONTAGES ELECT                  | 2-4-7-9-17-18-22-23-24                          |
| AUDIO ELECTRONICS                           | 30  |
| AUDIO EQUIPMENT CO PORT WASHINGTON          | 6-17-22   |
| AUDIO EQUIPMENT DETROIT                     | 13-17   |
| AUDIOSEARS CORP                             | 10-12-14  |
| AUTH ELECTRIC CO                            | 30  |
| AUTOMATIC ELECTRIC CO                       | 2-10-17-30                                      |
| AUTOMATIC ELECTRIC LAB                      | 0   |
| AUTOMATION DYNAMICS CORP                    | 19  |
| AUTON ENG INC                               | 17  |
| AVCO CORP ELECTRONICS & ORDNANCE DIV        | 16-20-22-24-26                                  |
| BAIRO ATOMIC INC                            | 16  |
| BARBER LABS ALFRED W                        | 23-26-36  |

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| BARKER & WILLIAMSON INC                      | 3-9-20-26-34-35-36-37                        |
| BASSETT INC REX                              | 18   |
| BELL AIRCRAFT CORP                           | 19   |
| BELZ INDUSTRIES DIV EL TRONICS INC           | 19   |
| BENCO TELEVISION ASSOC LTD                   | 5-19-38                                      |
| BENDIX CORP BENDIX RADIO DIV                 | 1-8-9-17-19-20-21-22-23-24-28-34-35-36-37-39 |
| BENRUS WATCH CO INC                          | 21   |
| BERKELEY INSTRUMENTS                         | 29   |
| B & K MFG CO                                 | 38   |
| BLOCK ASSOC                                  | 16   |
| BOFHME INC H O                               | 9-32   |
| BOEING AIRPLANE CO                           | 1  |
| BRAMCO INC SUB LEDEX INC                     | 29   |
| BRIDGE ELECTRONICS CO INC                    | 1-26-29-32                                   |
| BRIGHT RADIO LABS INC                        | 10-14-17                                     |
| BRISTOL MOTORS DIV VOCALINE CO AMERICA INC   | 5  |
| BROWN ENG CO INC                             | 29   |
| BROWNING LABS INC                            | 5-6-8-21-23-24-35-36-37                      |
| BRUMBERGER CO                                | 17-30-31-39                                  |
| BRUNING CO INC CHARLES                       | 7  |
| BRUNO NEW YORK INDUSTRY CORP                 | 17   |
| BUDD ELECTRONICS A DIV OF THE BUDD CO        | 1-19-20-21-23-24-26-36-37                    |
| BUDELMAN ELECTRONICS CORP                    | 4-19-21-22-23-24-25-26-30-34-35-36-37        |
| RUNNELL & CO J H                             | 9-35-36                                      |
| B W MFG INC PHILLIPS RADIO DIV KOKOMO IND    | 17-23  |
| B-W MFGS INC PHILLIPS RADIO DIV              | 17   |
| CADRE INDUSTRIES CORP                        | 5-6-17-39                                    |
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| TRANSITEL INTERNATIONAL CORP                 | 9-29                               |
| TRANVISION INC                               | 38                                 |
| TREPAC CORP OF AMERICA                       | 32                                 |
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| ULTRAUDIO DIV OBERLINE INC                   | 12-25                              |
| UNION SWITCH & SIGNAL DIV                    | 15-22                              |
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| UNIVERSITY LOUDSPEAKERS INC                  | 22                                 |
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| VALU-ENG PROD INC                            | 0                                  |
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| VIEWLEX INC                                  | 1-6                                |
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| WELEX ELECTRONICS CORP                       | 1-2                                |
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| WESTREX CO DIV OF LITTON SYS INC             | 2-6-7-9-18-21-23-26-27-28-36       |
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| WILCOX ELECTRIC CO INC                       | 1-2-26-27-35-36                    |
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| WOODLAND ELECTRONICS CO INC                  | 7-17                               |
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| Computer circuits                        | 4  |
| Computer heads                           | 5  |
| Computer testers                         | 6  |
| Computers, special-purpose               | 7  |
| Converters, binary                       | 8  |
| Converters, card-type                    | 9  |
| Converters, code                         | 10 |
| Converters, punched tape                 | 11 |
| Counters                                 | 12 |
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| Data recorders, digital                  | 14 |
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| Delay line, magnetostrictive             | 17 |
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| APPLIED DYNAMICS INC                       | 1  |
| ARCH GEAR WORKS INC                        | 19-20-21-22  |
| AR & DA ENGG CO                            | 1-17   |
| ARENBERG ULTRASONIC LABORATORY INC         | 4  |
| ARMSTRONG WHITWORTH EQUIP                  | 2-4  |
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| BARKER & WILLIAMSON INC                                      | 16  |
| BARTH ENGRG & MFG CO INC                                     | 7   |
| BARTON INSTRUMENT CORP                                       | 7-14  |
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| BOONSHAFT & FUCHS INC  | 1-7   |
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| BROOKS RESEARCH  | 21  |
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| BRUBAKER ELECTRONICS INC                                     | 4-7-27-43   |
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| TALLER & COOPER INC                           | 2-7-12-14-25-26-36-39-53-54-55                      |
| TALLY REGISTER CORP                           | 9-10-11-14-37-41-43-52-53-55                        |
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| TELEMET CO                                    | 2-22-24-41-49-54                                    |
| TELEMETRICS INC                               | 2-6-8-15-22-43                                      |
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| THETA INSTRUMENT CORP                         | 2-12-13-24  |
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| VARD INC                                      | 2-25-52   |
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| VENNER ELECTRONICS LTD                        | 2-12-14-39-41                                       |
| VERCO INC                                     | 4-27  |
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| VICTOR ADDING MACHINE CO                      | 4-7-8-10-11-12-14-41-53-54-55                       |
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| Connectors, anode                        | 3  |
| Connectors, antenna                      | 4  |
| Connectors, audio                        | 5  |
| Connectors, battery                      | 6  |
| Connectors, cable                        | 7  |
| Connectors, coaxial cable                | 8  |
| Connectors, feed through                 | 9  |
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| ALDEN PRODUCTS CO                        | 3-7-9-12-13-14-17-22-28-35-36-38-39-41   |
| ALITE DIV U S STONWARE CO                | 9-11-37  |
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| AUDIOTEX MFG CO/DIV G C TEXTRON INC      | 2-5-7-14-16-35   |
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| AUTO-SWAGE PRODUCTS INC                  | 14-21-25-29-39-40  |
| AVCO CORP ORDNANCE DIV RICHMOND          | 34   |
| AVIEL ELECTRONICS INC                    | 2-4-8-11-15-20-24-35   |
| AVNET CORP LOS ANG                       | 7-8-11-15-17-22  |
| AVNET ELECTRONICS CORP OF N CALIF        | 7-8-17-22-23   |
| AVNET ELECTRONICS CORP WESTBURY          | 15-22  |
| BARKER & WILLIAMSON INC                  | 8  |
| BARKER PRODUCTS CO                       | 5-7-14-16  |
| BARNES DEVELOPMENT CO                    | 2-33   |
| BEAD CHAIN MFG CO                        | 14-17-22-35-36   |
| W A BEAUCHAINE & SONS INC                | 7-19-22-23-35  |
| BELLAIRE ELECTRONICS INC                 | 34   |
| BELZ INDUSTRIES DIV EL TRONICS INC       | 4-8-19-20-24   |
| BENCO TELEVISION ASSOC LTD               | 8  |
| BENDIX CORP/SCINTILLA DIV                | 7-11-12-15-17-20-22-23-24-25-27-28-31  |
| BERG MFG CORP                            | 17-21-22-25-26-27-32-36-38-39-41-42  |
| BETTS & BETTS CORPORATION                | 1-7-15-34  |
| B G CORP THE                             | 11-12-36-37-40   |
| BILL JACK INDUSTRIES                     | 8  |
| BLINN CO DELBERT                         | 36-40  |
| BRADLEY ELECTRONICS CO INC               | 2-8-9-20-22-24-27  |
| BRAUN TOOL & INSTRUMENT CO INC           | 10   |
| BREEZE CORPS                             | 6  |
| BREW & CO RICHARD D                      | 8-9-11-12-20-31  |
| BRIGHT RADIO LABS INC                    | 34-41  |
| BROOKS & PERKINS INC                     | 34   |
| BROWN ENG CO INC                         | 21   |
| BUCHANAN ELECTRICAL PROD CORP            | 25-26-36-39-41-42  |
| BUCKBEE MEARS CO                         | 7-21   |
| BUD RADIO INC                            | 1-33-34  |
| H H BUGGIE DIV BURNDY CORP               | 1-4-5-7-8-9-10-12-13-14-15-17-21-23-24-25-26-28-31-35-41                           |
| BURNDY-ESCON INC                         | 9-11-15-22-23-27-31  |
| BURNDY CORP OMATON DIV                   | 1-2-4-6-7-8-9-10-11-12-13-15-17-19-20-21-22-23-24-25-26-27-28-29-30-31-35-36-37-38 |
| CAMBLOCK CORP SUB WALTHAM PREC INST      | 5-9-15-17-21-25-27-36-39-41-42   |
| CAMBRIDGE THERMIONIC CORP                | 33-35-40-41  |
| CANNON ELECT CANADA LTO                  | 6-7-8-9-12-15-17-19-20-22-23-27-31   |
| CANNON ELECTRIC CO EASTERN DIV           | 4-8-12-17-21-24-25-27-31-35  |
| CANNON ELECTRIC CO PHOENIX               | 2-6-7-9-10-11-12-13-15-17-19-20-22-24-27-28-31-32                                  |
| CARBORUNDUM CO                           | 37   |
| CARBORUNDUM CO THE REFRACTORIS DIV       | 9  |
| CAROL ELECT DIV WEECO                    | 15   |
| CARTER PARTS CO                          | 33-35  |
| CATON INDUSTRIES                         | 32-33  |
| C B C ELECTRONICS CO                     | 2-5-16-18  |
| CENTRALAB DIV GLOBE UNION                | 9  |
| CENTRAL PORCELAIN CO                     | 7  |
| CENTURY LIGHTING INC N Y                 | 19   |
| CERAMASEF INC                            | 11-37-40   |
| CERAMCO INC CHEMISTS                     | 11   |
| CERAMICS INTERNATIONAL CORP              | 8-11   |
| CHASSIS-TRAK CORP INGLEWOOD              | 21   |
| CICOIL CORP                              | 7  |
| CINCH MFG CO CINCH JONES DIV             | 1-2-3-5-6-7-9-11-12-13-15-16-17-18-19-21-22-23-25-26-27-32-33-35-36-39-41-42       |
| CIRCON COMPONENTS CORP                   | 17-21-27   |
| CIRCUIT STRUCTURES LAB                   | 25   |
| CLARE CERAMICS INC                       | 11-32-37   |
| CLEVELAND METAL SPEC CO                  | 21   |
| CLEVELAND METAL SPECIALTIES CO           | 11   |
| CLEVITE ORDNANCE DIV CLEVITE CORP        | 11   |
| CLOVER INDUSTRIES INC                    | 1-35   |
| COAXIAL COMPONENTS CORP                  | 2-4-5-8-12-15-22-23-24-26  |
| COLUMN MACHINE CO                        | 2-7-8-11-12-20-24  |
| COMMERCIAL RADIO SOUND CORP              | 24   |
| COMMUNICATIONS PRODUCTS CO               | 2-4-7-8-24-25-35   |
| COMPONENTS FOR RESEARCH INC              | 8-9-12-19-40   |
| COMPONENTS CORP                          | 21   |
| CONNECTOR CORPORATION DF AMERICA         | 8  |
| CONNECTOR CORP                           | 4-6-13-14-21-35-38   |
| CONSOLIDATED CERAMICS & METALIZING CORP  | 37   |
| CONSOLIDATED ELECT CORP                  | 17-23  |
| CONSOLIDATED MOLDED PRODUCTS CORP        | 35-36-41-42  |
| CONSTANTIN CO L L                        | 11-32-37   |
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| APPLIED DEVELOPMENT CORP MONTEREY PK  | 21   |
| ARCO ELECT INC                        | 2-7-8-11-15-17-20-21-22-23-25-27-28-31   |
| ARCON ELECTRONICS DIV OF ARCON INDUST | 8-11-17-21-22-23-24-25-26-27   |
| ARK LES SWITCH CORP                   | 22-41  |
| ARMEL ELECTRONICS INC                 | 9-12-15-17-19-21-23-27-36-40-41  |
| ART WIRE & STAMPING CO                | 36-39  |
| ASSOCIATED ENG & MFG CORP             | 1-11-20-21-23-24   |
| ASSOCIATED ENG CORP BROOLINE          | 35   |
| A T ELECTRONICS INC                   | 8  |
| ATLAS CONNECTORS CORP                 | 1-2-7-8-9-11-12-13-14-15-17-19-20-21-23-25-26-31-32-36-37                          |
| AUDIO ACCESSORIES                     | 14-33-35   |
| AUDIOSEARS CORP                       | 14-17-34   |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC   | 2-5-7-14-16-35   |
| AUTOMATIC METAL PROD CORP             | 8  |
| AUTO-SWAGE PRODUCTS INC               | 14-21-25-29-39-40  |
| AVCO CORP ORDNANCE DIV RICHMOND       | 34   |
| AVIEL ELECTRONICS INC                 | 2-4-8-11-15-20-24-35   |
| AVNET CORP LOS ANG                    | 7-8-11-15-17-22  |
| AVNET ELECTRONICS CORP OF N CALIF     | 7-8-17-22-23   |
| AVNET ELECTRONICS CORP WESTBURY       | 15-22  |
| BARKER & WILLIAMSON INC               | 8  |
| BARKER PRODUCTS CO                    | 5-7-14-16  |
| BARNES DEVELOPMENT CO                 | 2-33   |
| BEAD CHAIN MFG CO                     | 14-17-22-35-36   |
| W A BEAUCHAINE & SONS INC             | 7-19-22-23-35  |
| BELLAIRE ELECTRONICS INC              | 34   |
| BELZ INDUSTRIES DIV EL TRONICS INC    | 4-8-19-20-24   |
| BENCO TELEVISION ASSOC LTD            | 8  |
| BENDIX CORP/SCINTILLA DIV             | 7-11-12-15-17-20-22-23-24-25-27-28-31  |
| BERG MFG CORP                         | 17-21-22-25-26-27-32-36-38-39-41-42  |
| BETTS & BETTS CORPORATION             | 1-7-15-34  |
| B G CORP THE                          | 11-12-36-37-40   |
| BILL JACK INDUSTRIES                  | 8  |
| BLINN CO DELBERT                      | 36-40  |
| BRADLEY ELECTRONICS CO INC            | 2-8-9-20-22-24-27  |
| BRAUN TOOL & INSTRUMENT CO INC        | 10   |
| BREEZE CORPS                          | 6  |
| BREW & CO RICHARD D                   | 8-9-11-12-20-31  |
| BRIGHT RADIO LABS INC                 | 34-41  |
| BROOKS & PERKINS INC                  | 34   |
| BROWN ENG CO INC                      | 21   |
| BUCHANAN ELECTRICAL PROD CORP         | 25-26-36-39-41-42  |
| BUCKBEE MEARS CO                      | 7-21   |
| BUD RADIO INC                         | 1-33-34  |
| H H BUGGIE DIV BURNDY CORP            | 1-4-5-7-8-9-10-12-13-14-15-17-21-23-24-25-26-28-31-35-41                           |
| BURNDY-ESCON INC                      | 9-11-15-22-23-27-31  |
| BURNDY CORP OMATON DIV                | 1-2-4-6-7-8-9-10-11-12-13-15-17-19-20-21-22-23-24-25-26-27-28-29-30-31-35-36-37-38 |
| CAMBLOCK CORP SUB WALTHAM PREC INST   | 5-9-15-17-21-25-27-36-39-41-42   |
| CAMBRIDGE THERMIONIC CORP             | 33-35-40-41  |
| CANNON ELECT CANADA LTO               | 6-7-8-9-12-15-17-19-20-22-23-27-31   |
| CANNON ELECTRIC CO EASTERN DIV        | 4-8-12-17-21-24-25-27-31-35  |
| CANNON ELECTRIC CO PHOENIX            | 2-6-7-9-10-11-12-13-15-17-19-20-22-24-27-28-31-32                                  |
| CARBORUNDUM CO                        | 37   |
| CARBORUNDUM CO THE REFRACTORIS DIV    | 9  |
| CAROL ELECT DIV WEECO                 | 15   |
| CARTER PARTS CO                       | 33-35  |
| CATON INDUSTRIES                      | 32-33  |
| C B C ELECTRONICS CO                  | 2-5-16-18  |
| CENTRALAB DIV GLOBE UNION             | 9  |
| CENTRAL PORCELAIN CO                  | 7  |
| CENTURY LIGHTING INC N Y              | 19   |
| CERAMASEF INC                         | 11-37-40   |
| CERAMCO INC CHEMISTS                  | 11   |
| CERAMICS INTERNATIONAL CORP           | 8-11   |
| CHASSIS-TRAK CORP INGLEWOOD           | 21   |
| CICOIL CORP                           | 7  |



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 NUCLEAR ENTERPRISES G B LTD 15  
 NUGENT ELECT CO INC 17-21-22-27  
 NU-LINE INDUSTRIES 2-4-5-6-7-8-9-10-11-12-13-15-16-17-19-20-21-22-23-24-25-27-28-31-32-35-37  
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 OLYMPIC PLASTICS CO INC 41-42  
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 PAGE FOGWELL CORP 35  
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 PELLEY CO 41  
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 PHALO PLASTICS CORP 13-35  
 PHYSICAL SCIENCES CORP 9-11-15-17-20-27-31-36-37-42  
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 PRECISION MADE PRODUCTS INC 41  
 PRECISION METAL PRODUCTS CO 36-40-41-42  
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 PYLON CO INC 9-17-21-27-36-39-40-41  
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 REMLER CO 31-33  
 RENFREW ELECTRIC CO LIMITED 1-2-7-8-9-11-12-13-14-15-16-17-19-20-21-22-23-24-25-27-29-30-31-35  
 REYNOLDS INDUSTRIES INC 8-9-11-12-17-21-27-28-32  
 R F PRODUCTS INC DIV AMPHENOL BORG 2-4-8-15-17-20-25-30  
 RICHFIELD COINED PRODUCTS CO 23-27-32-36  
 RIMAK ELECT INC 34-36-38-39-40-41-42  
 ROBINS INDUSTRIES CORP 5-7-14-16-18  
 ROBINSON MACHINE WORKS INC 8-9-17-21-27  
 RODALE MFG CO 13-31  
 ROSENTHAL ISOLATORNS GMBH OF SELB W GERMA 36-37-39  
 ROSS METALS CO MILTON 9-13-15-17-21-25-27-32-36-39-40-41-42  
 ROSS CO MILTON 32  
 SANGAMO ELECTRIC CO 26  
 SAYRE ELECTRONICS 9-36-37-39-40-41  
 SCIENTIFIC ELECTRONIC LABS INC 29  
 SCINTILLA DIV BENDIX CORP 7-11-12-15-17-20-22-23-24-25-27-28-31  
 SEAELECTRO FAYETTE AVE 2-7-9-17-21-23-24-27-40  
 SEAELECTRO CORP 2-7-8-9-11-15-17-22-24-27-30-31-35  
 HOYT ST 35-36-39-40  
 SEALTRON CORP 11-37  
 SEMITRONICS CORP 24  
 SERWELL PRODUCTS CO 25-39  
 SHAMBAN & CO W S CULVER CITY 9-40  
 SHEFFCO MFG CORP 36-39  
 SHERMAN MFG CO H B 0-36  
 SILICONE INSULATION INC 41-42  
 SILICONE SEALS INC 36-37  
 SITTLER CORP 6-7-10  
 C SJOBERG & SON 6-7-14-17-25-36-39  
 SKYROM CORPORATION 1-2-3-4-5-6-7-9-10-13-14-15-16-17-21-22-23-25-26-27-29-32-36-38-39-40-41-42  
 SMITH INC HERMAN H 4-5-6-8-14-16-35-36-40  
 SNAP TITE INC 22-23  
 SORENSEN INDUSTRIAL ELECTRONIC CO 6  
 SPACE CONTROL CORP 7  
 SPERTI FARADAY INC 34-36-41  
 THE SPHERE CO INC 37  
 SPRUCE PINE MICA CO 41  
 ST MARYS CARBON CO 36  
 STANDARD ELECTRIC TIME CO 24-33-35  
 STANDARD PLASTICS CO INC 7-40  
 THE STANDARD PRODUCTS CO 22  
 STAR-TRONICS INC 2-7-8-11-12-20-24  
 STATES CO 41-42  
 STATHAM INSTRUMENTS INC DF PUERTO RICE 1  
 HATO REY IND SUBDIV 37  
 STONE CITY PRODUCTS CO 36-39  
 STRAT-O-SEAL MFG CO 36-37  
 SUNAIR DYNAMICS CORP 1-2-3-4-5-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34  
 SUNBANK ELECTRONICS INC 1-2  
 SUPERIOR ELECTRIC CO 2-19-35  
 SWITCHCRAFT INC 2-5-7-14-15-17-18-22-23-24-33-35  
 SYLVANIA ELECTRIC PROD INC PARTS DIV 4-21-23-25-39  
 SYNTHANE CORP 40-41  
 TABET MFG CO 21  
 TAFFET ELECTRONICS INC 7-11-19-33-34-41



## Connectors & Terminals • Control Equipment

|   |  |
|---|--|
| TAMAR ELECTRONICS INC                     | 2-4-7-8-28   |
| TAP A LINE MFG CO                         | 35   |
| TAURUS CORP                               | 36-40-41   |
| TEALE MACHINE CO INC                      | 36-39  |
| TECHNICAL OIL TODL CORP                   | 32   |
| TECHRON CORP                              | 25-39  |
| TED MFG CORP                              | 11-17-20-24-27-37  |
| TELCO ELECTRONICS MFG COMPANY             | 2-4-8-40   |
| TERLERAD MFG CORP                         | 8  |
| TELEX INC                                 | 35   |
| TELKOR INC                                | 34   |
| THOMAS & BETTS CO INC                     | 8-10-22-23-25-26-36-39-41-42   |
| THOR CERAMICS INC                         | 9-11-36-37-40-41   |
| TITEFLEX INC                              | 3-5-7-9-12-15-17-25-26   |
| TORWICO ELECTRONICS INC                   | 37   |
| TRI-DEX ELECTRONICS                       | 41   |
| TRIMM INC                                 | 14-33-35-42  |
| TRI-POINT INDUSTRIES INC                  | 40-41  |
| TROMPETER ELECTRONICS                     | 4-8-14-22-24-33-35   |
| TRONEX INC                                | 32-37-40   |
| TRU-CONNECTOR CORP                        | 2-4-7-8-9-11-12-20-22-24-31-33-35  |
| TUBULAR RIVET & STUD CO                   | 36   |
| U S COMPONENTS                            | 9-11-12-13-15-17-19-21-22-23-25-27   |
| U S DIELECTRIC INC                        | 2-4-17-27  |
| U S PLASTIC MOLDING CORP                  | 6-7  |
| UCINITE CO DIV UNITED CARR FASTENER CORP  | 1-   |
|   | 2-3-4-5-6-9-12-13-14-15-16-17-18-19-21-22-23-25-27-29-31-33-35-36-38-39-41 |
| UNI SEAL INC                              | 11-37  |
| UNIFORM TUBES INC MICRO DELAY DIV         | 7-8-32   |
| UNIVERSAL CIRCUIT CONTROLS                | 33-35  |
| UNIVERSAL RELAY CORP                      | 40   |
| UNIVOX CORP LOS ANG                       | 8-33-34  |
| VACO PRODUCTS CO                          | 25-38-39   |
| VECTOR ELECTRONIC CO                      | 21-23-25-26-35-36-38-39-41-42  |
| VERITRON WEST INC                         | 11-15-17-19-23-26-32-35-36-37-40   |
| VIBRA SEAL CORP                           | 22-28-29-31  |
| VICKERS INC ELECTRIC PRODUCTS DIV         | 21   |
| VIKING INDUSTRIES INC                     | 11-12-17-20-21-22-23-27-28-31  |
| VIRGINIA ELECTRONICS CO                   | 33   |
| VITRO ELECTRONICS DIV OF VITRO CORP OF AM | 33-42  |
| WADE ELECTRIC PRODUCTS CO                 | 7-21-26-36-41-42   |
| WALDOM ELECTRONICS INC                    | 3-5-13-18-22-25-36-39-42   |
| WALSCO ELECTRONICS MFG CO                 | 3-4-6-18-23-39   |
| WALTHAM SCREW CO                          | 7-8-14-17-27-35-36-40  |
| WARREN COMPONENTS DIV EL-TRONICS INC      | 9-11-29-32-36-37-41-42   |
| WATERBURY COS INC                         | 36   |
| WAVELABS INC                              | 17   |
| WELWYN ELECTRIC LIMITED                   | 37   |
| WESTERN DEVICES INC                       | 21   |
| WESTERN INTL CO                           | 2-4-7-8-9-12-14-15-24-35   |
| WHITSO INC                                | 33-36-42   |
| WINCHESTER ELECTRONICS INC NORWALK        | 7-8  |
| WINCHESTER ELECT INC NEW MILFORD          | 11   |
| ZIERICK MFG CORP                          | 36-38-39   |

### CONTROL EQUIPMENT 1500

|                              |    |
|------------------------------|----|
| Controls, alarm system       | 1  |
| Controls, automatic tuning   | 2  |
| Controls, chemical           | 3  |
| Controls, conductivity       | 4  |
| Controls, counting           | 5  |
| Controls, density            | 6  |
| Controls, door               | 7  |
| Controls, dynamometer        | 8  |
| Controls, electroplating     | 9  |
| Controls, fluid conductivity | 10 |
| Controls, fluid flow         | 11 |
| Controls, gas                | 12 |
| Controls, heat treating      | 13 |
| Controls, humidity           | 14 |
| Controls, illumination       | 15 |
| Controls, liquid level       | 16 |
| Controls, loop regulation    | 17 |
| Controls, machine            | 18 |
| Controls, overload           | 19 |
| Controls, oxygen             | 20 |
| Controls, pH                 | 21 |
| Controls, photoelectric      | 22 |
| Controls, photographic       | 23 |
| Controls, position           | 24 |
| Controls, power level        | 25 |
| Controls, pressure           | 26 |
| Controls, printing           | 27 |
| Controls, servo              | 28 |
| Controls, specific gravity   | 29 |
| Controls, strain             | 30 |
| Controls, telemetering       | 31 |

|                                   |    |
|-----------------------------------|----|
| Controls, temperature             | 32 |
| Controls, tension                 | 33 |
| Controls, thickness               | 34 |
| Controls, timing                  | 35 |
| Controls, traffic                 | 36 |
| Controls, turbidity               | 37 |
| Controls, vacuum                  | 38 |
| Controls, voltage regulator       | 39 |
| Controls, welding                 | 40 |
| Controls, x-ray                   | 41 |
| Ignition systems, electronic      | 42 |
| Injection equip. fuel, electronic | 43 |
| Regulators, automatic current     | 44 |
| Regulators, automatic voltage     | 45 |
| Solenoid valves                   | 46 |
| Thermostats                       | 47 |
| Timers, counting                  | 48 |
| Timers, cyclic                    | 49 |
| Timers, impulse                   | 50 |
| Timers, inertia                   | 51 |
| Timers, interval                  | 52 |
| Timers, photoelectric             | 53 |
| Timers, sequence                  | 54 |
| Timers, thermal                   | 55 |

|   |   |
|---|---|
| ABACUS INC                                  | 5-35-48   |
| ABRAMS INSTRUMENT CORP                      | 13-35-49-52-54  |
| ABTRONICS INC                               | 35  |
| ACCURATE ELECTRONICS CO CHICAGO             | 9-15-39-44-45   |
| AC ELECTRONICS INC                          | 17-44-45  |
| ACCESSORY PROD CO DIV OF TEXTRON INC        | 11-12-38-46   |
| ACME ELECTRIC CORP                          | 45  |
| ACME INDUSTRIAL CO                          | 11-18-26-28-46  |
| ACOUSTICA ASSOCIATES INC                    | 5-16  |
| ACROMAG INC                                 | 1-32  |
| ACRO WELDER MFG CO                          | 18-40-54  |
| AC SPARK PLUG ELECT DIV GMC                 | 1-14-16-25-28-38-43-44-45-46  |
| ADAMS & WESTLAKE CO                         | 35  |
| ADAMS RITE MFG CO                           | 24  |
| ADVANCE INSTRUMENT CORP                     | 28  |
| ADVANCED ELECTRONICS INC                    | 1   |
| ADVANCED INSTRUMENTS                        | 0   |
| ADVANCED KINETICS INC                       | 16  |
| AERO GEO ASTRO CORP                         | 28-31   |
| AERO MECHANISMS INC                         | 1   |
| AERONAUTICAL & INST DV ROBERTSHAW FULTON CO | 3-10-11-12-13-16-26-32  |
| AEROSPACE ELECTRONICS INC                   | 20-22   |
| AEROSPACE RESEARCH INC                      | 32-35   |
| AFFILIATED MANUFACTURERS INC                | 35-52-54  |
| AGASTAT TIMING INSTRUMENTS                  | 1-2-4-5-9-10-11-15-16-17-18-19-22-24-26-31-35-40-46-48-52-53-54   |
| AIRBORNE ACCESSORIES CORP                   | 17-24-26-32   |
| AIRESEARCH MFG CO DIV GARRETT CORP          | 11-12-16-18-26-38-46  |
| AIRPAX ELECTRONICS PACIFIC DIV              | 1-31  |
| ALLEN-BRADLEY CO                            | 16-19-26-32-35  |
| ALLIED CONTROL CO INC                       | 46  |
| ALMA ENGINEERING                            | 42-44-45  |
| ALPHA CORP                                  | 1-2-31  |
| ALPHA MDLYKOTE CORP                         | 18  |
| AMERICAN AEROSPACE CONTROLS INC             | 26-28-32  |
| AMERICAN ASTRO-SYSTEMS                      | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55 |
| AMERICAN BOSCH CORP                         | 31  |
| AMERICAN BRAKE SHOE CO RAYMOND ATCHLEY DIV  | 11-18-24-28   |
| AMER CHAIN & CABLE BRISTOL CO               | 3-4-6-9-10-11-12-13-14-16-19-20-21-22-24-25-26-29-30-32-34-38   |
| AMERICAN DATA MACHINES                      | 18-24   |
| AMERICAN DISTRICT TELEGRAPH CO              | 1   |
| AMERICAN ELECTRIC CABLE CO                  | 1   |
| AMERICAN ELECT INC TALLER & COOPER DIV      | 5-  |
|   | 35-48   |
| AMERICAN ELECT LABS INC                     | 8-11-34   |
| AMERICAN ELECTRONICS CO MINN                | 7-44-45-54  |
| AMERICAN ELECTRONICS INC FULLERTON          | 24-28-44-45-52-54   |
| AMERICAN ELECTRIC SWITCH DIV                | 44-45   |
| AMERICAN GYRO DIV TAMAR ELECT INC           | 52  |
| AMERICAN INSTRUMENT CO                      | 32  |
| AMERICAN MEASUREMENT & CONTROL BURLINGTON   | 28  |
| AMERICAN MEASUREMENT & CONTROL INC          | 11-24-26-28-30-33-44-45   |
| AMERICAN RECTIFIERS CORP                    | 44-   |
| MFRS RICHARDSON ALLEN POWER SUPPLIES        | 45  |
| AMERICAN SPACE EXPLORATION INC              | 36  |
| AMERICAN STANDARD CONTROL DIV DETROIT       | 16-   |
|   | 20-26-31-38   |
| AMERICAN STANDARD CONTROL DV ROCHESTER      | 16-   |
|   | 26-32-38  |
| AMGLO CORP                                  | 35-49-52-54   |

## PRODUCTS & MANUFACTURERS

|  |   |
|--|---|
| AMTEL AMERICAN MICROWAVE & TELEVISION        | 48-   |
|  | 52-54   |
| AMTRON INC MIDLOTHIAN                        | 5-18-22-28  |
| AMULEX ELECTRONICS INC                       | 28-39-44-45   |
| ANALYTIC SYSTEMS CO                          | 1-3-20-22-29-31-37  |
| ANALYTICAL MEASUREMENTS INC                  | 21  |
| ANCHOR SPEC MFG CO                           | 1-18  |
| ANDERSEN LAB INC                             | 32  |
| ANTLAB INC                                   | 31  |
| ANTREX CORP                                  | 1   |
| APPLIED CONTROL CORP                         | 5-6-17-34-39  |
| APPLIED TECHNOLOGY CORP                      | 3-5-13-15-18-24-40-54                                       |
| ARCH GEAR WORKS INC                          | 28  |
| AR & DA ENGG CO                              | 18-24-28  |
| ARK LES SWITCH CORP                          | 32  |
| ARMSTRONG WHITWORTH EQUIP                    | 11  |
| ASKANIA REGULATOR CO                         | 26-28   |
| ASSEMBLY PRODUCTS INC                        | 1-22-24-28-32-34-38   |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD         | 1-5-7-13-15-17-18-22-24-28-32-33-35-39-40-44-45-48-52-53-54 |
| ASTRA TECHNICAL INSTRUMENT CORP              | 32  |
| ASTRO DYNAMICS INC                           | 32  |
| ASTRO SYSTEMS INC                            | 28  |
| ASTROSYSTEMS INTL INC                        | 11  |
| ATELIERS DE MONTAGES ELECT                   | 1-5-28  |
| ATOMATIC VALVE CO INC                        | 46  |
| ATLANTIC INSTRUMENTS & ELECTRONICS INC       | 14-40   |
| ATLAS CONTROLS INC                           | 32  |
| ATLAS OVERHEAD DORR CO                       | 7   |
| AUSTIN ELECTRONICS DIV AUSTIN CO             | 5-56  |
| AUTHORIZED MFRS SERVICE CO                   | 1-16  |
| AUTOMATIC CONTROL CO                         | 1-16-24-31-49   |
| AUTOMATIC CONTROLS DIV HAYS MFG CO           | 11-46   |
| AUTOMATIC ELECTRIC CO                        | 1   |
| AUTOMATIC SWITCH CO                          | 11-46   |
| AUTOMATIC TIMING & CONTROLS INC              | 5-11-23-24-26-27-33-34-40-41-49-50-52-54                    |
| AUTOMATION DEVICES INC                       | 18-19-22  |
| AUTOMATION DYNAMICS CORP                     | 1-28-31-32  |
| AUTOMATION INC                               | 18-35   |
| AUTOMATION MANAGEMENT INC                    | 5-36  |
| AUTOMATION PRODUCTS INC                      | 3-6-12-16-29-37   |
| AUTOTRON INC                                 | 5-7-15-16-22-35   |
| AUTRONICS CORP                               | 52-54   |
| AVEY DIV MOTCH & MERRYWEATHER                | 18  |
| AVIONICS INC                                 | 5-7-16-24   |
| AVTRON MFG INC                               | 5-33-39-52  |
| BABCOCK & WILCOX BAILEY METER CO             | 0   |
| BAILEY METER COMPANY CLEVELAND               | 1-3-4-10-11-12-20-21-32-37                                  |
| BAILEY METER CO WICKLIFF                     | 4-11-12-13-16-20-21-24-26-31-32-37-38                       |
| BALCRANK INC MACHINE TOOL DIV                | 18  |
| BARBER COLMAN CO AIRCRAFT & MISSILE PROD DIV | 24-32-46  |
| BARBER-COLMAN CO                             | 1-3-13-18-21-24-32-35                                       |
| BARNES DEVELOPMENT CO                        | 28  |
| BAR RAY PRODUCTS INC                         | 23-32   |
| BARTON INSTRUMENT CORP                       | 3-6-12-14-16-26-29-   |
|  | 32  |
| BARWOOD ELECTRONICS INC                      | 52  |
| BASLER ELECTRIC CO                           | 44-45   |
| BAYLEY INSTRUMENT CO                         | 32  |
| BAYSIDE TIMERS                               | 15-18-35-49-52-54   |
| BECK CO HAROLD                               | 22  |
| BECKMAN & WHITLEY                            | 23  |
| BECKMAN INST INC                             | 14  |
| BECKMAN INST INC BERKELEY DIV                | 1-17  |
| BELFAB CORP                                  | 26-28-32-33-38  |
| BELL & HOWELL PHOTO PRODUCTS DIVISION        | 22-23   |
| BENDIX CORP IND CONTROLS DIV                 | 18-24-28  |
| BENDIX CORP RED BANK DIV                     | 39-44-45  |
| BENDIX CORP THE SHEFFIELD CORP SUB           | 34-41   |
| BENSON LEHNER CORP                           | 32  |
| BERGEN LABS INC                              | 23  |
| BERKELEY DYNAMICS                            | 1-12-22-31  |
| B & F INSTRUMENTS INC                        | 30  |
| BIOPHYSICAL ELECT DIV COMM IND               | 41  |
| BLACKBURN ELECTRONIC CORP                    | 15  |
| BLUE M ELECTRIC CO                           | 13-14-16-32   |
| BOEHM CO R A                                 | 18-24-40  |
| BON DE ELECTRONIC LABS INC                   | 38  |
| BOONSHAFT & FUCHS INC                        | 8-28-39   |
| BOWMAR INSTRUMENT CORP                       | 28  |
| BOWMAR INSTRUMENT TIC DIV                    | 28  |
| BOY-MAR ELECTRICAL SERVICE CO                | 1-5-7-22-36-53  |
| BRABENDER INST INC C W                       | 32  |
| BRAILSFDRO & CO                              | 49-52-54  |
| BRAMCO INC SUB LEXED INC                     | 31  |
| BREW & CO RICHARD D                          | 13-26-32-38   |
| BRISTOL CO LOS ANG                           | 11-12-13-14-16-21-26-29-31-32-35-38-49-54                   |
| BRISTOL MOTORS DIV VOCALINE CO AMERICA INC   | 5-35-48-52  |
| BROOKS INSTRUMENT CO INC                     | 1-6-11-16-29-31-32  |
| BROOKS ROTAMETER CO                          | 1-6-11-16-29-31-32  |
| BROWN BROCKMEYER CO                          | 7   |
| BROWN ENG CO INC                             | 32  |
| BUDD ELECTRONICS A DIV OF THE BUDD CO        | 14-26-32  |
| BURGESS CELLULOSE CO GRADE D MAT DIV         | 22  |
| BURGMASER CORP                               | 5-11-18   |
| BURLING INSTRUMENT CO                        | 32  |
| BUSH TRANSFORMER CORP                        | 39-45   |
| B/W CONTROLLER CORP                          | 1-11-16   |
| BYREX CORP                                   | 30-33   |
| BYREX CORP                                   | 26-30   |
| CABLE SPEC OF CONN                           | 52-54   |
| CADDILLAC GAGE CO                            | 28-46   |
| CALATROL ELECTRONIC INC                      | 32  |
| CALBEST ELECTRONICS CO                       | 7   |
| CALIF ELECTRO SCIENTIFIC CORP                | 27-48-50-52-54  |
| CALTRON PRODUCTS CO                          | 39-46   |
| CAMBRIDGE SYSTEMS INC                        | 14-32   |
| CAMPBELL X RAY CORP                          | 34-41   |

# PRODUCTS & MANUFACTURERS

# Control Equipment

|  |   |                                |  |   |
|--|---|--------------------------------|--|---|
| CANADIAN APPLIED RESCH DV A V ROE CANADA LT4 |   | 30                             | ELLIS & WATTS PRODUCTS INC                   | 32  |
| 52-54  |   |                                | ELLISON DRAFT GAGE CO                        | 1-11-12   |
| CANADIAN AVIA ELECTS                         | 28  |                                | ELM MFG CO INC                               | 35  |
| CANADIAN RESEARCH INSTITUTE                  | 21-22-39-44-45-47-48-53                   |                                | EMCEE ELECTRONICS INC                        | 28-32   |
| CAPTIVE SEAL CORP                            | 11-12-26-46                               |                                | EMERSON ELECTRIC ST LOUIS                    | 11-16-19-35-52  |
| CARAD CORP                                   | 45  |                                | EMERSON ELECTRIC MFG CO ELECT & AVIONICS DIV | 28  |
| CARLETON AVIATION CO INC                     | 26  |                                | ENERGY CONVERSION INC                        | 32  |
| CAROL ELECT DIV WECO                         | 23  |                                | ENG NORTHWEST                                | 39-40   |
| CAROLINA MEDICAL ELECTRONICS INC             | 35  |                                | ENGLER INSTRUMENT CO                         | 1-35-48-52  |
| CARMA MANUFACTURING CO                       | 1   |                                | EPIC INC                                     | 32  |
| CARTER PRINCETON ELECTR DIV                  | 32  |                                | EPSCO INC CAMBRIDGE                          | 31  |
| CASTLE ENGINEERING CO                        | 39-45                                     |                                | ERIE PACIFIC                                 | 5-11-18-22-24-35-48-52                                    |
| C B C ELECTRONICS CO                         | 28  |                                | ERWOOD INC                                   | 31  |
| CDAR ENG DIV CONTROL DATA CORP               | 1-22-23                                   |                                | ESSEY MFG & ELECTRONICS CORP                 | 17-19-35-39-40-44-45-55                                   |
| CFETRONICS                                   | 1-2-32                                    |                                | ESS GEE INC                                  | 28-31   |
| CENTRAL COIL CORP                            | 11-48                                     |                                | E-T-A PRODUCTS CO OF AMERICA                 | 19-55   |
| CENTRAL DYNAMICS LTD                         | 1-18-24-25-26-32-35                       |                                | EXACT ENGG MFG INC                           | 28-52   |
| CENTRAL ENG CO                               | 31  |                                | FAE INSTRUMENT CORP                          | 28-35   |
| CENTURY ELECTRONICS & INSTS INC              | 15  |                                | FAIRCHILD CONTROLS CORP COMPONENTS DIV       | 26  |
| SUB CENTURY GEOPHYSICAL CORP                 | 15  |                                | FAIRCHILD SPACE & DEFENSE PRDTS              |   |
| CENTURY LIGHTING INC N Y                     | 1   |                                | DIV FAIRCHILD CAMERA & INST CORP             | 23-48-52-54   |
| CERBERUS AG WERK ELEKTROTECHNIK              | 17-24-28-39-44-45-49                      |                                | FARMER ELECTRIC PRODUCTS CO                  | 22-35   |
| CHALCO ENGINEERING CORP                      | 1-32                                      |                                | FARMER ELECTRIC PRODUCTS CO                  | 22-35-53  |
| CHATHAM CONTROLS CORP                        | 42  |                                | FARRAND OPTICAL CO INC                       | 1-18-24   |
| CHATHAM ELECTRONICS DIV-TUNG-SOL ELECTRIC    | 23  |                                | FASCO INDUSTRIES INC                         | 32-42-47  |
| CHICAGO AERIAL INDUSTRIES                    | 46  |                                | FEDERAL LAB INC                              | 12  |
| CHRONO LOG CORP                              | 1-5-35-48-50-52-54                        |                                | FEDERAL MFG & ENGG CORP                      | 45  |
| CINCINNATI MILLING MACHINE CO                | 18-24-28-34-46                            |                                | FEDERAL TOOL ENGINEERING CO                  | 40  |
| CINEMATIC DEVELOPMENTS CO                    | 23  |                                | FEEDBACK CONTROLS INC                        | 24-28   |
| CLARE & CO P J                               | 5   |                                | FENWAL INC                                   | 13-16-32-47   |
| CLARK CONTROLLER CO CLEVELAND                | 18-19-33-39                               |                                | FIDELITY AMPLIFIER CO                        | 1-5-22-35-49-54   |
| CLARK CONTROLLER CO LOS ANG                  | 18-24                                     |                                | FIDELITY INSTRUMENT CORP                     | 39-40-44-45   |
| CLARKE H JOY CO                              | 1-18-32                                   |                                | FIFTH DIMENSION INC                          | 48  |
| CLEVELAND METAL SPEC CO                      | 48  |                                | FIRE CONTROL CO INC                          | 1   |
| CLEVITE ORNANCE DIV CLEVITE CORP             | 24-33-49                                  |                                | FISCHER & PORTER CO                          | 1-4-5-6-10-11-12-14-16-21-26-28-29-31-32-36               |
| CO ENGINEERING CO                            | 6-29                                      |                                | FISCHER ELECTRONICS INC                      | 1   |
| COLEMAN ELECTRONIC SYSTEMS                   | 18-24                                     |                                | FISHER AKIN CO                               | 35-48-49-50-52-54   |
| COLEMAN ELECTRONICS INC                      | 18-24                                     |                                | FISHER CO INC OSCAR                          | 23  |
| COLLINS CORP G L                             | 24  |                                | FISHER GOVERNOR CO                           | 16-26   |
| COLUMBUS ELECT MFG CO                        | 32  |                                | FISHER PIERCE CO                             | 15  |
| COMMUNICATION MEASUREMENTS LABS              | 18-45                                     |                                | FLUIDYNE ENGG CORP                           | 11-24-26-28-32-35-38                                      |
| COMMUNICATIONS ELECTRONICS CO                | 1-5-18-48-52-54                           |                                | FORD INSTRUMENT CO DIV SPERRY RAND CORP      | 28  |
| COMPACT CONTROLS CO INC                      | 35-54                                     |                                | FORMSPRAG INC                                | 24  |
| COMPTON CORP                                 | 32  |                                | FOSTORIA CORP DEPT D2                        | 18-32   |
| COMPUDYNE CORP                               | 1-16-24-28-31                             |                                | FOXBORO CO                                   | 3-4-6-10-11-12-14-16-21-26-28-29-31-32-38-54              |
| COMPUTER CONTROL CO INC EASTERN DIV          | 18  |                                | FREBANK CO                                   | 46  |
| COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC      | 31  |                                | FREDERICKS CO                                | 38  |
| COMPUTER LOGIC CORP                          | 5-18-28-35-48-52                          |                                | FRONTIER ELECT CO                            | 35-48-49-50-52-54   |
| COMPUTER MEASUREMENTS CO                     | 32  |                                | FUEL WATCHMAN INC                            | 32  |
| CONAX CORP                                   | 5   |                                | FURNAS ELECTRIC CO                           | 16-26   |
| CONOFLOW CORP                                | 11-46                                     |                                | FYR-FYER ELECTRONIC & ALARM CORP             | 1   |
| CONRAD CARSON ELECTRONICS INC                | 14-32                                     |                                | GALLAND-HENNING NOPAK DIV                    | 46  |
| CONSOLIDATED AIRBORNE SYSTEMS INC            | 16-26-28-31-32                            |                                | GAP INSTRUMENT CORP WESTBURY                 | 28  |
| CONSOLIDATED AVIONICS CORP                   | 39-44-45                                  |                                | GARDNER LAB INC                              | 22-37   |
| CONSOLIDATED CONTROLS CORP                   | 1-6-11-16-24-26-28-32-38                  |                                | GB COMPONENTS INC                            | 45  |
| CONSOLIDATED ELECT CORP                      | 3-38                                      |                                | GELMAN INSTRUMENT CO                         | 12-20   |
| CONTINENTAL SENSING INC                      | 1-32                                      |                                | GEMS CO                                      | 11-16   |
| CONTINENTAL X RAY CORP                       | 35-41-50-53                               |                                | GENERAL ATOMATICS INC                        | 0   |
| CONTROL CORP                                 | 1   |                                | GENERAL ATRONICS CORP ATRONIC PROD DIV       | 5-22  |
| CONTROL DATA CORP                            | 28-35-51-52                               |                                | GENERAL ATOMATICS INC                        | 1-16-18-27-35   |
| CONTROL EQUIPMENT CORP                       | 1-5-11-18-24-31-39-48-50-54               |                                | GENERAL CONTROL CO                           | 35  |
| CONTROL LOGIC INC                            | 5   |                                | GENERAL CONTROLS CO GLENDALE                 | 11-12-16-26-32-46-47                                      |
| CONTROLLED ATMOSPHERE ENCLOSURES ORANGE      | 14-32-38                                  |                                | GENERAL CONTROLS CO AIRCRAFT/ELEC CONTROLS   | 5-22-32-46-47   |
| JERVIS B WEBB CO CONTROL ENG CO DIV          | 8-18-19-24-28-35-52-54                    |                                | GENERAL CONTROLS CO IRON MOUNTAIN DIV        | 3-5-11-12-13-14-16-18-22-26-27-32-35-38-46-47-48-50-54-55 |
| CONTROL INDICATING CORP                      | 1-16-32-35-49                             |                                | GENERAL DYNAMICS TELECOMMUNICATION           | 54  |
| CONTROL MFG CO                               | 16-26-36                                  |                                | GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 2   |
| CONTROLMAG LABS                              | 4-10-34-35                                |                                | GENERAL ELECTRIC CO SHELBYVILLE              | 13-32-47  |
| CONTROL TECHNOLOGY CO                        | 1-2-17-22-25-28-31-32-39-45               |                                | GENERAL ELEC CO MISSILE & SPACE VEH DEPT     |   |
| CONTROLS CO OF AMER MILWAUKEE                | 12-26-32-46-47                            |                                | VALLEY FORGE SPACE TECH CTR                  | 28  |
| COOK ELECT CO WIRECOM DIV                    | 1-26-32-35-38-54                          |                                | GENERAL ELECT CO WIRING DEVICE DEPT          | 14-47   |
| COOPER CO D C                                | 14-32-35                                  |                                | GENERAL ELECTRIC CO INDUSTRY CONTROL DEPT    | 5-8-11-17-18-19-24-27-28-33-34-41                         |
| CORONA ENGG SERVICE                          | 16  |                                | GENERAL ELECTRIC CO SPECIALTY CONTROL DEPT   | 1-5-6-7-16-18-22-24-29-45-48-53                           |
| COX & CO                                     | 32  |                                | GENERAL METERS INC                           | 7   |
| COX INSTRUMENTS DIV GEORGE C NANKERVIS CO    | 9-11-18                                   |                                | GENERAL MILLS INC MINN                       | 24-54   |
| CP ELECTRONICS INC                           | 24  |                                | GENERAL RADIO CO                             | 45  |
| CRAMER DIV GIANNINI CONTROLS CORP            | 5-23-35-41-49-50-52-54                    |                                | GENERAL RAILWAY SIGNAL CO                    | 31  |
| CRANE ELECTRONICS CO                         | 5-35-50-52                                |                                | GENERAL TEL & ELECT ANNARBOR PLANT           | 23  |
| CRESCENT EAST ENGR & RES CO                  | 1-8-16-24-26-31-33-36                     |                                | GENERAL TIME CORP ELECTR SYS DIV             | 5-35-48-49-50-54  |
| CROUSE HINDS CO                              | 36  |                                | GEORGE GORTON MACHINE CO                     | 28  |
| CROWN ENGG DIV DATA TECH INC                 | 30  |                                | GERST & CO PAUL E                            | 16-44-45  |
| CROYGENICS INC                               | 12-16-32                                  |                                | GIANNINI CONTROLS CORP SERVO COMP DIV        | 24-28   |
| CRYONETICS CORP                              | 32  |                                | GIANNINI CONTROLS CORP TRANSDUCER DIV        | 11-16-26-32   |
| CRYO THERM INC                               | 32  |                                | GIANNINI CONTROLS CORP CRAMER DIV            | 35-48-49-52-54  |
| CRYSTAL RESEARCH PRODUCTS                    | 15  |                                | GIANNINI CONTROLS CORP NJ DIV                | 11-16-26-28   |
| CTS OF CANADA LTD                            | 22  |                                | GILMORE INDUSTRIES INC                       | 1-26-28-32-33   |
| CUBIC CORP                                   | 28-31-35                                  |                                | GIRDLER PROCESS EQUIP DIV                    | 49  |
| CUMMINS CHICAGO CORP                         | 23-37                                     |                                | GLOBE INDUSTRIES INC                         | 50-51   |
| CURTIS INSTRUMENTS INC                       | 35-49-53-54                               |                                | GORDON ENTERPRISES                           | 23  |
| ELECTRONICS DIV CURTISS WRIGHT               | 16-34-55                                  |                                | G P E CONTROLS INC                           | 24-26-27-28-38  |
| CURTISS-WRIGHT CORP ELECTRONICS DIV          | 55  |                                | GRAPHICS INC KEARNY                          | 1   |
| CUSTOM PRODUCTS CORP                         | 19  |                                | GRAY GAINER ELECTRONICS                      | 15  |
| CYBETRONICS INC                              | 18  |                                | GREEN RECTIFIER CO                           | 9-18-38-39-44-45  |
| DALES CO FRANKLIN                            | 19-32                                     |                                | GREENBRIER INSTRUMENTS INC                   | 3-4-12-20   |
| DALES MFG CO                                 | 32  |                                | GREINER CO EMIL                              | 9-26-32-38-47-52  |
| OA-LITE SCREEN CO                            | 18-35                                     |                                | GUARDIAN ELECTRIC MFG CO                     | 1-5-7-11-22-46-56   |
| DALLONS LABS                                 | 22  |                                | GUIDANCE CONTROLS CORP                       | 18-24-33-54   |
| DALMO VICTOR CO DIV TEXTRON INC              | 24-26-28-31                               |                                | GUIDE MFG CO                                 | 25-35-38-39-44-45-48-49-50-51-52-54                       |
| DAMPP CHASER INC                             | 14  |                                | GULTON INDUSTRIES INC METUCHEN               | 11-13-16-26-28-30-31-32-39-44-45                          |
| DANLY MACHINE SPECIALITIES INC CHICAGO       | 18  |                                | GULTON INDUSTRIES INC ENGG MAGNETICS DIV     | 39-44-45  |
| DANLY MACHINE SPEC INC CICERO                | 18-19-24-46                               |                                |  |   |
| DARCO IND INC                                | 26-46                                     |                                |  |   |
| DATA INSTRUMENTS                             | 5-35                                      |                                |  |   |
| DATA TECH                                    | 28-45                                     |                                |  |   |
| DATA TECHNOLOGY INC                          |   | 30                             |  |   |
| DATASCAN INC                                 |   | 5-64-45-48-52                  |  |   |
| DATLEX CORP                                  | 18-24-26-28-30-31-33-34-35-48-54          |                                |  |   |
| DATRAX DIV W W HENRY CO                      |   | 0                              |  |   |
| DAYSTROM INC MILITARY ELECTRONICS DIV        | 13-                                       | 26-32-39                       |  |   |
| DAYSTROM INC CONTROL SYSTEMS DIV             |   | 17-24-32                       |  |   |
| DAYTON ELECT PROD CO INC                     |   | 39-44-45                       |  |   |
| DAYTRONIC CORP                               | 1-8-19-24-30-33-34                        |                                |  |   |
| DBM RESEARCH CORP                            |   | 31-35                          |  |   |
| DECKER CORP                                  |   | 5-24-26-34-38                  |  |   |
| DEITZ CO S J                                 |   | 5-10-22-24-33-35               |  |   |
| DEL ELECTRONICS CORP                         |   | 19-44-45                       |  |   |
| DELTA DESIGN INC C O NON LINEAR SYSTEMS INC  |   | 32-38                          |  |   |
| DELTA SONICS INC                             |   | 16                             |  |   |
| DESTRON CO                                   |   | 35                             |  |   |
| DE-TEC-TRONIC CORP                           | 5-6-7-11-16-18-22-24-27-34-35-40-48-50-53 |                                |  |   |
| DEVCO DIV R E PHELONCO INC                   |   | 39-45-52-54                    |  |   |
| DEVCO ENGG INC                               |   | 1-12-18                        |  |   |
| DEVELCO INC                                  |   | 35                             |  |   |
| DEVELOPMENT ASSOCIATES                       |   | 1-32                           |  |   |
| DIAL PRODUCTS CO                             |   | 0                              |  |   |
| DI-AN CONTROLS INC                           | 5-24-27-35-40-48-49-54                    |                                |  |   |
| DIATRON INC                                  |   | 1                              |  |   |
| DICE CO J W                                  |   | 34                             |  |   |
| DIETZ CO HENRY G INC                         | 11-16-26-35-38-54                         |                                |  |   |
| DIETZ CO S J                                 |   | 5-10-22-24-33-35               |  |   |
| DIGITAL DESIGN CORP                          |   | 5-18-35-46-54                  |  |   |
| DIGITAL ELECTRONICS INC                      |   | 5                              |  |   |
| DIGITAL EQUIPMENT CORP                       |   | 48-52-54                       |  |   |
| DIGITAL SYSTEMS INC                          |   | 24                             |  |   |
| DIGITROL SYSTEMS INC                         |   | 16-22                          |  |   |
| DILLON & CO INC W C                          |   | 33                             |  |   |
| DIMCO-GRAY CO                                |   | 52                             |  |   |
| DJORDJEVIC ENGG CO                           |   | 34-39-44                       |  |   |
| DOCKENDORFF & CO INC                         |   | 19                             |  |   |
| DORMEYER INDUSTRIES CHICAGO                  |   | 46                             |  |   |
| DORSETT ELECTRONICS                          |   | 45                             |  |   |
| DRESSER ELECT SIE DIV                        |   | 25-31                          |  |   |
| DRY SCREEN PROCESS INC                       |   | 49                             |  |   |
| DRYOMATIC CORP                               |   | 14                             |  |   |
| DUNN ENGG CORP                               |   | 8                              |  |   |
| DURANT MFG CO MILWAUKEE                      |   | 5-22                           |  |   |
| DURO MATIC PRODUCTS CO                       |   | 46                             |  |   |
| DYNALECTRON CORP MATTERN DIV                 |   | 22-41-50                       |  |   |
| DYNAMU MAGNETRONICS CORP DIV MAICO ELECT IN3 |   | 18                             |  |   |
| OYNAPAR CORP                                 |   | 5                              |  |   |
| DYNASCIENCES CORP                            |   | 23                             |  |   |
| DYNATRONIC INST CORP ELECTR DIV              |   | 1-25-32-44-45-48               |  |   |
| LAB LINE INSTRUMENTS INC                     |   | 1-16-31                        |  |   |
| DYNEL INC                                    |   | 5-9-11-18-35-40-48-49-50-52-54 |  |   |
| EAGLE SIGNAL CO DIV GAMEWELL CO              |   | 8-17-18-19-24-30-              |  |   |
| EATON MFG CO DYNAMIC DIV                     |   | 32                             |  |   |
| ECLIPSE-PIONEER DIV BENDIX CORP              |   | 28                             |  |   |
| EDGERTON GERMESHAUSEN & GRIER BOSTON         |   | 35-54                          |  |   |
| EDISON INDUST THOMAS A INST DIV              |   | 1-14-16-26-28-32               |  |   |
| E D L CO                                     |   | 23                             |  |   |
| EDO CANADA LTD                               |   | 28                             |  |   |
| ELDORADO ELECT CO                            |   | 48-52                          |  |   |
| ELECT MECHANICAL RES INC                     |   | 31                             |  |   |
| ELECTRIC EYE EQUIPMENT CO                    |   | 17-22-23-25-27-33-34           |  |   |
| ELECTRIC MACHINERY MFG CO                    |   | 39                             |  |   |
| ELECTRIC REGULATOR CORP                      |   | 17-28-39-44-45                 |  |   |
| ELECTRICAL SERVICE CO                        |   | 22-35-48-50-53                 |  |   |
| ELECTRODATA DIV BURROUGHS CORP               |   | 17-28                          |  |   |
| ELECTRO DEVELOPMENT CORP SEATTLE             |   | 44-45-49-52-54                 |  |   |
| ELECTRO DEVICES INC PATERSON                 |   | 18-24-28-33                    |  |   |
| ELECTRODYNAMIC INSTRUMENT CORP               |   | 28-52                          |  |   |
| ELECTRO FLEX HEAT INC                        |   | 32                             |  |   |
| ELECTROID CORP                               |   | 46                             |  |   |
| ELECTRO INSTRUMENT INC                       |   | 48                             |  |   |
| ELECTRO KINETICS CORP                        |   | 18-24-25-28                    |  |   |
| ELECTROL SPECIALITIES CO                     |   | 4-18                           |  |   |
| ELECTROMATIC EQUIP CO                        |   | 34                             |  |   |
| ELECTROMATION CO                             |   | 16-22-24-28                    |  |   |
| ELECTRO MECHANICAL CORP                      |   | 1-22-28-44-45                  |  |   |
| ELECTRO-MEDICAL LAB INC                      |   | 52                             |  |   |
| ELECTRONEX INDUSTRIAL LABORATORIES           |   | 4-10-34-                       |  |   |
| THE ELECTRO NUCLEAR SYS CORP                 |   | 28                             |  |   |
| ELECTRO PHYSICS CO                           |   | 15-21-23                       |  |   |
| ELECTRO PROD LABS INC                        |   | 5-18-24                        |  |   |
| ELECTRO SEAL CORP                            |   | 32-45                          |  |   |
| ELECTRO SOLID CONTROLS INC                   |   | 14-15-23-28-32                 |  |   |
| ELECTRO VISION LAB                           |   | 5-50-52-53-54                  |  |   |
| ELECTRON ARC DIV IONICS INC                  |   | 4-40                           |  |   |
| ELECTRON BEAM DEVICES CORP                   |   | 18-28-40                       |  |   |
| ELECTRONIC CONTROL CORP                      |   | 1-4-7-10-16-18-19-             |  |   |
| ELECTRONIC CONTROLS INC                      |   | 22-25-32                       |  |   |
| ELECTRONIC CONTROLS SYSTEMS INC              |   | 5-18-22-28-35-48-49-52-54      |  |   |
| ELECTRONIC COUNTERS INC                      |   | 13-32                          |  |   |
| ELECTRONIC DEVELOPMENT CORP                  |   | 5-18-22-35                     |  |   |
| ELECTRONIC MACHINE PARTS INC                 |   | 1                              |  |   |
| ELECTRONIC MODULES CORP                      |   | 22                             |  |   |
| ELECTRONIC PRODUCTS DIV POST MACHINERY       |   | 5-48                           |  |   |
| ELECTRONIC PROCESSES CORP OF CALIF           |   | 5-                             |  |   |
| ELECTRONIC PRODUCTS CO DIV VICTOREEN         |   | 22-35-52                       |  |   |
| ELECTRONIC PRODUCTS CORP BALTIMORE           |   | 32                             |  |   |
| ELECTRONIC TIMERS CO                         |   | 35-50-52-54                    |  |   |
| ELECTRONIC TRANSFORMERS CORP                 |   | 44-45                          |  |   |
| ELECTRONICS CORP OF AMER ONTARIO             |   | 1-5-16-22-35-40-48-53          |  |   |
| ELECTROSONICS INTERNATIONAL INC              |   | 1-7                            |  |   |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       |   | 48-                            |  |   |
| ELIOTT INSTRUMENTS INC                       |   | 49-50-51-52-54                 |  |   |
| ELIOTT BROS LONDON LTD RAOAR DIV             |   | 38                             |  |   |
| ELIOTT BROS LTD                              |   | 1                              |  |   |



# Control Equipment

GULTON INDUSTRIES INC WEST INSTRUMENT CORP 13-32  
 47-55  
 G-V CONTRLS INC 1-3-4-16-24-28-32  
 HAGAN CHEMICALS & CONTROLS INC 35-49-52  
 HAIRSPRING VIBRATING CO 42  
 HALLETT MFG CO 31  
 HALLCRAFTERS PACIFIC DIV 29-32  
 HALLKAINEN INSTRUMENTS 10-11-17-32  
 HALLMARK INST CORP 26  
 HAMILTON STANDARD ELECTRONICS DEPT 32  
 HAMILTON STANDARD DIV OF UNITED AIRCRAFT 31  
 HAMMARLUND MFG CO INC MARS HILL 48-49-52  
 HAMNER ELECTRONICS CO INC 15  
 HANOVIA LAMP DIV/ENGLEHART INDUSTRIES INC 32  
 HARREL INC 16-26  
 HARRIS MFG CO INC 32  
 HART MFG CO 49-52  
 HARTMAN ELECTRICAL MFG CO 3-10-11-34  
 HARWALD CO INC 12-26-38  
 HASTINGS-RAYDIST INC 35-48-49-50-51-52-54  
 HAYDON CO A W WATERBURY 18-35-48-49-50-52-54  
 HAYDON DIV GENERAL TIME CORP 35-48  
 HAYS CORP 11-16-20-26  
 H B INSTRUMENT CO 47  
 HEALY-RUFF CO 16-26-31  
 HENES MFG CO 40  
 HEYER INDUSTRIES INCORPORATED LAB OF MARQUETTE CORP 38-47  
 HIGH VACUUM EQUIP CORP 32  
 HILL & CO E VERNON 38  
 HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV 1-22-31-36  
 HOKE INC 46  
 HONEYWELL CONTROLS LTD 4-11-12-13-14-16-21-26-28-29-30-31-36-38-46-47  
 HORLICK CO INC WM I 18  
 HOWARD CRYSTAL HOLDERS INC 22  
 HOWELL INSTRUMENTS INC 1  
 HUGHES AIRCRAFT CO IND SYSTEMS DIV 18-24  
 HUGHES AIRCRAFT CO LOS ANG 5  
 HUGHES AIRCRAFT CO VACUUM TUBE PROD DIV 38-40  
 HUGHEY & PHILLIPS 22  
 HUNT ELECTRONICS 4-15-18-23-25  
 HUPPERT CO K H 13-32  
 HURLETRON INCORPORATED ELECTRIC EYE EOP DIV 17-22-23-25-27-33-34  
 HURLETRON INC WHEATON ENG DIV 19-35-48-49-50-52-54  
 HUYCK SYSTEMS CO DV OF HUYCK CORP 28-36  
 H W ELECTRONICS INC 5-48  
 HYDRA POWER CO 11-26-46  
 HYDRAULIC RES ELECT DIV 18  
 HYDROMATICS INC 11-12-20-38-46  
 HYDROPOISE INC SUB BROOKS INST CO 5-11  
 HYGRODYNAMICS INC 1-14-32  
 HYSON MFG CO PASADENA 1-22-23-24-28  
 ICONIX INC 5-54  
 ILIKON CORP 38  
 IMC MAGNETICS CORP PHOENIX 46  
 IMPERIAL ELECT INC 32  
 INDUSTRIAL CONTROL CO 14-17-23-28  
 INDUSTRIAL ELECTRONIC ENGINEERS INC 1-36  
 INDUSTRIAL ELECTRONICS INC 22  
 INDUSTRIAL ELECTRONICS OF OMAHA INC 26-31-35  
 INDUSTRIAL INSTRUMENTS INC 14  
 INDUSTRIAL TIMER CORP 35-45-48-49-50-52-54-55  
 INSTRUIONICS CONTROLS INC 5-18-26-34  
 INERTIA SWITCH INC 18-19-35-51  
 INFORMATION SYSTEMS INC 0  
 INFRARED INDUSTRIES INC WESTERN DIV 1-5-7-22-32-36  
 INSCO COMPANY 24-35  
 INSTRUMENT CORP OF FLA 23-48  
 INSTRUMENT DEVELOPMENT LABS INC 32  
 INSTRUMENTS INC 6-16  
 INSTRUMENTS OF N E 34-49-52-54  
 INTERNATIONAL DATA SYSTEMS INC 49-50-52-54  
 INTERNATIONAL INSTRUMENTS INC 1-24  
 INTL INSTRUMENT INC 1  
 INTERNATIONAL RECTIFIER CORP 45  
 INVAC CORP 53  
 IONICS INC ELECTRON ARC DIV 4-40  
 IRCON INFRARED CONTROLS INC 32  
 I TI ELECTRONICS INC 7  
 ITT KELLOGG COMM SYSTEMS DEPT 1-7-48  
 JACK & HEINTZ DIV SIEGLER CORP 40-45  
 JACKES-EVANS MFG CO 46  
 JACOBS INSTRUMENT CO 48  
 JAMESBURY CORP 11-12  
 JARVIS ELECTRONICS CORP 17-18-22-27-33-36-48  
 JFD ELECTRONICS SOUTHERN INC 39  
 JO-BELL PRODUCTS INC 1-16  
 JOHNSON SERVICE CO 14-32-47  
 JORDAN CONTROLS INC 24  
 KAHLBERG BROS CO 46  
 KAHN & CO 14-32  
 KEARFOT DIV GPI INC CLEVELAND 39  
 KEN-DELL PRODUCTIONS INC 32-33-34-35-50-52-54  
 KEUFFEL & ESSER CO 22  
 KIDDE & CO WALTER 1-28  
 KINETICS CORP 48-54  
 KINNELECTRONICS CORP 14  
 KINNEY VACUUM DIV THE NEW YORK AIR BRAKE CO 38  
 KIRKLAND CO H R 1-15  
 KLEER-TRONICS INC 1  
 KLIEGEL BROS UNIV ELEC STAGE LIGHTING CO I 15  
 KOLLSMAN INST CORP STD KOLLSMAN IND INC 22-28

KOLLSMAN INSTRUMENT CORP SUB STANDARD KOLLSMAN IND 22-28  
 KOONTZ WAGNER ELECT CO INC 46  
 KPT MFG CO 24-28  
 KYLE PRODUCTS 24  
 LABLINE INC 14-15-16-22-32-35-47-49-52  
 LABORATORY FOR ELECTRONICS INC 36-43  
 LAKE CITY INC SUB OF CONTROLS CO OF AMERICA 49-52-54  
 LAKE SHORE ELECTRIC CORP 32-39-45  
 LAMOTTE CHEMICAL PRODUCTS CO 3-21  
 LARSON INSTRUMENT CO 19-32  
 LEACH CORP INET DIV 39-44-45  
 LEACH CORP SPECIAL PRODUCTS DIV 35-39-48-52  
 LEAR INC ASTRONICS DIV 0  
 LEAR INC ELECTRO-MECHANICAL DIV 3-8-11-18-24-28  
 LEAR ROMEC DIV LEAR INC 11-26-28  
 LEAR SIEGLER INC POWER EQUIP DIV 28-39-45  
 LEBOV ASSOCIATES 26  
 LEEDS & NORTHRUP CO 1-3-4-10-11-12-13-14-16-20-21-26-28-30-32-34  
 LEHIGH VALLEY ELECT ENGG & MFG CO 22-27-52  
 LEKTRA LABS INC 22-23-49-52-53-54  
 LELAND AIRBORNE PRODUCTS 39-44-45  
 LESLIE CO 11-16-26-32-38-47  
 LE SUEUR MFG CO INC 0  
 LIBRASCOPE DIV GENERAL PRECISION INC 5-23-24-28-42  
 LINDLY & CO 13-45  
 LINK AVIATION INC SUB GEN PREC EQUIP CORP 22  
 LINK DIV GENERAL PRECISION INC 11-12-18-24-26-28-39-44-45  
 LIQUIDMETER CORP 16-32  
 LOCKHEED ELECT CO INFORMATION TECHNOLOGY DIV 1-31  
 LOENCO INC 3-32  
 LOGEMAN CO C W 52  
 LOGETRONICS INC 14-22-23  
 LDUU MACHINE WORKS INC 0  
 LUMEN INC 1-5-28-32-35-36-39-44-45  
 LYNCH COMMUNICATION SYSTEMS INC 1-31  
 MACHINE O MATIC 22  
 MACHINERY ELECTRIFICATION INC 1-16-19-22-35-53  
 MACK ELECTRIC DEVICES INC 1-36  
 MADIGAN CORP 28  
 MAGNADYNE CORP 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37-38-39-40-41-42-43-44-45-46-47-48-49-50-51-52-53-54-55  
 MAGNETIC CONTROLS CO 32  
 MAGNETIC INSTRUMENT CO INC 16-28  
 MAGNETIC INC 28  
 MAGNETICS INC 1-5-13-15-18-19-24-25-28-30-32-33-34-35-39-40-44-45  
 MAICO ELECTRONICS INC 24  
 MAICO ELECTRONICS INC DYNAMU MAGNETRONICS DIV 24-36  
 MAICO ELECTRONICS INC ENG DIV 24-36  
 MALLORY ELECT CO 1-17-19-25-35-44-45-48-49-52-54  
 MANSON LABORATORIES INC 2  
 MARANTZ CO 0  
 MARINE ELECTRIC CORP 1-3-4-10-14-16-32-35-49-52  
 MARQUETTE DIV CURTISS-WRIGHT CORP 11-24-26-28  
 MARS INDUSTRIES INC 40  
 MARYLAND TELECOMMUNICATIONS INC 5  
 MATTER CORPORATION 35-41-50-53  
 MAXSDN ELECTRONICS CORP ELECTRONIC DES DIV 35-48-52  
 MCDONNELL & MILLER INC 1-11-16  
 MEASUREMENT ENGG LTD 16-19-22-32-37-49  
 MEASUREMENT SYSTEMS INC 22-23-28-37  
 MECHANICS FOR ELECTRONICS INC 24  
 MELABS 1-2  
 MERCOLD CORP 16-26-32-38  
 METALS & CONTROLS INC COMMERCIAL CONTRLS DPT 32-47-55  
 METROTEK ELECTRONICS INC 21  
 MICRO BALANCING INC 22  
 MICRO GEE PROD INC 26-28  
 MICRO INSTRUMENT CO 18-32  
 MICRO MEASUREMENTS CORP 22  
 MICRO METRICS INC 1-5-18-24-28  
 MID-EASTERN ELECTRONICS INC 39-44-45  
 MIDWESTERN INSTRUMENTS 28-46  
 MILLER FRANKLIN P & SON INC 3-18  
 MILLER-HARRIS INSTRUMENT CO 35-52  
 MILLER-TROJAN CO INC 15  
 MILLETRON INC 32  
 MILTON-ROY CO 0  
 MINE SAFETY APPLIANCES CO 1-20  
 MINNEAPOLIS-HONEYWELL FALL RIVER DIV 1-3-11-13-16-17-26-28-31-32-38  
 MINNEAPOLIS HONEYWELL APPARATUS CONTRLS DIV 1-11-12-13-14-16-18-24-26-28-32-33-38-46-47-49  
 MINNEAPOLIS-HONEYWELL ORDANCE DIV 4-6-14-18-22-26-52  
 MINNEAPOLIS-HONEYWELL AERO DIV 5-6-16-17-24-26-28-32-38-39-44-45-46-47-52  
 MINNEAPOLIS-HONEYWELL BROWN INST DIV 3-4-6-10-11-13-14-16-21-24-25-26-28-30-31-32-38-45  
 MINNEAPOLIS-HONEYWELL SPECIAL SYS DIV 25  
 MINSTER MACHINE CO 17-18-19  
 MIRATEL INC NEW BRIGHTON 0  
 MIRATEL INC ST PAUL 1  
 MITE CORP 27-31  
 MKS INSTRUMENTS INC 11-16-26-38  
 MODEL ENGG & MFG INC 1-5-11-12-24-26-28-32-39-43-45-46

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MODELECTRIC PRODUCTS CORP 1-18-43  
 MODERN LABORATORY EQUIP CO 32-47  
 MONITOR CONTROLLER 18-26-27  
 MONITOR SYSTEMS INC 1-31  
 MONTEK ASSOCIATES INC 1-24-28-39-45  
 MONTGOMERY MFG CO 35-49-54  
 MOORE ASSOCIATES INC 1-31  
 MORSE INSTRUMENT CO 23-24-52  
 MOSLER RESEARCH PROD INC 1  
 MOTOROLA INC SOLID STATE SYSTEMS DIV 3-27-31  
 MUIRHEAD & CO LTD 28  
 MUIRHEAD INSTRUMENTS INC 28-32-34  
 MULTI-PRODUCTS CO 0  
 NANILOA CORP 5-18-24-28-31-48-54  
 NATIONAL COMPANY INC 28  
 NATIONAL INSTRUMENT LABS INC 11-12  
 NATL WATER LIFT CO DIV PNEUMO DYNAMICS CORP 28  
 NATURAL LIGHTING CORP 39  
 NAVIGATION COMPUTER CORP 5-48-52-54  
 NEPTUNE ELECTRONICS CO 2  
 NEWARK CONTROLS CO 6-12-16-26-38  
 NEWTON INSTRUMENT CO INC 9  
 NIAGARA ELECTRON LABS 3-11-16-24-26-32  
 NORBATROL ELECTRONICS CORP 1-17-18-24-28-32-39-44-45  
 NORDEN DIV UNITED AIRCRAFT CORP 18-28  
 NORTH ATLANTIC INDUST INC 17-28-30-31-32-34-39-44-45  
 NORTHERN PRECISION LABORATORIES 24-31  
 NORTHERN RADIO CO 31  
 NORTHROP CORP 1  
 NUCLIDE ANALYSIS ASSOC 1-38-44-45-49-54  
 OAK MFG CO 49-54  
 OHIO SEMICONDUCTORS DIV TECUMSEN PRODS CO 25  
 OHMART CORP 1-6-16-29-34  
 OIL RITE CORP 1-11-16-35-46-49  
 OMTRONICS MFG INC 32  
 ONIC DEVICES INC 42  
 OPAD ELECTRIC CO 9-19-39-45  
 OPTO ELECTRONIC DEVICES INC 22  
 ORBITRAN CO INC 30-31  
 ORTRONIX INC 31  
 OSTER MFG CO JOHN AVIONIC DIV 28  
 OTIS ELEVATOR CO DEFENSE & INDUSTRIAL DIV 28-35-39-44-45  
 OVERHEAD DOOR CORP 7  
 OVERLOAD CONTROL CO 19  
 OXYGEN EQUIPMENT & SERVICE CO 20  
 PACE ENGINEERING CO 28-31  
 PACIFIC SCIENTIFIC CO 13-33  
 PACO ELECTRONICS CO INC 44-45  
 PANELLIT INC DIV INFORMATION SYS INC 1-32  
 PANELLIT LTD 1  
 MEMBER OF ELLIOTT AUTOMATION GROUP 1  
 PARABAM INC 35-48-50-52-54  
 PARAGON ELECTRIC CO 35  
 PARKS LAB HENRY FRANCIS 14-49-50-52-54  
 PAR PRODUCTS CORP 23  
 PARSONS CO RALPH M ELECTRONICS DIV 48-52-54  
 PARTLOW CORP 1-12-14-32-35-47-52  
 PARTNICK & WILKINS CO 1  
 PASTOR12A ELECT INC 1-3-17  
 THE PAVELLE CORP 15-23-53  
 PEER INC 40-45-54  
 PEGASUS LABS INC 2-11-18-24-28-30-33-34-40-46  
 PENN KEYSTONE CORP 1  
 PENN METER CO 12-16  
 PENNWOOD NUMECHRON CO 48-50-52  
 PERFECT COMPONENTS INC 28  
 PERFORMANCE MEASUREMENTS CO 11-12  
 PERMA-POWER CO 0-7  
 PESCO PRODUCTS DIV WESTERN BRANCH 18-32  
 PHILA SCIENTIFIC GLASS CO 1-14-32-38-44-47  
 PHILCO CORP LANSDALE DIV 14-32-38  
 PHILIPS ELECTRONIC INSTRUMENTS 41  
 PHOENIX PRECISION INSTRUMENT CO 1-3-6-22-23-37  
 PHOTOMATION INC 1-6-16-22-35-37  
 PHOTOBELL CO 1-5-7-15-16-17-18-22-34-36-48-52-53  
 PHOTO - CRYSTALS 1-5-12-14-15-22-53-56  
 PHYS CHEMICAL RES CORP 14  
 PICKARD & BURNS INC SUB GORHAM CORP 32  
 PIEZO PRODUCTS CO 32  
 PIONEER MAGNETICS INC 19  
 PLANAUTICS CORP 1-25-44-45-49-50-54-55  
 PLUG IN INSTRUMENTS INC 1-3-12-24-26-28-30-32-35  
 PNEUMO DYNAMICS CORP INST & CONTROL DIV 28  
 POLYTRONICS CO 22-32-39-45  
 POOLE INSTRUMENTS INC 29  
 POTTER AERONAUTICAL CORP 11  
 POTTER PACIFIC CORP 1  
 POTTER AERONAUTICAL CORP 5-6-11-16-17-29-48  
 POWERTON ULTRASONICS CORP 11-16-20  
 POWER TRONIC SYSTEMS INC 17-18-22-24-25-26-28-32-44-45  
 PRECISION SCIENTIFIC CO 3-13  
 PRECISION SENSORS INC 1-6-11-12-16-26-32-38  
 PRECISION SPECIALTIES INC 8-24-28-33-34-42  
 PRECISION THERMOMETER & INST CO 6-16-29-32-47  
 PRESIN CO INC 5-50  
 PRINCETON APPLIED RESEARCH CORP 32  
 PRINCETON DIV ELECTRO MECHANICAL RESCH INC 1  
 PROCESS & INSTRUMENTS 21-32-38  
 PRODUCERS SALES CORP & PHOTO-SONICS INC 23-53  
 PROJECTS UNLIMITED INC 18-32  
 PROTECTION EQUIPMENT CO INC HOPKINS 1  
 PROTECTION EQUIPMENT CO INC MPLS 1  
 PYROMETER INSTRUMENT CO 32  
 PYROTEL CORP 32  
 QUANTAMETRIC DEVICES INC 6-15-34



# PRODUCTS & MANUFACTURERS

# Crystals, Crystal Products & Accessories

|  |  |
|--|--|
| QUINDAR ELECTRONICS INC                      | 1-31-36  |
| RACINE HYDRAULICS & MACH INC                 | 11-18-24-28-46   |
| RADIAPHONE CO                                | 1-4-10-31-32-33-45                                     |
| RADIATION COUNTER LABS INC                   | 5-16-34-35-48-52                                       |
| RADIATION RESEARCH CORP WESTBURY             | 52   |
| RADIO COND CO SUB THOMPSON RAMO WOOLDRIDGE   | 1  |
| RADIO CORP OF AMER DETROIT                   | 13-18-24-34-35   |
| RAMSEY ENG CO                                | 6-16-29  |
| RAPIDS STANDARD CO INC                       | 36   |
| RDF CORP                                     | 32   |
| REACH CORP                                   | 1-16-31  |
| REDFORD CORP INSTRUMENT DIV                  | 5-48-54  |
| REGENT CONTROLS INC                          | 1-4-10-16-18-19-22-24-25-27-32-34-35-39-48-50-52-54    |
| RELIANCE TIME CONTROLS INC                   | 52   |
| REMANCO INC                                  | 28   |
| REMYNTOON CORP                               | 14   |
| RENFREW ELECTRIC CO LIMITED                  | 26-32-35-39  |
| REPUBLIC FLOW METERS CO                      | 11-16-24-26-28-32                                      |
| RESEARCH INCO RD3-13-15-24-25-26-28-30-32-40 |  |
| RESEARCH INC EDINA STA                       | 32-38  |
| RESEARCH INDUSTRIAL LAB OF ELECTRONICS       | 1-16-35-38   |
| RESEARCH INST CO INC                         | 5-18-19-24-26-35                                       |
| RESEARCH MFG CORP                            | 32   |
| RESEARCH SPECIALTIES CO                      | 32   |
| REYNOLDS ELECTRIC CO                         | 49-54-55   |
| RHEEM ELECTRONICS CORP                       | 18-22-24   |
| RICHARDSON ALLEN CORP                        |  |
| SUB STANDARD KOLLSMAN IND                    | 44-45  |
| RICH ELECTRONICS INC                         | 22   |
| RIL ELECTRONICS CORP                         | 1-3-4-5-6-10-16-29-34-38-54                            |
| RIPLEY CO                                    | 15-22  |
| RISCO  | 1  |
| RI TONE PRODS INC                            | 52   |
| RIVETT LATHE & GRINDER INC                   | 11-46  |
| RIXON ELECTRONICS INC                        | 5  |
| R M S ASSOCIATES INC                         | 2  |
| ROBERTSHAW-FULTON CONTROLS CO                | 14-16-21-26-32   |
| ROBERTSHAW FULTON CON CO FULTON SYLPHON DIV  | 16-26-32-38  |
| ROBINSON MACHINE WORKS INC                   | 1  |
| ROBOT INDUSTRIES INC                         | 18   |
| ROBOTOMICS ENTERPRISES INC                   | 48   |
| ROBOTRON CORP                                | 40-54  |
| ROCKSTER INSTRUMENT SYS INC                  | 1-19   |
| ROCKWELL ENGINEERING                         | 28-38  |
| RONAN & KUNZL INC                            | 35-52  |
| ROTARY LIFT CORP DIV DOVER CORP              | 0  |
| ROY CO MILTON                                | 11-16  |
| ROYCO INSTRUMENTS INC                        | 5  |
| RUCKER CO                                    | 11-18-24-26-28   |
| RYE CONTROLS INC                             | 24-38-41   |
| SAGE CRAFT INC                               | 35   |
| SANDERS ASSOCIATES                           | 28   |
| SARASOTA ENG CO INC                          | 10-36  |
| SCAICO CONTROLS INC                          | 13-26-32-47-55   |
| SCHAEVITZ ENGG                               | 1-8-11-16-19-24-26-27-28-33-34                         |
| SCHIRMER-NATIONAL ALARM CORP                 | 1-22   |
| SCHLIEBUS ELECTRONIC INSTRUMENT CO           | 1  |
| SCHMITT MFG CO                               | 11-32  |
| SCHOENE ELECTRONICS LABORATORY               | 45   |
| SCHRACK ELECTRICAL SALES CORP                | 18   |
| SCHUTTE & KOERTING CO                        | 24-28  |
| SCIACKY BROS                                 | 28-45-54   |
| SCIENTIFIC ATLANTA INC                       | 24-28  |
| SCOTT INC M H                                | 1  |
| SEABOARD ELECTRONIC CORP                     | 1-15-32-48-49-50-52-54                                 |
| SECTRON INC                                  | 18-32  |
| SECURITY CONTROLS INC                        | 1-5-16-18-24-34  |
| SECURITY DEVICES LAB                         | 1  |
| SEELY INSTRUMENT CO INC                      | 26-32-35-49-52-54                                      |
| SEL REX CORP                                 | 9-44-45  |
| SENECA FALLS MACHINE CO                      | 18-19-24-28-34   |
| SENSORY INC                                  | 1-5-11-18-22-35-53                                     |
| SEQUENTIAL ELECTR SYSTEM INC                 | 24-31-35   |
| SERDEX INC                                   | 34   |
| SERVICE ASSOCIATED INC                       | 13-32  |
| SERVO CONTROL DIV OILGEAR CO                 | 28   |
| SERVO CORP OF AMERICA                        | 1-2-13-28-31-32-34                                     |
| SERVOMECHANISMS INC EL SEGUNDO               | 6-26-31-32   |
| SERVO SYSTEMS CO                             | 28   |
| SERVOMECHANISMS INC EL SEGUNDO               | 16-24-26-28-32   |
| SERVO TEK PRODUCTS CO                        | 17-18-24-28  |
| SESSIONS CLOCK CO INDUSTRIAL TIMING DIV      | 35   |
| SHAND & JURS CO                              | 1-3-16-31  |
| SHEFFIELD CORP SUB THE BENDIX CORP           | 34-41  |
| SHERIDAN GRAY INC                            | 24   |
| SHERIDAN-GRAY INC                            | 24   |
| SIGMA INSTRUMENTS INC                        | 1-5-15-16-18-19-22-24-26-28-32-35-39-48-49-50-52-53-54 |
| SIMMONDS PRECISION PRODS TARRYTOWN           | 11-14-16-20-24-26-32                                   |
| SIMMONDS PRECISION PRODS GLENDALE            | 12   |
| SINGER MFG                                   | 5  |
| SINGER METRICS DIV SINGER MFG CO             | 19-44  |
| SINGLETON CO                                 | 3-9-14   |
| SKINNER PREC INDUST INC POLYNOID DIV         | 46   |
| SLIP RING CO OF AMERICA                      | 54   |
| SLOCUMB CO J T                               | 24-34  |
| SOLA ELECT CO SOLA TRANSFORMER DV            | 45   |
| THE SOLARTRON ELECTRONIC GROUP LTD           | 1-28-32  |
| SOLID STATE CONTROLS INC                     | 1-31   |
| SONEX INC                                    | 31   |
| SORENSEN INDUSTRIAL ELECTRONIC CO            | 48-55  |
| SOSTMAN & CO ME                              | 16-26  |
| SPACE CONTROL CORP                           | 28   |
| SPACE INSTRUMENTATION CORP                   | 11-24  |
| SPACEONICS & PORTABLE ELECTRIC TOOLS INC     | 32   |
| SPACE SYSTEMS INC                            | 25   |
| SPASORS INC SUB SILICON TRANSISTOR           | 39-44-45-52  |
| SPEC-HEATING INC                             | 32   |

|   |                                  |
|---|----------------------------------|
| SPECIAL INSTRUMENTS LABORATORY INC          | 4-21                             |
| SPECIALTIES INC CHARLOTTESVILLE             | 22-28                            |
| SPECTROLAB DIV TEXTRON ELECTRONICS INC      | 22                               |
| SPECTROLAB ELECTRONICS CORP SAN GABR        | 24-28-35-48-52-54                |
| SPEIDEL CORP PRESSURE CONT GRP              | 26-51                            |
| SPERRY FARRAGUT CO DIV SPERRY RAND CORP     | 28                               |
| SPERRY PHOENIX CO DV                        | 28-31                            |
| SPERRY UTAH CO DV SPERRY RAND CORP          | 31                               |
| SPERTI FARADAY INC                          | 1-15-35-49-50-52                 |
| SQUARE D CO COMM CONTROL DIV                | 1-3-7-11-16-18-19-26-32-38       |
| STACO INC STANDARD ELFC PRODS DIV           | 45                               |
| STANDARD INSTRUMENT CORP                    | 5-7-16-17-19-35                  |
| STANDARD PRODUCT INC SUB ELECTR COMM INC    | 28                               |
| STEVENS MFG CO                              | 32-55                            |
| STEWART & STEVENSON SERVICES INC            | 18                               |
| STRANDBERG ENGG LABS INC                    | 1-4-5-18-33                      |
| STROMBERG DIV GENERAL TIME CORP             | 35                               |
| SUNCOAST INSTRUMENTS DIV MILTON ROY CO      | 1-3-11-21-22-24                  |
| SUNDSTRAND CORP                             | 0                                |
| SUNDSTRAND DENVER                           | 12-17-18-19-24-25-26-28-32-39-45 |
| SUNSHINE SCIENTIFIC INSTRUMENT              | 52                               |
| SUPERIOR ELECTRIC CO                        | 15-18-24-39-45                   |
| SUPERIOR ELECT CO                           | 15-25-39-45                      |
| SYLVANIA ELECTRIC PRODS INC                 | 39                               |
| SYLVANIA ELECTRIC PRODS INC WALTHAM LABS    | 28                               |
| SYSTEMATICS OF MO INC                       | 48-49-54                         |
| SYSTEMS MATRIX INC                          | 52                               |
| SYSTRON DONNER CORP                         | 52                               |
| TABET MFG CO                                | 22                               |
| TABER INSTRUMENT CORP                       |                                  |
| AEROSPACE ELECTRONICS DIV                   | 26                               |
| TALLER & COOPER INC                         | 24-27-36                         |
| TAPCO GROUP THOMPSON RAMO WOOLDRIDGE INC    | 18-23                            |
| TAYLOR EMMETT CONTROLS INC                  | 26-32-35-49-54                   |
| TAYLOR INSTRUMENT CO INC                    | 35-49-54                         |
| TAYLOR INSTRUMENTS COMPANIES                | 1-3-11-16-17-21-27-28-32-54      |
| TAYLOR WINFIELD CORP                        | 40-44-45-46-48-52-54             |
| TECHNICAL OIL TOOL CORP                     | 24-35-48-49-50-51-52-54          |
| TECHNIC INC                                 | 9                                |
| TECHNIQUE ASSOCIATES                        | 32                               |
| TELECHROME MFG CORP                         | 3-12-16-24-31                    |
| TELETRON CO                                 | 16-34-35                         |
| TELEMET CO                                  | 39-45                            |
| TEL-INSTRUMENT ELECTRONICS CORP             | 14                               |
| TELOSTAT CORP                               | 32                               |
| TEMPIL CORP                                 | 35-39-48-49-50-52-54             |
| TEMPO INSTRUMENT INC                        | 28                               |
| TEN BOSCH INC M                             | 33                               |
| TENSITRON INC                               | 3                                |
| TENSOR ELECT DEVELOP CO                     | 52                               |
| TEXAS INSTRUMENTS INC APPARATUS DIV         | 1-32                             |
| TEXAS INSTRUMENTS INC APPARATUS DIV         | 13-32-55                         |
| THFMOLYNE CORP                              | 32-47                            |
| THERMO-O-DISC INC                           | 13-32-55                         |
| THERMOLYNE CORP                             | 11-16-32-47-55                   |
| THERMONETICS INC                            | 24-28                            |
| THETA INSTRUMENT CORP                       | 15                               |
| THOMAS INDUSTRIES INC                       | 32                               |
| TIPTRONIC INC                               | 27-30                            |
| TOLEDO SCALE DIV TOLEDO SCALE CORP          | 1                                |
| TOMORROW INC                                | 22-35                            |
| TORK TIME CONTROLS INC                      | 18                               |
| TORO ENGINEERED PRODUCTS INC                | 1                                |
| TRACERLAB INC RICHMOND                      | 45                               |
| TRANSFORMER TECHNICIANS INC                 | 31                               |
| TRANSITEL INTERNATIONAL CORP                | 1-28                             |
| TRANSMAGNETICS INC                          | 26-44                            |
| TRANS METRICS INC                           | 0                                |
| TRELCON ENGINEERING CO                      | 1-35-36                          |
| TREPEC CORP OF AMERICA                      | 16                               |
| TRIMOUNT INSTRUMENT DIV GENERAL CONTROLS CO | 32                               |
| TRI-R INSTRUMENTS                           | 5-22-53                          |
| TRI-TRONICS CO                              | 1-5-6-18-22-23-32-35-38-39-45-48 |
| TROTT ELECTRONICS INC                       | 5-6-35-39-48                     |
| TROXLER ELECTRONICS LAB INC                 | 32                               |
| TUTTLE ELECTRIC PRODUCTS INC                | 1-3-7-11-13-15-18-32-35          |
| U S CONTROLS INC N Y                        | 15-18-32-35                      |
| US CONTROLS INC BROOKLYN                    | 49                               |
| U S INSTRUMENT CORP                         | 18-28                            |
| U S SCIENCE CORP                            | 31                               |
| U S TIME CORP                               | 32-47-55                         |
| ULANET CO GEORGE                            | 38-40                            |
| ULMER CO THE DIV MICROTRON INDUSTRIES INC   | 38                               |
| ULTEK CORP                                  | 7-36                             |
| UNION SWITCH & SIGNAL DIV                   | 34                               |
| UNIT PROCESS ASSEMBLIES INC                 | 11-14-16-20-26                   |
| UNITED AIRCRAFT PROD INC FOREST             | 32                               |
| UNITED CONTROL CORP OVERLAKE INDUSTRIAL PK  | 32                               |
| UNITED DATA CONTROL INC                     | 49                               |
| UNITED ELECTRIC CONTROLS CO                 | 1-7-13-16-26-32-38-40-47         |
| UNITED ENGRS-ELECTRO NUCLEAR UNSTRS DIV     | 1-5-11-16-18-26-31               |
| UNIVERSAL MATCH CO UNDYNAMICS DIV           | 28                               |
| UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT  | 28                               |
| UNIVERSAL RELAY CORP                        | 46                               |
| UNIVERSAL TOROID COIL WINDING INC           | 15-32                            |
| UNIVOX CORP LOS ANG                         | 28                               |
| VACUUM ELECTRONICS CORP                     | 38                               |
| VALCOR ENG CORP                             | 46                               |
| VAP AIR DIV VAPOR CORP                      | 11-26-28-32-47                   |
| VARD INC                                    | 28                               |
| VARO MFG CO                                 | 39-44-45                         |
| VECTOR MFG CO SO HAMPTON                    | 5-31                             |

|   |  |
|---|--|
| VECTROL ENG DIV SPRAGUE ELEC CO             | 15-17-18-22-28-32-39-44-45                             |
| VEEDER ROOT INC ELECT CONTROLS DIV          | 5-18-22-24   |
| VENNER ELECTRONICS LTD                      | 5-33-48-49-50-52-54                                    |
| VERCO INC                                   | 39   |
| VICKERS INC ELECTRIC PRODUCTS DIV           | 15-17-24-28-33-39-40-44-45                             |
| VICTOREEN INSTRUMENT CO CLEVELAND           | 41-48  |
| VICTORY ENGG CO                             | 32   |
| VINSON ENGG & SALES CORP                    | 4-16-24-26-29-34                                       |
| VINSON MFG INC                              | 4-16-24-26-29-34                                       |
| VITRO LABORATORIES                          | 48-49-50-54  |
| VOCALINE CO OF AMERICA                      | 48-52-54   |
| VOLTRON PRODUCTS                            | 1-19-26-32   |
| WABASSO PRODUCTS INC                        | 32   |
| WABER ELECTRONICS INC                       | 1-3  |
| WAHLGREN MAGNETICS                          | 39-44-45   |
| WANG LABS INC                               | 5-18   |
| WARNER ELECTRIC BRAKE & CLUTCH CO           | 35   |
| WARNER & SWASEY CO                          | 18-24-34   |
| WARREN COMPONENTS DIV EL-TRONICS INC        | 14   |
| WARRICK CO CHARLES F                        | 16   |
| WASHINGTON TECHNOLOGICAL ASSOC INC          | 1-28-31-39-45-50                                       |
| WATLOW ELECTRIC MFG CO                      | 32   |
| WAVELABS INC                                | 1  |
| WEBER ELECT DIV                             | 31   |
| WEIGHING & CONTROL DIAGONAL TRANS-WIGH      | 14   |
| WELEX ELECTRONICS CORP                      | 1  |
| WELTRONIC CO                                | 5-9-12-13-15-18-24-25-27-32-35-39-40-44-45-48-49-52-54 |
| WEST COAST RESEARCH CORP                    | 28-30-32   |
| WEST INSTRUMENT CORP                        | 32   |
| WESTERN DIV PENN CONTROLS INC               | 32-47  |
| WESTGATE LAB INC                            | 26   |
| WESTINGHOUSE ELECTRIC CORP STANDARD CONTROL | 18-19  |
| WESTINGHOUSE ELECTRIC CORP TRANSFORMER DIV  | 45   |
| WESTMORE INC                                | 3-16-42  |
| WESTREX CO DIV OF LITTON SYS INC            | 49   |
| WHITE MFG CO                                | 32   |
| WIACKO ENG CO                               | 26-31  |
| WICKES ENGG & CONSTRUCTION CO               | 44-45  |
| WILCOLATOR CO                               | 32   |
| WILSON & CO G C                             | 35   |
| WINDSOR ELECTRONICS INC                     | 35-38-40-53  |
| WINSKO INSTRUMENTS & CONTROLS CO            | 32   |
| WINTERBURN MFG CO                           | 1-7-11-18-19-28-35                                     |
| WINTRONICS INC                              | 1-5-15-22  |
| WORNER ELECTRONIC DEVICES                   | 1-5-6-7-11-14-15-22-24-33                              |
| X RAY MFG CORP OF AMERICA                   | 50   |
| YARNALL WARING CO                           | 1-16   |
| YELLOW SPRINGS INSTRUMENT CO                | 32   |
| YORK RESEARCH CORP KIP ELECTRONICS DIV      | 42   |
| ZACHARIAS ELECTRONICS CORP                  | 14   |
| ZENITH ELECTRIC CO                          | 35   |
| ZOOMAR INC                                  | 6-22   |

## CRYSTALS, CRYSTAL PRODUCTS & ACCESSORIES 1600

|                                    |                |
|------------------------------------|----------------|
| Closures, crystal                  | 1              |
| Comparators, crystals              | 2              |
| Crystal blanks                     | 3              |
| Crystal cartridges                 | 4              |
| Crystal electrodes                 | 5              |
| Crystal heaters                    | 6              |
| Crystal mounts                     | 7              |
| Crystal ovens                      | 8              |
| Crystal sockets                    | 9              |
| Crystals, ADP                      | 10             |
| Crystals, barium titanate          | 11             |
| Crystals, communication            | 12             |
| Crystals, diode                    | 13             |
| Crystals, frequency control        | 14             |
| Crystals, galena                   | 15             |
| Crystals, germanium                | 16             |
| Crystals, mixers                   | 17             |
| Crystals, quartz                   | 18             |
| Crystals, raw                      | 19             |
| Crystals, rochelle salt            | 20             |
| Crystals, sapphire                 | 21             |
| Crystals, scintillation            | 22             |
| Crystals, silicon                  | 23             |
| Crystals, tourmaline               | 24             |
| Crystals, transducer               | 25             |
| HOLDERS, crystal                   | 26             |
| Probes, crystal                    | 27             |
| ACCURATE ELECTRONICS CORP ELYRIA   | 9              |
| ACOUSTICA ASSOCIATES               | 25             |
| AD-YU ELECTRONICS LAB INC          | 27             |
| AEROLITE ELECTRONICS CORP          | 25             |
| ALCAR INSTRUMENTS INC              | 26             |
| ALFRED ELECTRONICS                 | 26             |
| ALLEGHENY ELECTRONICS CHEMICALS CO | 15-16-23       |
| AMERICAN ELECT LABS INC            | 3-4-7-13-17-26 |

AMERICAN ELECT LARS MICROWAVE & PHASING 7-26  
 ANDERSON ELECTRONICS INC 26  
 ARRA RESEARCH ASSOCIATES 18  
 ASSOCIATED ELEC IND LTD ELEC APPARATUS DIV 7  
 ATLANTIC RESEARCH CORP 13-17  
 ATOMIC ACCESSORIES INC 27  
 AUGAT BROS 22  
 BAKER CHEMICAL CO J T 7-9-26  
 BARIUM CHEMICALS INC 19  
 BARNES DEVELOPMENT CO 11  
 BASSETT INC REY 3-12-14-18  
 BELZ INDUSTRIES DIV ELECTRONICS INC 7-17-26  
 BIRMINGHAM SOUND REPRODUCERS LTD 4  
 THE BIRCHER CORP INDUSTRIAL DIV 26  
 BILLEY ELECTRIC CO 6-12-14-18-25-26  
 BOMAC LABS INC 13  
 BORDEN CHEMICAL CO PHILA 26  
 BRAUN TOOL & INSTRUMENT CO INC 22  
 BRON LABS 3-14-18-19-26  
 BULOVA WATCH CO ELECT DIV 3-6-8-9-12-14  
 BURNETT RADIO LAB W W L 6-7-8-12-14-24  
 CANADIAN ASTATIC LTD 4  
 CARLSTEDT RESEARCH INC 23  
 CATHODION 1  
 CFI CORP 6  
 CHANNEL INDUSTRIES INC 11  
 CINCH MFG CO CINCH JONES DIV 9  
 CLARK CRYSTAL CO 3-8-14-18  
 CLEVITE ELECT COMPONENTS DIV CLEVITE 3-4-4  
 COLUMBIA RESEARCH LABS 10-11-20-25  
 CONSTANTIN CO L L 25  
 COX & CO 5-7-26  
 CROVEN LTD 8  
 CRYST TECH INC 8-12  
 DALLONS LABS 3-13-19  
 DAYTON ELECT PROD CO INC 3-25  
 DELTA F INC 7  
 DIAMOND ANTENNA & MICROWAVE CORP 8  
 DIOTRON INC 7-26-27  
 DOUGLAS MICROWAVE CO 13-17-23  
 DOW CORNING CORP 7  
 DX RADIO PRODUCTS CO 23  
 EASTERN CHEMICAL CORP 14-18  
 EBY SALES CO 22  
 EDO CANADA LTD 9  
 EDO CORP COLLEGE PT 10-11-14-18-25  
 EDISON ELECTRONIC CO 10-11-25  
 ELECTRA SCIENTIFIC CORP 3-14  
 ELECTRO CERAMICS INC SALT LAKE 25  
 ELECTRO FLEX HEAT INC 10-11-25  
 ELECTRONIC CRYSTALS CORP 6-8  
 ELECTRONIC CRYSTALS CORP 12-14-18  
 ELECTRONIC RESEARCH CO 8-14-18  
 ELECTRONIC TECHNOLOGY RESEARCH INC 7-26  
 ELION INSTRUMENTS INC 7-26  
 ELM MFG CO INC 10-25  
 EMI US LOS ANG 6-8-26  
 EMPRE DEVICES PRODUCTS CORP 22  
 ENDEVCO CORP 17  
 ENERGY CONVERSION INC 25  
 ENGELHARD INDUSTRIES INC 8  
 ERWOOD INC 13  
 FEN-TONE CORP 13  
 FRONTIER ELECT CO 8  
 F X R INC WOODSIDE 12-14-18  
 GARLOCK ELECTRONIC PRODUCTS PRODS PALMYRA 17  
 G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV 9  
 GENERAL CRYSTAL CO INC 27  
 GENERAL INSTRUMENT CORP NEWARK 3-14  
 GENERAL RADIO CO 11-26  
 GLASS-TITE INDUSTRIES INC 14  
 GRAYHILL MOLDRONICS INC 26  
 GREAT FALLS PRODUCTS CO INC 1  
 GREMAR MFG CO 7-26  
 GULFO MFG CO 7  
 GULTON INDUSTRIES INC METUCHEN 7-17-26-27  
 HARCROW CHEMICAL CO 11  
 HERMETIC SEAL CORP PASADENA 22  
 HEWLETT PACKARD CO 26  
 HOFFMAN CO P R 27  
 HOWARD CRYSTAL HOLDERS INC 3-18-19-25  
 HUGHES AIRCRAFT CO ELECT PROD DIV 1-5-7-9-26  
 HUGHES SEMICONDUCTORS DIV 13-14-16-17-23  
 HUNT CORP 3-6-8-14-18-25  
 INSACO INC 21  
 INTL CRYSTAL MFG CO INC 21  
 IRVAN FERROMAGNETICS CORP 12  
 ISOMET CORP 18-19-21  
 ISOTOPES INC 3-10-22-25  
 ITT FEDERAL LABS NUTLEY 3-10-22  
 JAVEY ELECTRONICS 11-13  
 JOHNSON CO F F 9  
 JONES ELECTRONIC CO INC M C 26  
 JONES OPTICAL WORKS A D 7-26  
 KAHLE ENGG CO 16-18-21-23  
 KEMET CO DIV UNION CARBIDE CORP 8  
 KEMTRON ELECTRON PRODUCTS INC 23  
 KEYSTONE ELECTRONICS CO NEWARK 16-23  
 KISTLER INSTRUMENT CORP 8-12-14-18  
 KNIGHTS CO JAMES 25  
 KOLLSTAN SEMICOND DIV KOLLSMN INST CORP 8-14-18  
 LAVOIE LABS INC 16-23  
 LEHIGH VALLEY ELECT ENGG & MFG CO 16-23  
 LFSA COSTRUZIONI ELETTROMECCANICHE SPA 8  
 LEWIS CO E B 6-8-10  
 MALLINCKRODT CHEMICAL WORKS ST LOUIS 4-20  
 MALLINCKRODT CHEMICAL WORKS 12-14-18-25  
 MANSON LABORATORIES INC 23  
 MASTER MOBILE MOUNTS INC 3-23  
 MCCOY ELECTRONICS INC 2-8  
 MCKENNA LABORATORIES 12-14-18  
 MFC & CO INC ELECTRONIC CHEM DIV 3-8-12-14-18  
 MFRIDIAN METALCRAFT INC 26-27  
 MICRO ELECTRIC INC 23  
 MICRO ELECTRIC INC 26

MICROMATIC MACHINF CORP 26  
 MICRO STATE ELECTRONICS CORP 13  
 MICROWAVE ASSOCIATES INC 13-17-23-26  
 MICROWAVE DEVELOPMENT LABS 26  
 MIDLAND MFG CO 12-18  
 MILLER MFG CO JAMES 9-10  
 MINNEAPOLIS-HONEYWELL CERAMIC LAB 11-25  
 MINNEAPOLIS-HONEYWELL ORDANCE DIV 11-16-18  
 MONITOR PRODUCTS CO INC 3-8-14-18  
 MONTRONICS INC 2  
 MOTOROLA INC SOLID STATE SYSTEMS DIV 14  
 MUNSTON ELECTRONIC MFG CORP 9-12  
 NATL RADIO CO INC 8-9  
 NIPPERT ELECTRIC PRODUCTS CO 7  
 NORRICH PLASTICS CORP 3  
 NORTHEASTERN ENG INC 8  
 NORTHERN ENGG LABS 1-8-12-14-18  
 NUCLEAR ENTERPRISES G B LTD 22  
 NUGENT ELECT CO INC 9  
 OLYMPIC PRODUCTS CO INC 1  
 OPTECH INC 21  
 OVENAIRE INC 6-8  
 PAN-ELECTRONICS CORP 14  
 PEARCE SIMPSON INC MARINE & COMM DIVISION 12  
 PHILMORE MFG CO INC 13-15  
 PIFZO CRYSTAL CO 3-6-8-12-14-18-25  
 PILOT CHEMICALS INC 22  
 PRD ELECTRONICS INC 7-27  
 PRECISION CRYSTAL LAB 3-8-14-25  
 PREMIER METAL PRODUCTS CO 3-6-8-14-18-24-25  
 PREMIER RESEARCH LABS INC 3-6-8-14-18-24-25  
 PROSCOPE CO INC 17  
 QUANTARON INC 7-26  
 RADAR MEASUREMENTS CORP 7-26  
 RADIATION COUNTER LABS INC 26-27  
 RADIATION INSTRUMENT DEVELOPMENT LAB INC 22  
 RAU FASTENER CO 26  
 RAYTHEON CO SEMICOND DIV 13-17  
 REEVES HOFFMAN DIV 3-8-12-14-18-25  
 REPUBLIC LENS CO 3-16-18  
 ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA 11-16-22-23-24  
 SAGE LABORATORIES INC 17-26  
 SANDERS ASSOCIATES 26  
 SAVOY ELECTRONICS INC GRIFFIN 3-12-14-25  
 SAVOY ELECTRONICS INC FT LAUDERDALE 3-12-14-18  
 SCIENTIFIC ATLANTA INC 7  
 SCIENTIFIC ELECTRONIC LABS INC 1  
 SCIENTIFIC RADIO PRODS INC 12-14-18  
 SCIENTIFIC RADIO SERVICE 11-14  
 SEAL-A-METIC CO DIV OF FILTERS INC 7-26  
 SEALECTRO CORP 26  
 SECO ELECTRONICS INC 27  
 SEMI-ALLOYS INC 3-19  
 SEMI ELEMENTS INC 1-3-5-7-10-11-12-13-14-15-16-18-19-20-21-22-23-24-25  
 SEMIMETALS INC 16-23  
 SHEROLD CRYSTALS INC 3-6-7-8-12-14-18  
 SKYRON CORPORATION 7-8  
 SMITH INC HERMAN H 9-12  
 SPERRY MICROWAVE ELECT INC 7  
 STAYER CO 1-7  
 SULLIVAN INDUSTRIES INC 3-18-26  
 SYLVANIA ELECT PRODS CHEM & METALLURG DIV 16-23  
 SYNCOR PRODUCTS CO 18-21  
 SYSTEMS INC 12-14-18  
 TECHNICAL DYNAMICS DIV JAMIESON IND INC 25  
 TELEDYNE PRECISION INC 8-12  
 TEXAS CRYSTALS 3-9-12-14-18-26  
 THERMAL AMERICAN FUSED QUARTZ CO 18  
 TRANCOA CHEMICAL CORP 23  
 TRAN SONICS 25  
 TRU CONNECTOR CORP 26  
 UNI SEAL INC 26  
 UNIVERSAL DYNAMICS CORP 11-25  
 VACUUM ELECTRONICS CORP 14  
 VALPEY CRYSTAL CORP 3-8-14-25  
 VERITRON WEST INC 1-7-26  
 VICTOREEN INSTRUMENT CO CLEVELAND 22  
 WALDOM ELECTRONICS INC 9  
 WALTHAM ELECTRONICS CORP 8  
 WARREN COMPONENTS DIV EL-TRONICS INC 7-13-26  
 WAVELINE INC 7-17-25-26-27  
 WEINSCHEL ENGG 7  
 WESTERN SEMICONDUCTORS INC 13-17-19-23  
 WRIGHT ELECTRONICS INC 8-14-18  
 X TRON ELECT INC 3-12-14-25

DETECTORS 1700

Detectors, current . . . . . 1  
 Detectors, fire . . . . . 2  
 Detectors, flaw . . . . . 3  
 Detectors, frequency . . . . . 4  
 Detectors, gas . . . . . 5  
 Detectors, infrared . . . . . 6  
 Detectors, intrusion . . . . . 7  
 Detectors, leak . . . . . 8  
 Detectors, lie . . . . . 9  
 Detectors, light intensity . . . . . 10  
 Detectors, magnetic . . . . . 11  
 Detectors, metal . . . . . 12  
 Detectors, mineral . . . . . 13

Detectors, phase . . . . . 14  
 Detectors, radiation . . . . . 15  
 Detectors, scintillation . . . . . 16  
 Detectors, smoke . . . . . 17  
 Detectors, standing wave . . . . . 18  
 Detectors, ultrasonic . . . . . 19  
 Detectors, vibration . . . . . 20  
 Detectors, voltage . . . . . 21

ACCESSORY CONTROLS EQUIPMENT 8  
 ACCUTRONICS INC 14-21  
 ACF ELECTRONICS DIV ACF INDUSTRIES INC 6  
 ACOUSTICA ASSOCIATES 19  
 ACR ELECTRONICS CORP 6  
 ACROMAG INC 4  
 AC SPARK PLUG ELECT DIV GMC 4  
 AC SPARK PLUG ELECT DIV GMC 14  
 ADVANCED ELECTRONICS INC 20  
 ADVANCED KINETICS INC 6  
 AD-YU ELECTRONICS LAB INC 14  
 AEROJET-GENERAL NUCLEONICS 15-16  
 AEROSPACE ELECTRONICS INC 4-15-16  
 ALCAR INSTRUMENTS INC 3-19  
 ALFORD MFG CO 18-21  
 AMERICAN AEROSPACE CONTROLS INC 6-11  
 AMERICAN DISTRICT TELEGRAPH CO 2-7-17-19-20  
 AMERICAN ELECT LABS INC 4-15-16  
 AMERICAN ELECTRONICS CO MINN 14-21  
 AMERICAN INSTRUMENT CO 5-6  
 AMERICAN RESEARCH & MFG CORP 11-20  
 AMERICAN SPACE EXPLORATION INC 11  
 AMPEREX ELECTRONIC CORP HICKSVILLE 15  
 ANADIX INSTRUMENT S INC 4-21  
 ANALYTIC SYSTEMS CO 5  
 ANCO INSTR DIV AMER NAME PLANE & MFG CO 20  
 ANTENNA SYSTEMS INC 18-21  
 ANTON ELECTRONICS LABS 15-21  
 APPLIED PHYSICS CORP 15-21  
 ARRA RESEARCH ASSOCIATES 4  
 ASSEMBLY PRODUCTS INC 3-11-21  
 ASSOCIATED ELECTRICAL INDUSTRIES LTD 7-8  
 ASSOCIATED ELECTRICAL INDUSTRIES LTD 17-18  
 ASSOCIATED RESEARCH INC 9  
 ASTRO SYSTEMS INC 14  
 ATELIERS DE MONTAGES ELECT 15-16  
 ATLANTIC RESEARCH CORP 19  
 ATOMIC ACCESSORIES INC 15-16  
 ATOMIC LABS INC 15  
 ATOMIUM CORP 16  
 AUTHORIZED MFRS SERVICE CO 21  
 AUTOMATION DEVICES INC 12  
 AUTOMATION PRODUCTS INC 5  
 AUTRONICS CORP 10  
 AVIONICS INC 12  
 BAIRD ATOMIC INC 6-16  
 BARBER-COLMAN CO 15  
 BARKER & WILLIAMSON INC 18  
 BARNES ENGINEERING CO 6  
 BEARING INSPECTION INC 3-20  
 BECKMAN INST SPINCO DIV 6  
 BERKELEY DYNAMICS 5-8-14  
 BERMAN LABS 12  
 BINARY ELECTRONICS INC 21  
 BIOPHYSICAL INSTRUMENTS INC 10  
 BLACK LIGHT EASTERN CORP 3-8-13  
 BLOCK ASSOC 6-10  
 BORDEN CHEMICAL CO PHILA 16  
 BRAMCO INC SUB LEDEX INC 3  
 BRANSON INSTRUMENTS INC 4  
 BRILMAYER LAB E W 12  
 BRUNO NEW YORK INDUST CORP 21  
 BUDD ELECTRONICS A DIV OF THE BUDD CO 7  
 RUELHMAN ELECTRONICS CORP 14  
 CALIF TECHNICAL INDUST DIV TEXTRON INC 5-14  
 CAMBRIDGE INSTRUMENT CO INC 15  
 CANADIAN RESEARCH INSTITUTE 1-9-10-21  
 CANOGA ELECT CORP 6  
 CARDOX DIV CHEMETRON CORP 17  
 CARLETON AVIATION CO INC 2  
 CASTLE ENGINEERING CO 2  
 CENTROL ENG CO 1-6-21  
 CERAMCO INC CHEMISTS 2-17  
 CERBERUS AG WERK ELEKTRONENTECHNIK 2-7-17  
 CHESAPEAKE INSTRUMENT CORP 19-20  
 CHICAGO AERIAL INDUSTRIES 6-10  
 CLEVELAND METAL SPECIALTIES CO 21  
 CLEVITE ELECT COMPONENTS DIV CLEVITE 20  
 CLEVITE ORDANCE DIV CLEVITE CORP 19  
 COLORADO RESEARCH CORP 2  
 COMPACT CONTROLS CO INC 2  
 CONSOLIDATED CONTROLS CORP 11  
 CONSOLIDATED ELECT CORP 8  
 CONSOLIDATED VACUUM CORP 8  
 CONTINENTAL SENSING INC 2  
 CONTROL PRODUCTS INC 2  
 CONTROL TECHNOLOGY CO 21  
 CONTROLS FOR RADIATION INC 15  
 CRESCENT EAST ENGR & RES CO 11-12  
 DATA CONTROL SYSTEMS INC 4  
 DAYSTROM INC CONTROL SYSTEMS DIV 1-21  
 DAYTON ELECT PROD CO INC 18  
 DECKER CORP 20  
 DEITZ CO S J 10  
 DEL ELECTRONICS CORP 5  
 DELCON CORP 19  
 DEMORNAY BONARDI CORP 18  
 DE-TEC-TRONIC CORP 17  
 DFVCO ENGG INC 5-8  
 DEVELCO INC 4-14  
 DEVICE SEALS INC 21  
 DICE CO J W 3-12  
 DIETZ CO S J 10



# PRODUCTS & MANUFACTURERS

|  |                    |
|--|--------------------|
| DON BOSCO ELECT SUB OF HOWELL ELECT MOTORSC6 | 20                 |
| DOUGLAS MICROWAVE CO                         | 18                 |
| DUBROW ELECTRONIC INDUSTRIES INC             | 11                 |
| DYNALECTRON CORP MATTERN DIV                 | 15-20              |
| DYNAMONICS CORPORATION                       | 19                 |
| EBERLINE INSTRUMENT CORP                     | 15                 |
| EDGERTON GERMESHAUSEN & GRIER INC GOLETA     | 15                 |
| EDGERTON GERMESHAUSEN & GRIER BOSTON         | 10-16              |
| EDISON INDUST THOMAS A INST DIV              | 2                  |
| EGAN LABORATORY                              | 6-15               |
| ELECTRO-MEDICAL LAB INC                      | 9                  |
| THE ELECTRO NUCLEAR SYS CORP                 | 15                 |
| ELECTRO PHYSICS CO                           | 10                 |
| ELECTRO PROD LABS INC                        | 12                 |
| ELECTRO RADIATION INC                        | 5-6-10-11-15       |
| ELECTRO SCIENTIFIC IND INC                   | 14-21              |
| ELECTRO SEAL CORP                            | 7                  |
| ELECTRO-SECURITY CORP                        | 7                  |
| ELECTRON OHIO INC                            | 3-11-12            |
| ELECTRONIC CONTROL CORP                      | 7-17               |
| ELECTRONIC COUNTERS INC                      | 6                  |
| ELECTRONIC MECHANICAL PROD CO                | 10                 |
| ELECTRONIC PRODUCTS CO DIV VICTOREEN         | 15                 |
| ELECTRONICS CORP OF AMER ONTARIO             | 17                 |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 4                  |
| ELION INSTRUMENTS INC                        | 3-8-12-16-19       |
| ENDEVCO CORP                                 | 20                 |
| ENGELHARD INDUSTRIES INC                     | 2-5                |
| ENTRON INC                                   | 4                  |
| ENY CORP                                     | 15                 |
| EPPLEY LAB INC                               | 6                  |
| EROCO ENGG CORP                              | 5                  |
| ERIE RESISTOR CORP                           | 15                 |
| ERWOOD INC                                   | 20                 |
| ESPEY MFG & ELECTRONICS CORP                 | 1-11-21            |
| FARRAND OPTICAL CO INC                       | 5-6                |
| FEDERAL LAB INC                              | 12                 |
| FEDERAL MFG & ENGG CORP                      | 15                 |
| FENWAL INC                                   | 2-6                |
| FIRE CONTROL CO INC                          | 2                  |
| FISHER RESEARCH LAB                          | 8-12-15            |
| FLAME RESEARCH INC                           | 6                  |
| FRANKLIN SYSTEMS INC                         | 16                 |
| FRONTIER ELECT CO                            | 4                  |
| F Y R INC WOODSIDE                           | 18-21              |
| FYR-FYTER ELECTRONIC & ALARM CORP            | 17                 |
| GARDINER ELECTRONIC CO                       | 12-13-16           |
| GARDNER LAB INC                              | 10                 |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV  | 1                  |
| GELMAN INSTRUMENT CO                         | 5-17               |
| GENERAL ATRONICS CORP ATRONIC PROD DIV       | 3                  |
| GENERAL CONTROLS CO IRON MOUNTAIN DIV        | 2                  |
| GENERAL ELECTRIC CO ATOM POWER EQUIP         | 15-16              |
| NUCLEAR ELECTRONIC PRODS SECT                | 5                  |
| GENERAL ELECTRIC CO UTICA                    | 5                  |
| GENERAL ELECTRIC CO SPECIALTY CONTROL DEPT   | 15-17              |
| GENERAL MICROWAVE CORP                       | 4-18               |
| GENERAL RADIO CO                             | 21                 |
| GENERAL RAILWAY SIGNAL CO                    | 6-19               |
| GENERAL SCIENTIFIC EQUIP CO                  | 5                  |
| GENERAL TIME CORP ELECTR SYS DIV             | 4                  |
| GEOTECHNICAL CORP                            | 20                 |
| GERTSCH PRODUCTS INC                         | 14                 |
| G M MFG CO                                   | 10-15              |
| GOW MAC INSTRUMENT CO                        | 5-8                |
| GREENBRIER INSTRUMENTS INC                   | 5                  |
| GUIDE MFG CO                                 | 4-18-21            |
| GULTON INDUSTRIES INC METUCHEN               | 4-19-20            |
| HALLICRAFTERS CO CHICAGO                     | 6                  |
| HAMNER ELECTRONICS CO INC                    | 15-16              |
| HARSHAW CHEMICAL CO                          | 15-16              |
| HARTMAN ELECTRICAL MFG CO                    | 1-4-14-21          |
| HARWALD CO INC                               | 3                  |
| HARWORTH MFG CO                              | 12                 |
| HAYS CORP                                    | 5                  |
| HEATH CO SUB OF DAYSTROM INC ST JOS          | 5-15               |
| HEATH CO DIV OF DAYSTROM INC B HARBOR        | 5                  |
| HEWLETT PACKARD CO                           | 18-21              |
| HILL & CO E VERNON                           | 8-20               |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 15                 |
| 3761 S HILL ST                               | 4-6-10-11-14-15-16 |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 15                 |
| 2621 S HILL ST                               | 15                 |
| HP ASSOCIATES AFF HEWLETT PACKARD            | 10                 |
| HYCON MFG CO                                 | 10                 |
| HYSON MFG CO PASADENA                        | 7-10               |
| IDEAL INDUSTRIES INC SYCAMORE                | 21                 |
| IMPERIAL ELECT INC                           | 2                  |
| INDIANA STEEL PRODUCTS DIV IND GEN CORP      | 12                 |
| INDIKON CO                                   | 20                 |
| INDUSTRIAL ELECTRONIC HARDWARE CORP          | 15                 |
| INDUSTRIAL TEST EQUIPMENT CO                 | 14                 |
| INDUSTRIAL TRANSFORMER CORP                  | 4-5-6-7-9          |
| INOUSTRONICS CONTROLS INC                    | 11-20              |
| INERTIA SWITCH INC                           | 20                 |
| INFRARED INDUSTRIES INC WESTERN DIV          | 7                  |
| INSTRUMENT CORP OF FLA                       | 14                 |
| INTERNATIONAL OATA SYSTEMS INC               | 21                 |
| INTERNATIONAL RESEARCH & DEVELOPMENT CORP    | 20                 |
| IRCO CORP                                    | 6                  |
| IRCON INFRARED CONTROLS INC                  | 6                  |
| ISOMET CORP                                  | 16                 |
| ISOTOPIES INC                                | 15-16              |
| I TEL INC                                    | 18                 |
| JERROLD ELECTRONICS CORP                     | 21                 |
| JOHNSON WILLIAMS INC                         | 5                  |
| JONES ELECTRONIC CO INC M C                  | 18                 |
| KAHN & CO                                    | 20                 |
| KEITHLEY INSTRUMENTS INC                     | 21                 |
| KELL STROM TOOL CO INC ELECT DIV             | 4                  |
| KIDOE & CO WALTER                            | 2-7-17             |
| KINETICS CORP                                | 21                 |
| KOLLSMAN INST CORP STO KOLLSMAN IND INC      | 6-8-10             |

|   |                        |
|---|------------------------|
| KOLLSMAN INSTRUMENT CORP                    |                        |
| SUB STANOARD KOLLSMAN IND                   | 6-8-10                 |
| LAKE SHORE ELECTRIC CORP                    | 21                     |
| LANO AIR INSTRUMENT & ELECT DIV             | 15-16                  |
| LANDSVERK ELECTROMETER CO                   | 15-16                  |
| LEAR SIEGLER INC ELECT INST DIV             | 21                     |
| LEE ELECTRIC INC                            | 2                      |
| LEEDS & NORTHRUP CO                         | 1-21                   |
| LEHIGH VALLEY FLECT ENGG & MFG CO           | 20                     |
| LEYGHTON-PAIGE CORP                         | 17                     |
| LIBRASCOPE DIV GENERAL PRECISION INC        | 6                      |
| LINK DIV GENERAL PRECISION INC              | 14                     |
| LIONEL CORP LIONEL ELECTRONIC LABS DIV      | 15                     |
| LIQUIDOMETER CORP                           | 14                     |
| LOENCO INC                                  | 5                      |
| LUCCI AIRCRAFT INC                          | 0                      |
| LUMEN INC                                   | 4-11-12-14-21          |
| MAGNAFLUX CORP                              | 3-8-11-12-19           |
| MAGNETICS INC                               | 1-21                   |
| MALLORY ELECT CO                            | 1-14-21                |
| MANSON LABORATORIES INC                     | 14                     |
| MARINE ELECTRIC CORP                        | 1                      |
| MARQUETTE DIV CURTISS-WRIGHT CORP           | 4                      |
| MASER OPTICS INC                            | 10                     |
| MATTERN CORPORATION                         | 1                      |
| MAXSON INSTRUMENTS                          |                        |
| DIV MAXSON ELECTRONICS CORP                 | 14                     |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV  | 14                     |
| MAYTAG ELECTRONICS INC                      | 7                      |
| MCGRAW EDISON PRIMARY BATTERY DIV           | 2                      |
| MCKENNA LABORATORIES                        | 19                     |
| MEASUREMENT ENGG LTD                        | 15-16-17               |
| MFAUREMENT SYSTEMS INC                      | 6-10-17                |
| MERIDIAN METALCRAFT INC                     | 14                     |
| MET-L-CHEK CO THE                           | 3                      |
| METROTEK ELECTRONICS INC                    | 15                     |
| MICRONETICS INC                             | 18                     |
| MIDWESTERN INSTRUMENTS                      | 4                      |
| MILLETRON INC                               | 2                      |
| MINATRON CORP                               | 12-20                  |
| MINE SAFETY APPLIANCES CO                   | 5-6-8                  |
| MINNEAPOLIS-HONEYWELL HEILAND DIV           | 6                      |
| MINNEAPOLIS-HONEYWELL AERO DIV              | 2-4-6-8-10-11-15-17-21 |
| MKS INSTRUMENTS INC                         | 8                      |
| MONTRONICS INC                              | 4-14                   |
| MOSLER RESEARCH PROD INC                    | 7                      |
| NATL RADIANC                                | 15-16                  |
| NEWARK CONTROLS CO                          | 5-8                    |
| NORTH ATLANTIC INDUST INC                   | 1-4-11-21              |
| NORTHEASTERN ENG INC                        | 15                     |
| NORTHERN RADIO CO                           | 4                      |
| NORTHRUP CORP                               | 15-16                  |
| NUCLEAR-CHICAGO CORP                        | 15-16                  |
| NUCLEAR CORP OF AMER DENVER                 | 15-16                  |
| NUCLEAR OEOPELMENT LAB INC                  | 13                     |
| NUCLEAR-ELECTRONICS CORP                    | 15-16                  |
| NUCLEAR ENTERPRISES G B LTO                 | 16                     |
| NUCLEAR MEASUREMENTS CORP                   | 15-16                  |
| NUCLEONIC CORP OF AMERICA                   | 13-15-16               |
| NUCLIDE ANALYSIS ASSOC                      | 1-8-11-21              |
| OHIO CHEMICAL & SURGICAL EQUIPMENT CO       | 5-8                    |
| OHIO SEMICONDUCTORS                         |                        |
| OIV TECUMSEN PRODS CO                       | 6-11                   |
| OMCO  | 15                     |
| OMNI SPECTRA INC                            | 18                     |
| ONEIDA ELECTRONICS INC                      | 1-4-14                 |
| OPTO ELECTRONIC DEVICES INC                 | 10                     |
| OPTO ELECTRONIC DEVICES INC                 | 6                      |
| OPTRON CORP                                 | 4-14-20                |
| ORION ELECTRONICS CORP                      | 1-4-14-21              |
| PACIFIC TRANSDUCER CORP                     | 15                     |
| THE PAVELLE CORP                            | 10                     |
| PERKIN ELMER CORP                           | 6-8                    |
| PERKIN-ELMER CORP SO WILTON PL              | 6-8                    |
| PHILCO CORP G & I DIV                       | 6                      |
| PHILCO CORP LANSOALE DIV                    | 6                      |
| PHILIPS ELECTRONIC INSTRUMENTS              | 16-20                  |
| PHOENIX PRECISION INSTRUMENT CO             | 8-17                   |
| PHOTOMATION INC                             | 17                     |
| PHOTOBELL CO                                | 3-6-10-17              |
| PHOTO - CRYSTALS                            | 2                      |
| PIASECKI AIRCRAFT CORP MAYFIELD ELECT OIV   | 15-16                  |
| PICKARD & BURNS INC SUB GORHAM CORP         | 4                      |
| PILOT CHEMICALS INC                         | 15-16                  |
| POOLE INSTRUMENTS INC                       | 8                      |
| POWEROYNE DIVISION                          | 15                     |
| POWERTON ULTRASONICS CORP                   | 8-19                   |
| PRO ELECTRONICS INC                         | 18                     |
| PRECISION RADIATION INSTRUMENTS INC         | 15-16                  |
| PRINCETON APPLIED RESEARCH CORP             | 14                     |
| PRINCETON DIV ELECTRO MECHANICAL RESCH INC  | 12                     |
| PROBESCOPE CO INC                           | 4-19-20                |
| QUANTAMETRIC DEVICES INC                    | 17                     |
| RADAR MEASUREMENTS CORP                     | 15-18                  |
| RAOATRON INC                                | 7                      |
| RAOIAPHONE CO                               | 14                     |
| RADIATION COUNTER LABS INC                  | 15                     |
| RAOIATION ELECT CO OIV COMPOMETER CORP      | 6                      |
| RAOIATION INSTRUMENT OEOPELMENT LAB INC     | 15-16                  |
| RADIO CORP OF AMER OETROIT                  | 12                     |
| RCA BRDCT & COMM PRODS OIV CAMOEN           | 3-12                   |
| RCA BRDCT & COMM PRODS DIV MEADOW LANOS     | 3-                     |
|   | 13                     |
| RADIO FREQUENCY LABS INC                    | 11                     |
| RAMSEY ENG CO                               | 11                     |
| RAWSON ELECTRICAL INSTRUMENT CO             | 11                     |
| RAYTHEON CO MICROWAVE & POWER TUBE DIVISION | 6                      |
| REEDER & CO CHARLES M                       | 6                      |
| REGENT CONTROLS INC                         | 11-12-21               |
| REPUBLIC ELECT INDUST CORP                  | 15                     |
| RESEARCH MFG CORP                           | 19                     |
| REUTER STOKES ELECT COMPONENTS              | 15                     |
| RFS ENGINEERING CO                          | 21                     |
| RICH ELECTRONICS INC                        | 19                     |

# Detectors • Dials & Front Panel Accessories

|  |                 |
|--|-----------------|
| ROBERTSHAW-FULTON CONTROLS CO                | 20              |
| ROCHFESTER INSTRUMENT SYS INC                | 8               |
| ROHDE & SCHWARZ                              | 18-20-21        |
| ROWE INDUSTRIES                              | 11              |
| SARASOTA ENGG CO INC                         | 12              |
| SCAICO CONTROLS INC                          | 2               |
| SCHIRMER-NATIONAL ALARM CORP                 | 2-7-17-19       |
| SCHLIEBUS ELECTRONIC INSTRUMENT OC           | 15              |
| SCOTT INC H H                                | 20              |
| SECTRON INC                                  | 1-14-21         |
| SECURITY DEVICES LAB                         | 4               |
| SEMI ELEMENTS INC                            | 6-15-16         |
| SEMITRONICS INC                              | 6               |
| SENSORY INC                                  | 12              |
| SERVO CORP OF AMERICA                        | 2-3-6           |
| SIGMA INSTRUMENTS INC                        | 1-4-10-11-14-21 |
| SINGER METRICS DOV SINGER MFG CO             | 11              |
| SIVERS LAB                                   | 18              |
| SMITH-FLORENCE INC                           | 3               |
| SOLID STATE ELECTRONICS CO                   | 4               |
| SPACE INSTRUMENTATION CORP                   | 4-11-12         |
| SPASORS INC SUB SILICON TRANSISTOR           | 7-14            |
| SPECIALTIES INC CHARLOTTEVILLE               | 10              |
| SPECTROLAB OIV TEXTRON ELECTRONICS INC       | 10              |
| SPERRY MICROWAVE ELECT INC                   | 18              |
| SPERRY PRODUCTS CO DIV HOWE SOUND CO         | 3-11-           |
|  | 19              |
| ST JOHN X-RAY LABORATORY                     | 15              |
| STATES ELECTRONICS CORP BLUDWORTH MARINE DIV | 12              |
| STEARNS MAGNETIC PRODUCTS                    | 11-12           |
| STOELTING CO C H                             | 9               |
| SUMMERS & MILLS INC                          | 19              |
| SUNDSTRAND DENVER                            | 4-11            |
| SUNSHINE SCIENTIFIC INSTRUMENT               | 3-5-8-12        |
| SWEENEY MFG CO B K                           | 1-21            |
| SYLVANIA ELECTRIC PRODS INC WALTHAM LABS     | 14              |
| SYSTEMS MATRIX INC                           | 6               |
| TE CO THE                                    | 7               |
| TECHNICAL ASSOCIATES BURBANK                 | 15-16           |
| TECHNICAL DEVELOPMENT CO                     | 11-12           |
| TECHNICAL MEASUREMENT CORP                   | 15-16-21        |
| TELECHROME MFG CORP                          | 4-15-16         |
| TELONIC INDUSTRIES INC                       | 4               |
| TEXAS INSTRUMENTS INC APPARATUS DIV          | 6-11            |
| THERMOMETICS INC                             | 2               |
| THETA INSTRUMENT CORP                        | 14              |
| TRACERLAB INC RICHMOND                       | 15              |
| TRANSMAGNETICS INC                           | 1               |
| TRAN SONICS                                  | 8               |
| TRICONIX INC                                 | 15              |
| TRIO LABS INC                                | 21              |
| TROXLER ELECTRONICS LAB INC                  | 4-15-16         |
| ULMER CO THE OIV MICROTRON INDUSTRIES INC    | 8               |
| ULTEK CORP                                   | 8               |
| UNITED ELECTRIC CONTROLS CO                  | 2-8             |
| UNITED ELECTRODYNAMICS                       | 20              |
| UNIVERSAL TRANSISTOR PROD CORP               | 15              |
| VACUUM ELECTRONICS CORP                      | 8               |
| VARO MFG CO                                  | 4-6             |
| VERCO INC                                    | 4-14-21         |
| VIBRATION ENGINEERING PLANT                  | 20              |
| VICKERS INC ELECTRIC PRODUCTS DIV            | 4-11-21         |
| VICTOREEN INSTRUMENT CO CLEVELAND            | 15-16           |
| VICTORY ENGG CO                              | 1-2-4-5         |
| VITRO LABORATORIES                           | 4               |
| THE WATERS CORP                              | 10              |
| WAVELABS INC                                 | 20              |
| WAVELINE INC                                 | 4-18            |
| WFLEX ELECTRONICS CORP                       | 7               |
| WESTINGHOUSE ELEC CORP ASTROELECTRONICS OEPY | 10              |
| WESTINGHOUSE ELECTRIC CO OIV AIR ARM OIV     | 6               |
| WINDSOR ELECTRONICS INC                      | 5-8             |
| WINTRONICS INC                               | 1-7-10-14-21    |
| N WOOD COUNTER LAB INC                       | 15-16           |
| WORNER ELECTRONIC OEVICES                    | 2-6-7-17        |
| ZIMNEY CORP                                  | 10-15-16        |

## DIALS & FRONT PANEL ACCESSORIES 1800

|                      |    |
|----------------------|----|
| Belts                | 1  |
| Bezels               | 2  |
| Cords, dial          | 3  |
| Decalcomanias        | 4  |
| Dials, instrument    | 5  |
| Dials, precision     | 6  |
| Dials, telephone     | 7  |
| Dials, turn counting | 8  |
| Escutcheon           | 9  |
| Faceplates           | 10 |
| Faceplates, TV       | 11 |
| Knobs, metal         | 12 |
| Knobs, non-metal     | 13 |
| Lights, dial         | 14 |
| Lights, indicator    | 15 |
| Lights, miniature    | 16 |
| Lights, panel        | 17 |
| Locks, dial          | 18 |
| Locks, shaft         | 19 |
| Luminous markers     | 20 |
| Nameplates           | 21 |
| Pointers, dial       | 22 |
| Rubbers, drive       | 23 |



DIALS AND FRONT PANEL ACCESSORIES--1800

(SEE PRODUCT CODE LIST  
ON PRECEDING PAGE)

|   |                        |
|---|------------------------|
| ACKERMAN ENGRAVERS                          | 5-6-12                 |
| ACROMARK CO                                 | 5-10-21                |
| ADCOM CORP                                  | 11                     |
| ADEPT INDUSTRIES INC                        | 4-21                   |
| AEROLITE ELECTRONICS CORP                   | 14-15-16-17            |
| AERONAUTICAL ELECT CO                       | 14-15-16-17            |
| AIRCRAFT & ELECT SPEC                       | 21                     |
| ALDEN PRODUCTS CO                           | 13-14-15-16-17-21      |
| ALDEN SYSTEMS CO                            | 15                     |
| ALLIAD DECALS INC                           | 4-21                   |
| AMALFID ELECTRONIC HARDWARE CO INC          | 2-12-13-18-19          |
| AMERAC INC                                  | 2                      |
| AMERICAN CYSTOSCOPE MAKERS INC              | 16                     |
| AMERICAN DECALCOMANIA CO                    | 21                     |
| AMERICAN EMBLEM CO                          | 21                     |
| ANCO INSTR DIV AMER NAME PLANE & MFG CO     | 2-5-9-10-21            |
| ANDERSON & SONS INC                         | 2-5-6-8-9-10-11-21-22  |
| ANDOYNE INC                                 | 9-10-11-21             |
| APAMOUSE CORP OF N E                        | 5-6-21                 |
| APPROVED PLASTICS CO                        | 13                     |
| ARCH GEAR WORKS INC                         | 5-6-21-22              |
| ARCON ELECTRONICS DIV OF ARCON INDUST       | 8-18                   |
| ARISTO CRAFT DISTINCTIVE MINIATURES         | 14-15-16-17            |
| ASQUITH CO S A                              | 6                      |
| ASSOCIATED PRODUCTION CO                    | 12                     |
| ASTROMATIC DIV CONTROL CO OF AMER           | 5-6-14-15-17           |
| AUBURN MFG CO                               | 23                     |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC         | 13                     |
| AUTOMATIC ELECTRIC CO                       | 7                      |
| AVIONICS LTD                                | 4-5-21                 |
| BACH-SIMPSON LTD                            | 5                      |
| BARBER & HOWARD CO                          | 2-5-6-20-21            |
| BEAU ELECTRONICS INC                        | 12-18                  |
| BEST MFG CO KANSAS CITY                     | 10-21                  |
| BEVIN WILCOX LINE CO                        | 3                      |
| BIRMA MFG CO INC                            | 2                      |
| BIRMINGHAM SOUND REPRODUCERS LTD            | 9-13                   |
| BOLTA PRODUCTS DIV GENERAL TIRE & RUBBER CO | 13                     |
| BORG EQUIP DIV AMPHENOL BORG ELECT CORP     | 5-6-8-4-21             |
| BRADY CO W H                                | 6                      |
| BRITISH RADIO ELECTRONICS LTD               | 6                      |
| BRUNSWICK INSTRUMENTS                       | 15                     |
| BUCKBEE MEARS CO                            | 21                     |
| BUD RADIO INC                               | 18                     |
| CANADIAN RADIUM URANIUM DV CANRAD PRES IND  | 5-6-10-20-21-22        |
| CARMA MANUFACTURING CO                      | 17                     |
| CARROLL PRESSED METAL INC                   | 2-5                    |
| C&H SUPPLY                                  | 9-10-21                |
| CHICAGO MINIATURE LAMP WORKS                | 14-15-16-17            |
| CHICAGO THRIFT ETCHING                      | 5-6-9-21               |
| CHICOPEE MILLS                              | 8                      |
| CIRCON COMPONENTS CORP                      | 14-15-16               |
| CK COMPONENTS INC                           | 15                     |
| CLEVELAND METAL SPEC CO                     | 21                     |
| CLEVELAND METAL SPECIALTIES CO              | 21                     |
| COLMAN ELECTRONIC PRODUCTS INC              | 3-13                   |
| CONN-CRAFT CO                               | 21                     |
| CONSOLIDATED MOLDED PRODUCTS CORP           | 6-7-9-10-13-14-21      |
| CONTROL DEVICES                             | 9-21                   |
| CONTROL SWITCH DIV CONTROLS AMER CHICAGO    | 14-15-16-17            |
| CRONAME INC                                 | 2-5-6-8-9-10-11-21     |
| CRYSTAL-X CORP                              | 21                     |
| DAISLEY CO INC RAY                          | 10                     |
| DALE ELECTRONICS INC COLUMBUS               | 12-13                  |
| DAVIES MOLDING CO HARRY                     | 5-13                   |
| DECIMETER PRODUCTS CO                       | 4                      |
| DELTA ELECT CO                              | 2-13-15                |
| DEMENT LABS                                 | 20                     |
| DEVCO ENGG INC                              | 5-10-14-15-16-17-20-21 |
| DIALIGHT CORP                               | 14-15-16-17            |
| DIETZ CO HENRY G INC                        | 21                     |
| DIMCO-GRAY CO                               | 13                     |
| DRAKE MFG CO                                | 2-9-14-15-16-17        |
| DUNCAN ELECT INC COSTA MESA                 | 8                      |
| DURAMIC PRODUCTS INC                        | 21                     |
| EAGLE ELECTRIC MFG CO                       | 14-17                  |
| EAGLE ELECTRIC MFG CO INC                   | 14                     |
| ELEMA CORP                                  | 14-15-16-17            |
| ELECTRICAL INSULATION CO INC                | 21                     |
| ELECTRO CHEMICAL ENGRAVING CO INC           | 2-5-10                 |
| ELECTRODYNAMIC INSTRUMENT CORP              | 12                     |
| ELECTRO SPACE FAB INC                       | 2-10                   |
| ELJAY CORP                                  | 5-6-9-10-12-21         |
| ELZEE METAL PRODUCTS CO                     | 2                      |
| EMMCO PLASTICS CORP ANDOVER                 | 2-5-6-10-13-21-22      |
| ENGINEERED ELECTRONICS CO                   | 15                     |
| ERWOOD INC                                  | 12                     |
| ETCHING CORP OF CALIF                       | 5-21                   |
| DIV ALLEGRI TECH INC                        | 5                      |
| EUGENE ENGINEERING CO INC                   | 4-5-6-10-21            |
| FABRA PRINT INC                             | 5-6-9-10-12-21         |
| FEAY CO NEAL                                | 14-15                  |
| FEDERAL SCREW PRODUCTS INC                  | 15                     |
| FIDELITY AMPLIFIER CO                       | 20                     |
| FILTRON CO INC WESTERN DIV                  | 20                     |
| FISHER & CROME                              | 5-6-21                 |
| FLORIDA GEARS & SYSTEMS INC                 | 5-6                    |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV | 1-3-4-14-22            |

|  |                             |
|--|-----------------------------|
| G-C ELECTRONICS CO KNOR & RESISTDR DIV       | 12-13                       |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 1-3-4-12-13-18-22-23        |
| GENERAL FORMULATIONS INC                     | 4-9-10-11-21                |
| GENERAL MILLS INC MINN                       | 5-10                        |
| GENERAL PLASTICS CORP                        | 5-6-13                      |
| GENERAL RADIO CO                             | 15-17                       |
| GENERAL RAILWAY SIGNAL CO                    | 5-6-9-21                    |
| GENERAL STENCILS INC                         | 1-5-6-8-10-21-22            |
| GENTAPE CORP                                 | 21                          |
| GEORGE GORTON MACHINE CO                     | 15                          |
| GODFREY MFG CO                               | 12                          |
| GOE ENGG CO                                  | 5-6-10-20-21                |
| GRAPHICS INC KEARNY                          | 2                           |
| GRAYHILL MOLDRONICS INC                      | 3                           |
| HACKENSACK CABLE CORP                        | 2                           |
| HELDOR MFG CORP                              | 5                           |
| HELIPOT DIV BECKMAN INSTS FULLERTON          | 8                           |
| HINCHMAN MFG CO INC                          | 13                          |
| HURLETRON INC WHEATON ENG DIV                | 15-17                       |
| IDENTIFICATION SERVICE CORP                  | 21                          |
| ILLUMINATED CONTROLS INC                     | 6                           |
| INDUSTRIAL DEVICES INC                       | 13-14-15-16-17              |
| INDUSTRIAL ELECTRONIC ENGINEERS INC          | 15                          |
| INDUSTRIAL ENGRAVERS INC                     | 5-6-10-21-22                |
| INGERSOLL PRODUCTS DIV BORG-WARNER CORP      | 17                          |
| INSTRUMENT MASTERS INC                       | 5                           |
| INSULEX CO                                   | 21-22                       |
| INTERNATIONAL RESISTANCE CO ST PETERSBG DIV  | 6-8                         |
| INTERNATIONAL RESISTANCE CO PHILA            | 6                           |
| JACKSON BROS LONDON LTD                      | 5-19-22                     |
| JAN HARDWARE MFG CO                          | 2-5-9-10-12-13-18-19        |
| JAY-EL PRODUCTS INC                          | 15-16                       |
| JFD ELECTRONIC CORP                          | 1-3                         |
| JFD ELECTRONICS SOUTHERN INC                 | 1-3                         |
| JOHNSON CO E F                               | 5-6-12-13-16-17             |
| JOHNSON CO E F                               | 8-13-17                     |
| KAY ELECTRIC CO PINLITE DIV                  | 14-15-16-17                 |
| KERRO PRODUCTS                               | 5-6-13-21                   |
| KEYSTONE ELECTRONICS CORP N Y                | 18-19                       |
| KILO ENGG CO                                 | 5-6-8-12-18-19              |
| KLANN ORGAN SUPPLY CO                        | 21                          |
| KORRY MANUF CO                               | 14-15-16-17                 |
| KURZ-KASCH INC                               | 13                          |
| LABELLE INDUSTRIES INC                       | 2-10                        |
| LAMINATED SHEET PRODUCTS CORP                | 21                          |
| LEED INSULATOR CORP                          | 13                          |
| LEITCH HUARD CORP                            | 2-10                        |
| LERCO ELECTRONICS INC                        | 13-22                       |
| LEYSE ALUMINUM CO                            | 2-5-10-11-22                |
| LIBBEY OWENS FORD GLASS CO LIBERTY MIRROR DV | 5-10                        |
| LIBRASCOPE DIV GENERAL PRECISION INC         | 2                           |
| LINK DIV GENERAL PRECISION INC               | 5-6-21-22                   |
| LUDWIG HONOLD MFG CO                         | 2                           |
| LUMINOUS PROCESSES INC                       | 5-20-22                     |
| MAHLER RESEARCH FOUNDATION                   | 4-9-10-21                   |
| MARTIN PROD INC                              | 5-6-9-21                    |
| MASTER ENGRAVING STUDIOS                     | 5-21                        |
| MATTERN CORPORATION                          | 2                           |
| MECHANICAL ENGRAVING CO INC                  | 2-5-6-8-9-10-12-13-20-21-22 |
| METAL SPECIALTY PRODUCTS CORP                | 12                          |
| METALPHOTO OF CINCINNATI                     | 5-6-10-21                   |
| METER MAKERS INC                             | 5                           |
| MICARTA FABRICATORS INC                      | 14                          |
| MICROSPACE INC                               | 6                           |
| MILLEN MFG CO JAMES                          | 2-5-6-8-12-13-18-19-22      |
| MILLER DIAL & NAMEPLATE CO                   | 4-5-9-10-11-20-21           |
| MINOR RUBBER CO                              | 23                          |
| MOLDED INSULATION CO PHILA                   | 13                          |
| MOLDING ENGINEERS INC                        | 13                          |
| MONROE INDUSTRIES INC                        | 6-22                        |
| MUIRHEAD & CO LTD                            | 6-13                        |
| MUIRHEAD INSTRUMENTS INC                     | 5-6-13                      |
| MURA CORP THE                                | 14-16                       |
| NAMEPLATES INC                               | 0-21                        |
| NATL RADIO CO INC                            | 6-12-13-18-19-22            |
| NATIONAL TEL TRONICS CORP                    | 10                          |
| NEW ENGLAND NUCLEAR CORP                     | 20                          |
| NICHOLS PRODUCTS CO                          | 6                           |
| NORMAN JONES INC                             | 13                          |
| NORRICH PLASTICS CORP                        | 3-12                        |
| NORTH ATLANTIC INDUST INC                    | 13                          |
| NORTH ELECTRIC CO                            | 7                           |
| NORTH SHORE NAMEPLATE DIV ANODYNE INC        | 1-2-3-4-5-6-7-9-10-11-21-22 |
| OPTICAL GAGING PRODUCTS INC                  | 5-6-21                      |
| O & S RESEARCH INC                           | 15                          |
| OXFORD ELECTRIC CORP                         | 14-15-16-17                 |
| PACIFIC TRANSDUCER CORP                      | 12                          |
| PANEL ENG CORP                               | 5-7-10-13-21                |
| PANELIT INC DIV INFORMATION SYS INC          | 2-15-16-17-21               |
| PANOB CORP                                   | 5-6-12-13-21                |
| PARK ELECTROCHEMICAL CORP                    | 2-4-5-7-9-10-11-21          |
| PARK NAMEPLATE CO                            | 2-9-12-21                   |
| PFLLEY CO                                    | 21                          |
| PFANDR INC                                   | 2-15-17                     |
| PERFECT COMPONENTS INC                       | 5-6-12-13-18-19-21          |
| PERMONITE MFG CO                             | 14                          |
| PFI PRODUCTS FOR INDUSTRY INC                | 2-9-10-12-21                |
| PITZER INDUSTRIES INC                        | 10                          |
| PHOTOVOLT CORP                               | 10-11                       |
| PRECISION METAL PRODUCTS CO                  | 19-21                       |
| PRINTLOID CORP DEPT E                        | 6-9-10-21-22                |
| RAYTHEON CO INDUSTRIAL COMPONENTS DIV        | 13-19                       |
| RAYTHEON CO DIST PROD DIV                    | 14-17                       |
| REEVES INSTRUMENT CORP                       | 6                           |
| REPUBLIC LENS CO                             | 6                           |
| RESEARCH DEVELOPMENT MFG INC                 | 22                          |
| REUTER INC                                   | 2-12                        |
| RIMAK ELECT INC                              | 10-21                       |
| ROGAN BROS INC                               | 5-9-13                      |
| ROSS METALS CO MILTON                        | 2-9-13-21-22                |

|   |                                  |
|---|----------------------------------|
| SCIENTIFIC ELECTRONIC LABS INC              | 15                               |
| SCIDTO SIGN CO                              | 4-5-9-10-11-20-21                |
| SECODE CORP                                 | 7                                |
| SILICONE INSULATION INC                     | 13                               |
| SILIKROME DIV APM-HEXSEAL CORP              | 15                               |
| SILLCOCKS MILLER CO                         | 5-6-7-9-10-11-12-13-21-22        |
| SIMMONDS PRECISION PRODS TARRYTOWN          | 15                               |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 5                                |
| SLOAN CO THE                                | 14-15-16-17                      |
| SMITH INC HERMAN H                          | 4-5-13-17-18-19                  |
| SPECTROL ELECTRONICS CORP SAN GABR          | 5-6-8                            |
| SPERTI FARADAY INC                          | 5-9-10-15                        |
| ST CROIX PLASTICS CORP                      | 13                               |
| STANDARD PRODUCT INC SUB ELECTR CDMH INC    | 5                                |
| STAR ENGRAVING & NAME PLATE CO              | 21                               |
| STEWART TRANS LUX CORP                      | 6                                |
| SYLVANIA ELECTRIC PRODUCTS SALEM            | 5-7-14-15-17-20-22               |
| TAFFET ELECTRONICS INC                      | 3-12                             |
| TECHNICRAFT CO                              | 5                                |
| TELEX INC                                   | 15                               |
| TEXSTAR PLASTICS DIV TEXSTAR CORP           | 5-6-12-13-16-17-20-21-22         |
| THETA INSTRUMENT CORP                       | 5-6                              |
| TORWICO ELECTRONICS INC                     | 8                                |
| TRANSISTOR ELECTRONICS CO                   | 14-15-16-17                      |
| TUNG SOL ELECTRIC INC NEWARK                | 14-15-16-17                      |
| TV DEVELOPMENT CORP                         | 13                               |
| U S RADIUM CORP HOLLYWOOD                   | 3-5-6-10-12-13-14-16-17-20-21-22 |
| U S RADIUM CORP BLOOMSBURG                  | 5-12-13-14-20-21-22              |
| UCINITE CO DIV UNITED CARR FASTENER CORP    | 14-15-16-17                      |
| ULTRAUDIO PRODUCTS                          | 13                               |
| UNHERSOLL PRODUCTS                          | 17                               |
| VEMALINE PRODUCTS CO                        | 5-12-13-14-15-16-17-22           |
| WALDMAN ELECTRONICS INC                     | 5-6-10-13-18-19-21-22            |
| WALSCO ELECTRONICS MFG CO                   | 1-3-4-22-23                      |
| WESTLAKE PLASTICS CO                        | 13                               |
| WILKENS INC ALWIN FR                        | 5-6-10                           |
| WILLSON CAMERA CO INC                       | 9-20                             |
| J H WINN INC                                | 22                               |
| ZERO MFG CO                                 | 5-6                              |

FILTERS 1900

|                             |    |
|-----------------------------|----|
| Filters, air                | 1  |
| Filters, antenna            | 2  |
| Filters, audio              | 3  |
| Filters, bandpass           | 4  |
| Filters, band rejection     | 5  |
| Filters, crystal            | 6  |
| Filters, equalizer          | 7  |
| Filters, high pass          | 8  |
| Filters, coaxial            | 9  |
| Filters, LF                 | 10 |
| Filters, line               | 11 |
| Filters, low pass           | 12 |
| Filters, mechanical         | 13 |
| Filters, microwave          | 14 |
| Filters, needle scratch     | 15 |
| Filters, noise suppressing  | 16 |
| Filters, radio interference | 17 |
| Filters, R-F                | 18 |
| Filters, SSB                | 19 |
| Filters, screen room        | 20 |
| Filters, strain gage        | 21 |
| Filters, UHF-VHF            | 22 |
| Filters, variable           | 23 |
| Filters, vestigial sideband | 24 |
| Filters, waveguide          | 25 |

|  |                                     |
|--|-------------------------------------|
| ACDC ELECTRONICS INC                   | 18                                  |
| AC ELECTRONICS INC                     | 2-3-4-5-7-8-10-11-12-16-17-18-21-23 |
| ACCESSORY PROD CO DIV OF TEXTRON INC   | 14                                  |
| ACF ELECTRONICS DIV ACF INDUSTRIES INC | 1                                   |
| AC SPARK PLUG ELECT DIV GMC            | 13                                  |
| ADAMS RUSSELL CO INC                   | 2-4-5-8-9-12-14-18-22-25            |
| ADC PRODUCTS DV OF MAGNETIC CONTROLS   | 3-4-5-7-8-10-11-12-15-16-19-24      |
| ADVANCED ELECT CORP                    | 11-16-18                            |
| AD-YU ELECTRONICS LAB INC              | 3-4-5-12-23                         |
| AEROSPACE ELECTRONICS INC              | 2-3-4                               |
| AEROSPACE RESEARCH INC                 | 10                                  |
| AEROVOX CORP                           | 11-16-17-18-20                      |
| AIRCRAFT ARMAMENTS INC                 | 14                                  |
| AIR FILTER CORP                        | 1                                   |
| AIRMAATIC VALVE INC                    | 1                                   |
| AIR MAZE DIV ROCKWELL STANDARD CORP    | 1-18                                |
| AIRPAX ELECT INC SEMINOLE DIV          | 4-5-12                              |
| AIRPAX ELECTRONICS PACIFIC DIV         | 4-5-6-8-9-12-22                     |
| AIRPAX ELECTRONICS INC PASADENA        | 3-4-5-7-8-12                        |

# PRODUCTS & MANUFACTURERS

# Filters

AIRTRON A DIV OF LITTON INDUST 14  
 AIRTRONICS INTL CORP 3-4-8-12  
 ALERT PRODUCTS INC 3-4-5-7-8-12  
 ALFORD MFG CO 9-12-24  
 ALLEN AVIONICS INC 4-11  
 ALLEN-BRADLEY CO 12-22  
 ALLEN ELECTRONIC CORP 4-5-12-23  
 ALLIED WITAN CO 1  
 ALLISON LABS INC 3-4-5-7-8-12-23  
 ALL TRONICS INC 12-16-17-18-20  
 ALMA ENGINEERING 3-4-5  
 ALPHA CORP 2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-22-23-24-25  
 ALSOP ENGRG CORP 13  
 AMERAC INC 14-18  
 AMERICAN AIR FILTER CO 1-13  
 AMERICAN ELECT LABS INC 2-5-14-18  
 AMERICAN ELECT LABS MICROWAVE & PHASING 14-25  
 AMERICAN STERILIZER SCIENTIFIC & IND DEPT 1  
 AMP INC CAPITRON DIV 17  
 ANDERSON ELECTRONICS INC 6-19  
 ANDREA RADIO CORP 3-5  
 ANDREW CALIF CORP 2-4-5-9-10-12-22  
 ANTENNA SYSTEMS INC 2-9-14-18-25  
 APPARATUS DEVELOPMENT CO 2-4  
 APPLIED RESEARCH INC 2-4-5-9-10-14-18-22  
 APW CO 3  
 ARK ELECT CORP 3-4-5-8-9-10-11-12-14-17-18-20-22  
 ARRA RESEARCH ASSOCIATES 4-5-8-9-12-14-22-25  
 ASSOCIATED ELECTRICAL INDUSTRIES LTD 14-25  
 ASTRON CORP  
 ATLANTIC INSTRUMENTS & ELECTRONICS INC 3-4  
 ATLAS COIL CORP 3-4-5-8-11-12  
 ATLAS ENG CO 4-8-12  
 AUTOMATIC COIL CO INC 10-18  
 AUTOMATION INC MAGNETICS DIV 3-4-5-6-7-8-10-11-12-16-17-18  
 AVIATION INSTRUMENT MFG CORP 1  
 AVIEL ELECTRONICS INC 18-25  
 AXEL ELECTRONICS INC 19-20  
 BAILEY METER COMPANY CLEVELAND 1  
 BARKER & WILLIAMSON INC 2-3-4-5-8-10-12-18-19-22  
 BARNEY CHENEY CO 1  
 BASLER ELECTRIC CO 3-4-5-8  
 BASSETT INC REX 16  
 BAY ROY ELECTRONICS INC 4-8-12-22  
 BELZ INDUSTRIES DIV EL TRONICS INC 14  
 BENCO TELEVISION ASSOC LTD 2-4-8-22  
 BENRUS WATCH CO INC 4-5  
 BIDDLE CO JAMES G 4  
 BILL JACK INDUSTRIES 8  
 BIRD ELECTRONIC CORP 18  
 BIRMA MFG CO INC 3-4  
 B I K INSTRUMENTS INC OF BRUEL & KJAER 3-4  
 BLACKBURN ELECTRONIC CORP 4-8-12  
 BLACKHAWK ENGINEERING CO 6  
 BLILEY ELECTRIC CO 6  
 BOGART MFG CORP 4-5-8-9-12-14-22-25  
 BRADLEY ELECTRONICS CO INC 9  
 BRAMCO INC SUB LEDEX INC 3  
 BREW & CO RICHARD D 3-4  
 BRUBAKER ELECTRONICS INC 4-5-8-12  
 BUCKBEE MEARS CO 23  
 BUDD RADIO INC 1-8-12  
 BUDD ELECTRONICS A DIV OF THE BUDD CO 2  
 BUDD STANLEY CO 25  
 BUDELMAN ELECTRONICS CORP 3-5-8-12-14-18-19-22  
 BULOVA WATCH CO ELECT DIV 3-4-5-6-8-10-12-19-24  
 BUNDT ELECTRONICS CORP 3-4-5-6-8-12-16  
 BURNELL & CO INC 3-4-5-6-7-8-10-12-19-24  
 BUSH TRANSFORMER CORP 3-4-5-8-12  
 CADRE INDUSTRIES CORP 2-4  
 CALEDONIA ELECTRONICS & TRANSFORMER CORP 3-4-5-8-10-12-14-18-19  
 CALIF MAGNETIC CONTROL CORP 4-5-8-12  
 CALMAG DIV CALIF MAGNETIC CONT CORP 3  
 CAMBRIDGE FILTER CORP 1  
 CANADIAN MARCONI CO 2-3-4-5-7-8-10-12-18-22  
 CAPCON INC 8-11-12-15-16-17-18-20  
 CARAD CORP 3-4-5-8-12  
 CAREY ELECTRONIC ENG 4  
 CAROL ELECT DIV WECO 4  
 C E S ELECTRONIC PRODUCTS INC 3-4-5  
 CHEM ELECTRO RESEARCH INC 3-4-8-11-12  
 CHICAGO ELECTRONIC ENGG CO 4-7-8-12  
 CIRCUITDYNE CORP 3-4-5-7-8-23  
 CLEAR BEAM ANTENNA CORP 4-22  
 CLEVITE ELECT COMPONENTS DIV CLEVITE 4-10  
 COAST COIL CO 3-4-12  
 COLCRAFT INC 4-5-8-10-12-18  
 COLLINS RADIO CO NEWPORT BCH 4-6-10-13-14-19  
 COLLINS RADIO CO CEDAR RAPIDS 19  
 COLUMBIA RECORDS 3  
 COLUMBUS PROCESS CO 3  
 COMMUNICATION ACCESSORIES CO 3-4-5-6-7-8-10-12-13-18-19-24  
 COMMUNICATION ELECTRONIC INC 12-22  
 CONDENSER PROD DIV NEW HAVEN CLOCK & WATCH 3  
 CONTROL SCIENCE CORP 3-4-5-8-10-11-12-19-24  
 CONTROLS CO OF AMER MILWAUKEE 1  
 COPPUS ENGRG CORP 1  
 CORNELL-DUBILIER ELECTRIC CORP VENICE 3-4-5-8-12-16-17-18  
 CORNELL-DUBILIER ELECTRIC CORP N BEDFORD 11-12-16-17-18-20  
 CORNELL-DUBILIER ELECTRONICS DIV SANFORD PLT 3-4-8-11-12-16-17  
 CORRIGAN COMMUNICATIONS INC 4-8-11-12  
 CP ELECTRONICS INC 3  
 CUSTOM COMPONENTS INC 14-25  
 DAITSLY CO INC RAY 18

DALE ELECTRONICS INC COLUMBUS 3-8-10-12-18  
 DALTRONICS INC 3-4-5-8-11-12-18  
 DAMON ENGINEERING INC 4-5-6-19  
 DATA TRONIX CORP 3-4-5-8-12  
 DAVEN CO 3-4-5-7-8-10-12  
 DEARBORN ELECTRONIC LABS INC 11-12-16-17-20  
 DECCO INC 3-4-5-8-11-12  
 DECOURSEY ENGG LAB 3-4-5-8-12  
 DERO ELECTRONICS 8-11-17  
 DEVCO DIV R E PHELONCO INC 17-18  
 DEVELCO INC 2-3-4-5-8-11-17  
 DIAMOND ANTENNA & MICROWAVE CORP 2-4-5-6-8-9-14-18-25  
 DIELECTRIC PRODUCTS ENGG CORAYMOND 3-14-17-25  
 DIELECTRIC PRODUCTS ENGG CO BRIOGETON 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25  
 DIETZ DESIGN INC 3-4-5-7-9-10-11-12-19  
 DITTMORE FREITHUM CORP 4-12  
 DORSETT ELECTRONICS 4  
 DOUBLE E PRODUCTS CO 4-5-8-11-12-16-17-18-20  
 DOUGLAS MICROWAVE CO 9-14-25  
 DRAKE CO R L 3-4-5-9-11-12-17  
 DRESSER ELECT HST DIV 3-4-5-7-8-10-12  
 DRICO INDUSTRIAL CORP 1  
 DX RADIO PRODUCTS CO 3-4-5-6-7-8-10-11-12-15-16-17  
 DYNAMICS INST CO 12  
 DYTRONICS CO 3-4-8-12-23  
 EDO CANADA LTD 3-4-5-6-7-8-10-11-12-23-24  
 ELECT MECHANICAL RES INC 4-12  
 ELECTRIC INC 23  
 ELECTRO-AIR CLEANER CO INC 4-5-8-10-11-12-18  
 ELECTRO ASSEMBLIES INC 4-5-8-12-17-23-25  
 ELECTRO INTERNATIONAL INC 4-5-16-17-25  
 ELECTROMAGNETIC TECHCORP 2-3-4-5-8-11-12-16-22  
 ELECTRO MECHANICAL CORP 22  
 ELECTRO WINDERS CO INC 0  
 ELECTRONIC RESEARCH CO 6  
 ELECTRONIC TRANSFORMERS CORP 3-4-5-7-8-11-12-15  
 ELECTRONICS OF CLEARFIELD INC 2-4-5-9-18-23  
 ELECTRONICS MISSILES & COMMUNICATIONS INC 22  
 ELECTRON PRODS DIV MARSHALL IND MONROVIA 11-17  
 ELITE ELECTRONICS ENGRG CO 4-8-12-16-17-18-19-20-25  
 ELPAC INC 16-17  
 EL-RAD MFG CO 12  
 EMPIRE DEVICES PRODUCTS CORP 14  
 ENGELMANN MICROWAVE CO 14-18  
 ENTRON INC 2-4-5-7-8-12-18-22-23  
 ERIE ELECTRONICS DIV 12  
 ERIE RESISTOR OF CANADA LTD 12  
 ERIE RESISTOR CORP 12  
 ESC ELECTRONICS CORP 3-4-8-12  
 ESPEY MFG & ELECTRONICS CORP 3-4-5-7-8-10-11-12-16-17-18-2  
 ESSEX ELECTRONICS DIV NYTRONICS INC 3-4-5-8  
 EWEN KNIGHT CORP 14  
 FARINON ELECTRIC 22  
 JOHN E FAST CO DIV VICTOREEN INST CO 16  
 FILTRON CO 11-12-16-17-20  
 FILTRON CO INC WESTERN DIV 2-4-5-8-11-12-16-17-18  
 FORBES & WAGNER INC 4-5-8-12  
 FREED TRANSFORMER CO 2-3-8-12  
 FREQUENCY ENGG LABS 2-4-5-8-9-10-12-14-18-22-23-25  
 FUGLE MILLER LABS INC 4-5-8-10-18-19  
 GAVIN INSTRUMENTS INC 2-4-5-8-9-12-18-22-23  
 GELMAN INSTRUMENT CO 1  
 GENERAL DYNAMICS TELECOMMUNICATION 3-4-5-6-8-12  
 GENERAL ELECTRIC CO POWER TUBE DEPT 14  
 GENERAL ELECTRIC CO 10-18  
 APPARATUS SALES DIV SCHENECTADY N Y 10-18  
 GENERAL ELECT CO SPECIALTY DEVICES OPER 18  
 GENERAL INSTRUMENT CORP NEWARK 4-10-18  
 GENERAL INSTRUMENT CORP F W SICKLES DIV 4-8-12-18  
 GENERAL MAGNETICS INC MINN 2-3-4-18  
 GENERAL MICROWAVE CORP 4-5-8-9-12-14-18-23-25  
 GENERAL MILLS INC MINN 4-17  
 GENERAL RADIO CO 3-4-8-9-12-22  
 GENISTROM INC 3-4-5-8-11-12-16-17-20  
 GENISTROM INC BENSENVILLE 3-4-5-8-11-12-16-17-18-20  
 GEOSCIENCE INSTRUMENTS CORP 1  
 GEOTRONIC LABS INC 4-7-8-12  
 GERTSCH PRODUCTS INC 3-4-23  
 GOMBOS INC CO JOHN 4-5-14  
 GREEN RECTIFIER CO 12  
 GRINNELL ELECTRONICS INC 2-3-4-5-8-9-11-12-14-16-17-18-20-22  
 THE GUDEMAN CO CHICAGO 2-3-9-11-12-16-17-18-20-22  
 GUIDE MFG CO 17-18  
 GUILD ELECTRONICS INC 4-5-8-12  
 GUILLEMIN NETWORKS INC 4-12  
 GULTON INDUSTRIES INC METUCHEN 3-4  
 GYREX CORP 4-8-12-16  
 HALL MFG CO 16-17-18  
 HALLETT MFG CO 1  
 HANOVIA LAMP DIV/ENGLEHART INDUSTRIES INC 1  
 HAZELTINE ELECTRONICS DIV/HAZELTINE CORP 25  
 HEATH CO DIV OF DAYSTROM INC 1  
 HILL ELECTRONICS INC 3-4-5-6-8-10-12-18-19  
 HISONIC INC 3-4-5-7-8-11-12-18-19-24  
 HONEYWELL CONTROLS LTD 1  
 HOPKINS ENGG CO 11-12-16-17-18-20

HUGHES AIRCRAFT CO ELECT PROD DIV 4-5-6-7-8-10-12-18-19  
 HYCOM MFG CO 14  
 INDUCTOR ENGG INC 4-5-8-12  
 INDUSTRIAL CONDENSER CORP 16-17  
 INDUSTRIAL ELECTRONICS OF OMAHA INC 3-4-5-8-12-16-17  
 INDUSTRIAL TRANSFORMER CORP 3-4-5-7-8-12-16  
 INFRARED INDUSTRIES INC WALTHAM 17  
 INSTRUMENTS FOR INDUSTRY INC 4-5-8-9-10-12-18-22  
 INTERFERENCE MEASUREMENT LAB INC 17-20  
 INTL ELECTRONICS MFG CO 2-8-12-17-22-23  
 INTL POWDER METALLURGY CO 1  
 INTERSTATE ELECTRONICS CORP 7-12-23  
 ITEX ELECTRO - PRODUCTS 4-5-6-10-18-19  
 I TEL INC 2-4-5-7-8-9-10-12-14-18-19-22-23-24  
 ITT KELLOGG COMM SYSTEMS DEPT 2-3-4-5-6-8-12-17  
 ITT KELLOGG PALO ALTO 4-6-7-8-10-19  
 JACK INDUSTRIES BILL 8  
 JAMES ELECTRONIC INC 3-4-11  
 JAMPRO ANTENNA CO 9-12  
 JARVIS ELECTRONICS CORP 3-4-11-12  
 JERROLO ELECTRONICS CORP 2-4-5-7-8-18-22  
 JFD ELECTRONIC CORP 2-3-4-5-8-11-12-16-17-18-19-22-23-24  
 JFD ELECTRONICS SOUTHERN INC 2  
 JOHNSON AIRCRAFT ENGG CO M J 1  
 JOHNSON CO E F 18  
 JOHNSON ELECTRONICS INC 3-4-5-8-10-12-16-17-18  
 J-V-M DIVISION FIDELITONE MICROWAVE INC 2-4-9-14-18-25  
 KAHLBERG BROS CO 1  
 KAME ENGINEERING LABORATORIES 4-5-8-12-14-22-25  
 KAPITOL MAGNETIC CORP 4-8-12  
 KAUK & CO INC 12  
 KENYON TRANSFORMER CO 3-4-5-12  
 KEYSTONE PRODUCTS CO 4  
 KNIGHTS CO JAMES 6  
 KROHN-HITE CORP 3-4-5-8-12-23  
 LANES INDS CORP DIV CORNELL DEEP DRAWING CO 1  
 LANGEVIN DIV OF SOMOTEC INCORP 3-7-12  
 LEAR INC ASTRONICS DIV 0  
 LEAR SIEGLER INC ELECT INST DIV 4-12  
 LEWIS CO E B 6  
 LIBBEY OWENS FORD GLASS CO LIBERTY MIRROR DIV 18  
 LIBRSCOPE DIV GENERAL PRECISION INC 10  
 LINDGREN & ASSOC ERIK A 14  
 LITTON INDUSTRIES ELECTRON TUBE DIVISION 14  
 LYNCH COMMUNICATION SYSTEMS INC 3-4-5-6-7-8-10-11-12-16-17-18-19-23-24  
 MADIGAN CORP 18  
 MAGNADYNE CORP 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25  
 MAGNETIC CIRCUIT ELEMENTS INC 8-12-23  
 MAGNETIC INDUSTRIES INC SUB PREC INSTR CO 3-4-5-7-8-12-19  
 MARINE ELECTRIC CORP 3-4  
 MATRIX ELECTRONICS CORP 3-4-5-8-11-12  
 MAXSON ELECTRONICS CORP N Y 14  
 MCCARRON ELECTRIC CO 3-4-5-8-12  
 MCCOY ELECTRONICS CO 4-5-6-8-10-12-19-22-24  
 MCMILLAN COMPANIES 2-5-11-12-14-16-17-18-20-22  
 MEAGHER ELECTRONICS CO 3  
 MELABS 2-4-5-6-7-8-9-10-11-12-14-17-18-19-22-23-24-25  
 MERIDIAN METALCRAFT INC 2-4-9-12-14-22-25  
 MERRIMAC RESEARCH & DEVELOPMENT INC 4-8-14-18-19-25  
 METAL SPECIALTY PRODUCTS CORP 3-4-11  
 METCON INC 4  
 METEX ELECTRONICS 17-18-25  
 METROPOLITAN TELECOMMUNICATIONS CORP 3-4-17  
 COIL WINDERS DIV 4-5-8-12  
 MICROMAG INSTRUMENT CO 9-14-25  
 MICROMEGA CORPORATION 25  
 MICRONETICS INC 4-8-10-12-13-14-17-23  
 MICROSECOND ELECT INC 4-5-6-10-18-19-22-24  
 MICROSONICS INC 14-25  
 MICROWAVE ASSOCIATES INC 14  
 MICROWAVE ELECT CORP 4-5-6-8-12-19  
 MIDLAND MFG CO 16-18  
 MILLER MFG CO JAMES 2-4-5-8-10-11-12-16-17-18  
 MILLIPORE FILTER CORP 13  
 MINNEAPOLIS-HONEYWELL AERO DIV 8-9-11-12-13  
 MOREY CORP 4-8-10-12-16  
 MUIRHEAD INSTRUMENTS INC 23  
 MULLARD EQUIPMENT LTD 6-8-12  
 MULTRONICS INC 2-18  
 NATL RADIO CO INC 4-19  
 NEICO MICROWAVE CO 2-9-14-25  
 NEPTUNE ELECTRONICS CO 16-17  
 NEWTON CO 5  
 NEW YORK TRANSFORMER CO 4-5-8-12  
 NORTH ELECTRIC CO 4  
 NORTH HILLS ELECTRONICS INC 2-3-4-5-7-8-10-11-12-18-19  
 NRK MICROWAVE DIV COOK ELECT CO 25  
 NYTRONICS INC BERKELEY HTS 12-18  
 OMNI SPECTRA INC 14  
 ORBITRAN CO INC 4-8-12  
 ORTHO FILTER CORP 2-3-4-5-6-7-8-12-16-17-19-22  
 ORTHOLOG DIV GULTON INDUST 4-12-23  
 PARSONS CO RALPH M ELECTRONICS DIV 2-4-18-24  
 PCA ELECTRONICS INC 3-5-8-10-12-16-17-18-22  
 PHILCO CORP SIERRA ELECTRONIC DIV 12-25  
 PHOENIX PRECISION INSTRUMENT CO 17  
 PHYSIONICS INC 3-4-5-8-10-12-17-18-22



# Filters • Gages & Indicators

|  |                                       |
|--|---------------------------------------|
| PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV    | 3                                     |
| PIEZO CRYSTAL CO                             | 6                                     |
| POLARAD ELECTRONICS CORP                     | 14                                    |
| POLYPHASE INSTRUMENT CO                      | 4-5-8-11-12                           |
| THE POTTER CO                                | 11-12-18                              |
| POTTER CO THE                                | 16                                    |
| PRD ELECTRONICS INC                          | 14                                    |
| PROBSCOPE CO INC                             | 6                                     |
| PULSE TECHNIQUES INC                         | 3-7-23                                |
| PURLOART PRODUCTS INC                        | 1-13                                  |
| QUINDAR ELECTRONICS INC                      | 3-4-5-12                              |
| RACON ELECTRIC CO                            | 3                                     |
| RADAR DESIGN CORP                            | 14                                    |
| RADAR MEASUREMENTS CORP                      | 14                                    |
| RADDEX CORP                                  | 1                                     |
| RADIAPHONE CO                                | 2-3-4-5-7-8-10-12-16-21               |
| RADIATRONICS INC                             | 2-25                                  |
| RADIO COND CO SUB THOMPSON RAMO WOOLDRIDGE   | 4-8-12                                |
| RADIO ENG LABS INC                           | 4-18                                  |
| RADIO ENGG PRODUCTS                          | 4-5-7-8-12                            |
| RAILWAY COMMUNICATIONS INC                   | 4-7-8-12                              |
| RAYTHEON CO INDUSTRIAL COMPONENTS DIV        | 3-4-13                                |
| REDCOR CORP                                  | 13                                    |
| REED & REESE INC                             | 4-12                                  |
| REEVES HOFFMAN DIV                           | 3-4-5-11-12                           |
| REGENCY ELECTRONICS INC                      | 4-5-6-8-10-12-18-19                   |
| RFLCOIL PRODUCTS                             | 3-6-22                                |
| REMANCO INC                                  | 4-8-10-12-16-18                       |
| RF INTERONICS INC                            | 14                                    |
| RHG ELECTRONICS LAB INC                      | 4-5-10-18-22-23                       |
| RISCO  | 3-4-5-17                              |
| RIVERBANK LABS ENGG DEPT                     | 3-4-13                                |
| RIXON ELECTRONICS INC                        | 3-4-5-7-8-10-12-19-24                 |
| ROHDE & SCHWARZ                              | 4                                     |
| RYTRON CO INC                                | 4-5-6-7-8-12-18                       |
| SAGE LABORATORIES INC                        | 4-5-8-9-12-14-25                      |
| SANDERS ASSOCIATES                           | 14                                    |
| SANGAMO ELECTRIC CO                          | 4-5-8-11-12-16-17-18                  |
| SANGAMO MICROSONICS INC                      | 4-5-6-8-12-19                         |
| SARTRON INC                                  | 4-5-8-12-16-17                        |
| SATURN ELECTRONICS CORP                      | 3-4-5-8-11-12-16-18-19                |
| SAVOY ELECTRONICS INC FT LAUDERDALE          | 16                                    |
| SCOTT INC H H                                | 3-4-16-23                             |
| SECODE CORP                                  | 3-4                                   |
| SECO ELECTRONICS INC                         | 16                                    |
| SECURITY DEVICES LAB                         | 13                                    |
| SEG ELECTRONICS CO INC                       | 2-3-4-5-6-7-8-10-11-12-16-17-18-19-20 |
| SEMI ELEMENTS INC                            | 6                                     |
| SERCO ELECT RESEARCH CORP                    | 0                                     |
| SERVO CORP OF AMERICA                        | 3-4-22-23                             |
| SERVOMECHANISMS INC EL SEGUNDO               | 1                                     |
| SHEROLO CRYSTALS INC                         | 6                                     |
| SICKLES F W DIV GIC                          | 4-8-12-18                             |
| SIERRA ELECTRONIC DIV PHILCO CORP            | 4-9-12-25                             |
| SIVERS LAB                                   | 14-25                                 |
| SPARTON ELECTRONICS                          | 3-4-5-8-10-12-18                      |
| SPASORS INC SUB SILICON TRANSISTOR           | 2-14-25                               |
| SPECTRAL DYNAMICS CORP OF SAN DIEGO          | 23                                    |
| SPECTRAN ELECTRONICS CORP                    | 3-4-5-13-18-24                        |
| SPECTRUM INSTRUMENTS INC                     | 3-4-5-8-23                            |
| SPENCER-KENNEDY LABS INC                     | 2-23                                  |
| SPERRY MICROWAVE ELECT INC                   | 14                                    |
| SPRAGUE ELECTRIC CO N ADAMS                  | 3-4-5-7-8-10-11-12-16-17-18-20        |
| ST MARYS CARBON CO                           | 1                                     |
| STANCOR ELECTRONICS INC                      | 3-4-7-8-12                            |
| STANOARD WINDING CO DIV OF OVITRON CORP      | 4-5-8-10-11-12-16-17-18-19-22-23      |
| STEPHENS TRU-SONIC INC                       | 3                                     |
| STEWART WARNER ELECT DIV STEWART-WARNER CORP | 3-4-8-10-12                           |
| STODDART AIRCRAFT RADIO CO                   | 12                                    |
| SWIFT TEXTILE METALLIZING & LAMINATING CORP  | 20                                    |
| SYLVANIA ELECTRIC PRODUCTS IPSWICH           | 4                                     |
| SYLVANIA ELECTRIC PROOS INC WALTHAM LABS     | 14-25                                 |
| SYSTEMS INC                                  | 4-5-6-19-22-24                        |
| TAFFET ELECTRONICS INC                       | 4-11                                  |
| TAPCO GROUP THOMPSON RAMO WOOLDRIDGE INC     | 14-25                                 |
| TECHNICAL PRODUCTS CO INSTRUMENT DIV         | 6                                     |
| TELECHROME MFG CORP                          | 24                                    |
| TELEMETRICS INC                              | 12-23                                 |
| TELERAQ MFG CORP                             | 4-5-8-9-14-25                         |
| TELEX/BALLASTRA                              | 3-4-5-8-10-11-12                      |
| TELONIC ENGINEERING CORP                     | 2-3-4-5-8-9-10-12-18-22-23            |
| TOROTEL INC                                  | 4-5-11-12                             |
| TOROTRON CORP                                | 3-4-5-8-12                            |
| TORWICO ELECTRONICS INC                      | 4-12                                  |
| TRANSFORMER & ELECTRONIC SPECIALTIES         | 3-4-5-8-12                            |
| TRANSFORMER OESIGN INC OF MILWAUKEE          | 3-4-5-8-12                            |
| TRANSFORMER ENGINEERS                        | 3-4-8-12                              |
| TRANSFORMER TECHNICIANS INC                  | 3-4-5-8-12                            |
| TRANSFORMERS INC                             | 4-8-11-12-13-17                       |
| TRANSICOIL CORP                              | 13                                    |
| TRANSONIC INC                                | 3-4-5-7-11-12                         |
| TRELCON ENGINEERING CO                       | 4-8-12                                |
| TRESCO INC                                   | 3-4-5-8-12                            |
| TRG INCORPORATED BOSTON                      | 14                                    |
| TRIAD TRANSFORMER CORP                       | 3-4-5-8-12                            |
| TRINITY EQUIPMENT CORP                       | 1                                     |
| TRION INC                                    | 1                                     |
| T T ELECTRONICS INC                          | 3-4-5-7-8-11-12-15-16-19-21           |
| UNIQUE WIRE WEAVING CO INC                   | 13                                    |
| UNITED TRANSFORMER CORP                      | 2-3-4-5-7-8-11-12-14-18-20-23-24      |
| UNITED TRANSFORMER CORP PACIFIC DIV          | 3-4-5-8-11-12-16                      |
| UTAH RADIO CORP                              | 3                                     |

|                                    |                     |
|------------------------------------|---------------------|
| VACUDENT MFG CO                    | 1                   |
| VALOR ELECTRONICS CO               | 4-10-12-18          |
| VALOR INSTRUMENTS INC              | 4-9-10-12           |
| VARO MFG CO                        | 4-5-8               |
| VIDAIRE ELECTRONICS MFG CORP       | 8-11                |
| VITRO LABORATORIES                 | 22                  |
| WABASH MAGNETICS INC               | 3-4-5-8-12          |
| WABER ELECTRONICS INC              | 3-4-5-8             |
| WAHLGREN MAGNETICS                 | 3-4-5-8-11-12       |
| WASHINGTON TECHNOLOGICAL ASSOC INC | 3                   |
| WATKINS-JOHNSON CO APPL ENGRG      | 4-5-14-18           |
| WAVELABS INC                       | 23                  |
| WAVELINE INC                       | 4-5-8-12-14-25      |
| WELEX ELECTRONICS CORP             | 2-4-5-8-12-16-17-18 |
| WELLS INDUSTRIES CORP              | 1                   |
| WESCO ELECTRIC & MFG CO            | 11-12-16-17         |
| WESTERN ELECTRO ACOUSTIC LAB INC   | 3-4-7-12            |
| WESTERN FELT WORKS                 | 16                  |
| WESTREX CO DIV OF LITTON SYS INC   | 3                   |
| WHEELABRATOR CORA                  | 1                   |
| WHITE INSTRUMENT LABS              | 3-4-5-8-12          |
| WHITEWATER ELECTRONICS INC         | 4-5-10-13-18        |
| WILCOX ELECTRIC CO INC             | 12                  |
| WINEGARD CO                        | 2                   |
| WINTRONICS INC                     | 4                   |
| WYTH ENG INC                       | 12-16-17-18-20      |
| YORK CO INC OTTO H                 | 13                  |

## GAGES & INDICATORS 2000

|  |          |
|--|----------|
| Anemometers                            | 1        |
| Barographs                             | 2        |
| Gages, beta                            | 3        |
| Gages, displacement                    | 4        |
| Gages, ionization                      | 5        |
| Gages, pirani                          | 6        |
| Gages, pressure                        | 7        |
| Gages, strain                          | 8        |
| Gages, stylux pressure                 | 9        |
| Gages, temperature                     | 10       |
| Gages, tension                         | 11       |
| Gages, thickness                       | 12       |
| Gages, vacuum                          | 13       |
| Gages, wire                            | 14       |
| Indicators, antenna position           | 15       |
| Indicators, arc-over                   | 16       |
| Indicators, data display               | 17       |
| Indicators, capacitor leakage          | 18       |
| Indicators, deviation                  | 19       |
| Indicators, dew point                  | 20       |
| Indicators, dielectric constant        | 21       |
| Indicators, fluid flow                 | 22       |
| Indicators, frequency                  | 23       |
| Indicators, ground detector            | 24       |
| Indicators, hardness                   | 25       |
| Indicators, humidity                   | 26       |
| Indicators, illumination               | 27       |
| Indicators, level                      | 28       |
| Indicators, linear displacement        | 29       |
| Indicators, magnetic field             | 30       |
| Indicators, modulation                 | 31       |
| Indicators, moisture                   | 32       |
| Indicators, null                       | 33       |
| Indicators, oxygen                     | 34       |
| Indicators, phase                      | 35       |
| Indicators, power level                | 36       |
| Indicators, pressure                   | 37       |
| Indicators, proximity                  | 38       |
| Indicators, radiation                  | 39       |
| Indicators, R-F                        | 40       |
| Indicators, servo                      | 41       |
| Indicators, shorted turn               | 42       |
| Indicators, sound level                | 43       |
| Indicators, speed                      | 44       |
| Indicators, strain                     | 45       |
| Indicators, telemetering               | 46       |
| Indicators, temperature                | 47       |
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| Indicators, torque                     | 49       |
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| ADVANCE INSTRUMENT CORP                    | 18-26-41-48                               |
| AD-YU ELECTRONICS LAB INC                  | 35  |
| AERO MECHANISMS INC                        | 37  |
| AEROSPACE ELECTRONICS INC                  | 33-34-39-40                               |
| AEROSPACE RESEARCH INC                     | 23  |
| AFFILIATED MANUFACTURERS INC               | 12  |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC  | 40  |
| AIRCRAFT INSTRUMENTS CO                    | 15-18-28-37                               |
| AIRCRAFT RADIO CORP                        | 19  |
| AIRGUIDE INSTRUMENT CO                     | 2-10-26-44                                |
| ALEXANDRIA OIV AMF                         | 18-23                                     |
| ALLARD INSTRUMENT CORP                     | 18  |
| ALLARD INSTRUMENT CORP                     | 18  |
| ALLIS CO LOUIS                             | 18-44                                     |
| ALMA ENGINEERING                           | 31  |
| ALNOR INST CO DV OF ILL TESTING LABS INC   | 10-20-47-52                               |
| AMERAC INC                                 | 23-40                                     |
| AMERICAN AEROSPACE CONTROLS INC            | 30  |
| AMERICAN BOSCH CORP                        | 46  |
| AMERICAN BRAKE SHOE CO RAYMOND ATCHLEY DIV | 7-15-33                                   |
| AMER CHAIN & CABLE BRISTOL CO              | 22-23-26-28-32-33-34-35-36-37-45-46-47-51 |
| AMERICAN GYRO DIV TAMAR ELECT INC          | 18-41-47                                  |
| AMERICAN INSTRUMENT CO                     | 12  |
| AMERICAN RESEARCH & MFG CORP               | 30-50                                     |
| AMERICAN STANDARD CONTROL DIV DETROIT      | 7-8                                       |
| AMERICAN STANDARD CONTROL DIV ROCHESTER    | 10-37-46-47                               |
| AMERICAN STANDARD CONTROL DIV ROCHESTER    | 7-8                                       |
| AMERICAN STANDARD CORP NORWOOD PRODS       | 37-44-47                                  |
| AMERICAN TIME PROD INC                     | 23  |
| B C AMES CO                                | 12-29                                     |
| AMETEK INC HUNTER SPRING DIV               | 11  |
| AMMON INSTRUMENTS INC                      | 18-33-43-47                               |
| AMSTRO CORPORATION                         | 44-47-48-52                               |
| ANADEX INSTRUMENT S INC                    | 23  |
| ANALYTICAL MEASUREMENTS INC                | 32  |
| ANTLAB INC                                 | 15  |
| APPLIED TECHNOLOGY CORP                    | 31  |
| ARMSTRONG WHITWORTH EQUIP                  | 8   |
| ASSEMBLY PRODUCTS INC                      | 4-10-36-44-47                             |
| ASSOCIATED ELECTRICAL INDUSTRIES LTO       | 26-30-33                                  |
| ASSOCIATED RESEARCH INC                    | 24-35                                     |
| ASTRA TECHNICAL INSTRUMENT CORP            | 47  |
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| ASTRO SYSTEMS INC                          | 35-41                                     |
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| AUSTIN ELECTRONICS DIV AUSTIN CO           | 33  |
| AUTHORIZED MFRS SERVICE CO                 | 19-33                                     |
| AUTO OATA                                  | 33  |
| AUTOMATIC TIMING & CONTROLS INC            | 4-7-8-11-12-14-22-28-29-37-38             |
| AUTOMATION PRODUCTS INC                    | 28  |
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| BACH-SIMPSON LTD                           | 33  |
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| BAILEY METER CO WICKLIFF                   | 7-10-13-22-28-34-37-46-47-52              |
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| BAUSCH & LOMB INCORP                       | 12-25                                     |
| BEARING INSPECTION INC                     | 50  |
| BECKMAN INST INC                           | 32  |
| BECKMAN INST INC BERKELEY DIV              | 18-19-23                                  |
| BELL HELICOPTER CO ELECTRONIC OEP          | 18  |
| DIV BELL AEROSPACE                         | 18  |
| BENOIX CORP THE POINEER CENTRAL DIV        | 34-41                                     |
| BENDIX CORP THE FRIEZ INST DIV             | 2-26-44-47-49                             |
| BENDIX CORP THE SHEFFIELD CORP SUB         | 12-25-29                                  |
| BERGEN LABS INC                            | 47  |
| B & F INSTRUMENTS INC                      | 45-47-49                                  |
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| B & K INSTRUMENTS INC OF BRUEL & KJAER     | 43-50                                     |
| BLOCK ASSOC                                | 52  |
| BLUE M ELECTRIC CO                         | 26-47-52                                  |
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| BOSTON AUTO GAGE CO                        | 28  |
| BRAILSFORD & CO                            | 48  |
| BRAMCO INC SUB LEDEX INC                   | 23  |
| BRANSON INSTRUMENTS INC                    | 12  |
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| BROOKS INSTRUMENT CO INC                   | 22-28                                     |
| BROOKS ROTAMETER CO                        | 22-28                                     |
| BROWN & SHARPE MFG CO                      | 14-29                                     |
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| BUDELMAN ELECTRONICS CORP                  | 19-23-40                                  |
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| CAMBRIDGE INSTRUMENT CO INC                | 26-32                                     |
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| CAROLINA MEDICAL ELECTRONICS INC           | 22  |
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 MODEL ENGG & MFG INC 37-41  
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| RADIATION RESEARCH CORP PALM BCH                | 47                                    |
| RADIATION RESEARCH CORP WESTBURY                | 47                                    |
| RADIO CORP OF AMER DETROIT                      | 12                                    |
| RCA DEFENSE ELECT PRDOS CAMDEN                  | 18-41                                 |
| RADIO FREQUENCY LABS INC                        | 30                                    |
| RAMSEY ENG CO                                   | 32                                    |
| RANSON ELECTRICAL INSTRUMENT CO                 | 30                                    |
| RDF CORP  | 46                                    |
| RED POINT CORP                                  | 13                                    |
| REEVES INSTRUMENT CORP                          | 41                                    |
| REPUBLIC FLOW METERS CO                         | 22-37-41-47                           |
| RESEARCH INDUSTRIAL LAB OF ELECTRONICS          | 12-13                                 |
| RESITRON LABS INC                               | 5-10-13                               |
| RIL ELECTRONICS CORP                            | 5-12-13                               |
| ROBERTSHAW-FULTON CDNTROLS CO                   | 28-47                                 |
| ROBERTSHAW FULTON CON CO FULTON SYLPHON DIV     | 7-13-28-37                            |
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| RDYCO INSTRUMENTS INC                           | 10-52                                 |
| SARASOTA ENG CO INC                             | 32                                    |
| SCHAEVITZ ENGG                                  | 4-7-11-12-22-29-33-37-41-45           |
| SCHUTTE & KOERTING CO                           | 13-22-28                              |
| SCIENTIFIC ATLANTA INC                          | 15-29-41                              |
| SCIENTIFIC ELECTRONIC LABS INC                  | 13                                    |
| SCOTT INC H H                                   | 33-43-50                              |
| SECURITY CONTRDLS INC                           | 19-22-28-38                           |
| SEISOR MFG CO DIV SEISMOGRAPH SERVICE CORP      | 18-41                                 |
| SEMITRONICS INC                                 | 39                                    |
| SENTRY INC                                      | 38-44                                 |
| SENDEX INC                                      | 26                                    |
| SERVO CORP OF AMERICA                           | 41-47-52                              |
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| SERVONIC INSTRUMENTS INC                        | 7-29-37                               |
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| SIERRA ELECTRONIC DIV PHILCO CORP               | 13-36                                 |
| SIERRA ENGG CO                                  | 7-8-13-22-34-37                       |
| SIGNALITE INC                                   | 27                                    |
| SIMMONDS AERCESSARIES INC                       | 41-46-51                              |
| SIMMONDS PRECISION PRODS TARRYTOWN              | 7-10-22-26-28-29-32-33-34-37-46-47-51 |
| SIMMONDS PRECISION PRODS GLENDALE               | 46-51                                 |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO     | 23-30-47-52                           |
| SIMPSON ELECTRIC CO MERCER                      | 17-23-33                              |
| SINGER MFG                                      | 22                                    |
| SINGER METRICS DOV SINGER MFG CO                | 23-31-33-36-40-46-47-50               |
| SKIDMORE-WILHELM MFG CO                         | 49                                    |
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| SMITH-FLORENCE INC                              | 33                                    |
| SOLID STATE ELECTRONICS CO                      | 23                                    |
| SONEX INC                                       | 46                                    |
| SOSTMAN & CO HE                                 | 7-10-37-47                            |
| SPACE INSTRUMENTATION CORP                      | 12-18-22-23-29-38-44                  |
| SPECIALTIES INC CHARLOTTEVILLE                  | 27-41                                 |
| SPEC TOOL CO                                    | 23                                    |
| SPECTRAL DYNAMICS CORP OF SAN DIEGO             | 50                                    |
| SPERRY PRODUCTS CO DIV HOWE SOUND CO            | 12                                    |
| SPERTI FARADAY INC                              | 18                                    |
| STANDARD CONTROLS INC                           | 22-37                                 |
| STANDARD PRODUCT INC SUB ELECTR COMM INC        | 18-41                                 |
| STOKES CORP F J                                 | 13                                    |
| STRANDBERG ENGG LABS INC                        | 32                                    |
| STUCKER & YALE INC                              | 12                                    |
| SUNCOAST INSTRUMENTS DIV MILTON ROY CO          | 28                                    |
| SUNSHINE SCIENTIFIC INSTRUMENT                  | 12-24-33-35-42-49                     |
| SWEENEY MFG CO B K                              | 11-17-24-49                           |
| SWIFT LUBRICATOR CO INC                         | 28                                    |
| SYLVANIA ELECTRIC PRODS S EMPORIUM SYSTEMS INC  | 13                                    |
| TABER INSTRUMENT CDRP                           | 18                                    |
| TAFT PEIRCE MFG CO                              | 37                                    |
| TABER INSTRUMENT CDRP AEROSPACE ELECTRONICS DIV | 0                                     |
| TAYLOR INSTRUMENTS COMPANIES                    | 7-10-22-26-41-47                      |
| TECHNICAL OIL TOOL CORP                         | 19-48                                 |
| TECHNI RITE ELECTRONICS INC                     | 12                                    |
| TECHNOLOGY INC                                  | 22                                    |
| TEL-INSTRUMENT ELECTRONICS CORP                 | 30                                    |
| TELOSTAT CORP                                   | 26-32                                 |
| TEMPIL CORP                                     | 47                                    |
| TESTING MACHINES INC                            | 12-25-26-49                           |
| TEXAS INSTRUMENTS INC APPARATUS DIV             | 7-8                                   |
| THERMOLYNE CORP                                 | 52                                    |
| THETA INSTRUMENT CORP                           | 15-33-35-41                           |
| THING ALBERT INSTRUMENT CO                      | 47-52                                 |
| TIPTRONIC INC                                   | 47                                    |
| TORQ ENGINEERED PRODUCTS INC                    | 44                                    |
| TRADE WINDS MFG CO                              | 1                                     |
| TRANSISTOR ELECTRONICS CO                       | 18                                    |
| TRANS METRICS INC                               | 7                                     |
| TRAN SONICS                                     | 10-13-22-37-47                        |
| TRIMOUNT INSTRUMENT DIV GENERAL CONTROLS CO     | 28-29-38                              |
| TRINITY EQUIPMENT CORP                          | 26-32-47                              |
| TRI-R INSTRUMENTS                               | 47                                    |
| TROTT ELECTRONICS INC                           | 17-48                                 |
| TROXLER ELECTRONICS LAB INC                     | 19-23-39                              |
| TUNG SOL ELECTRIC INC NEWARK                    | 18                                    |
| U S SCIENCE CORP                                | 7-37-44-45-47                         |
| ULMER CO THE DIV MICROTRON INDUSTRIES INC       | 6-8-13                                |
| ULTEK CORP                                      | 13                                    |
| UNION SWITCH & SIGNAL DIV                       | 18-46                                 |
| UNIT PROCESS ASSEMBLIES INC                     | 12                                    |

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| UNITED ENGRS ELECTRO NUCLEAR UNSTRS DIV | 18-22-28                             |
| VACTITE                                 | 5                                    |
| VACTRONIC LAB EQUIPMENT INC             | 37                                   |
| VACUUM APPARATUS CO                     | 13                                   |
| VACUUM ELECTRONICS CORP                 | 5-6-13                               |
| VEEDER ROOT INC ELECT CONTROLS DIV      | 18                                   |
| VERCO INC                               | 19-23-33-35                          |
| VIBRAC CDRP                             | 44                                   |
| VIBRATION ENGINEERING PLANT             | 50                                   |
| VICTORY ENGG CD                         | 1-10-22-28-46-47                     |
| VINSON ENGG & SALES CORP                | 29-37-49                             |
| VINSON FLY INC                          | 29-37-49                             |
| WABASH MAGNETICS INC                    | 42                                   |
| WAELINE INC                             | 15                                   |
| WADDELL DYNAMICS INC                    | 37                                   |
| WARREN COMPONENTS DIV EL-TRONICS INC    | 26-32                                |
| WAVELABS INC                            | 50                                   |
| WEKSLER INSTRUMENTS CORP                | 7-19                                 |
| WELLS INDUSTRIES CORP                   | 20-26-32                             |
| WEST COAST RESEARCH CDRP                | 4-8-15-20-22-26-29-37-41-45-47-49-50 |
| WEST INSTRUMENT CORP                    | 47-52                                |
| WESTBERG MFG CO                         | 23-32-44                             |
| WESTERN RADIATION LAB                   | 12                                   |
| WESTGATE LAB INC                        | 7                                    |
| WESTINGHOUSE ELEC CDRP ELEC TUBE DIV    | 5-6-13                               |
| WESTMORE INC                            | 22                                   |
| WESTONICS INC                           | 45-47                                |
| WIANCKO ENG CO                          | 2-7-11-46-49                         |
| WILTRON CO                              | 35                                   |
| WIND TURBINE CO                         | 15                                   |
| WINDSOR ELECTRONICS INC                 | 27-39                                |
| WINSCO INSTRUMENTS & CONTRDLS CO        | 10-47                                |
| WINTRONICS INC                          | 35-38                                |
| YARNALL WARING CO                       | 28-33                                |
| YELLOW SPRINGS INSTRUMENT CO            | 47                                   |
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**HARDWARE 2100**

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| Bases                     | 3  |
| Bearings                  | 4  |
| Boards, plug-in           | 5  |
| Bolts                     | 6  |
| Brackets                  | 7  |
| Breadboards               | 8  |
| Bushings                  | 9  |
| Cabinets, audio equipment | 10 |
| Cabinets, cases           | 11 |
| Cabinet covering          | 12 |
| Cabinets, metal           | 13 |
| Cabinets, non-metal       | 14 |
| Caddy, tube               | 15 |
| Cams                      | 16 |
| Cans                      | 17 |
| Cases, portable           | 18 |
| Casters                   | 19 |
| Castings                  | 20 |
| Chassis                   | 21 |
| Clamps                    | 22 |
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| Clips, alligator          | 24 |
| Clips, crystal diode      | 25 |
| Clips, fannstock          | 26 |
| Clips, grid               | 27 |
| Clips, spring             | 28 |
| Clips, test               | 29 |
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| Consoles                  | 31 |
| Detents                   | 32 |
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| Grommets                  | 43 |
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| Rivets                   | 58 |
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| Shafts, flexible         | 61 |
| Slides, chassis          | 63 |
| Slides, equipment        | 64 |
| Spacers                  | 65 |
| Springs                  | 66 |
| Stampings                | 67 |
| Strain reliefs           | 68 |
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| ABALON PRECASOUN MFG CORP                  | 10-11-13-21-22-31-33-56-59-67                        |
| ABBOTT PRODUCTS INC                        | 38-59  |
| ABBOTT SCREW & MFG CO                      | 6-38-48-53-58-59-60-67-70                            |
| ABC FAIRCO INC                             | 6-60   |
| ACCURATE SPRING MFG CD                     | 28-66  |
| ACE DRILL BUSHING CO INC                   | 9  |
| ACE SPRING MFG CO                          | 66   |
| ACKERMAN ENGRAVERS                         | 53-54  |
| ACME BRASS FOUNDRY CO OF S A INC           | 9-20   |
| ACME MFG & GASKET CO                       | 39-40-67-70  |
| ACME MODEL ENGG CO                         | 7-28-67  |
| ACROMARK CO                                | 51   |
| ACRO TOOL & DIE WORKS                      | 51   |
| AC SPARK PLUG ELECT DIV GMC                | 33-34-40-41  |
| ADAMS RITE MFG CO                          | 38-44-47-49  |
| ADEL PRECISION PROD DV GENERAL METALS CORP | 22-28  |
| ADVANCE GEAR & MACHINE CORP                | 30-36-41-56-57-59                                    |
| AEROFLEX LABORATORIES INC                  | 52   |
| AEROLITE ELECTRONICS CORP                  | 5-7-22-24-27-28-30-36-52-54-55-57-61-67              |
| AEROGUIP CORP                              | 22-23-30   |
| AETNA FELT CO                              | 39   |
| AFFILIATED SCREW PROD CO                   | 46-59  |
| AINSLIE CORP                               | 35   |
| AIRCONDUCTORS                              | 30   |
| AIRCRAFT ARMAMENTS INC                     | 13   |
| AIR O TRONICS ENG CO                       | 24-29  |
| AKRON METALLIC GASKET CO                   | 40   |
| ALAC INC                                   | 44-59-65   |
| ALAN ELECTRONICS                           | 8  |
| ALCON METAL PRODUCTS INC                   | 23   |
| ALDEN PRODUCTS CO                          | 5-7-11-13-17-18-19-21-23-27-28-37-38-44-53-56        |
| ALDEN SYSTEMS CO                           | 35   |
| ALLEN MFG CO                               | 38   |
| ALLIED ALLEGRI MACHINE CO INC              | 59-70  |
| ALLIS CHALMERS W ALLIS                     | 41   |
| ALLMETAL SCREW PRODUCTS CO                 | 6-38-48-53-58-59-60-70                               |
| ALLOYS UNLIMITED INC                       | 70   |
| ALL STAINLESS INC                          | 6-9-38-46-48-53-58-60                                |
| ALPHA CORP                                 | 11-13-14   |
| ALPINE ELECTRONIC COMPONENTS INC WOLCOTT   | 44-46-59   |
| ALPITEC INC                                | 2-7-10-11-12-13-17-18-21-28-31-30-33-56              |
| ALTHOR PRODUCTS                            | 18   |
| ALUMINUM ALLOYS CORP                       | 20   |
| ALUMINUM CO OF AMERICA PITTSBURG           | 6-38-46-48-58-59-70                                  |
| AMATOM ELECTRONIC HARDWARE CO INC          | 4-6-7-9-22-25-26-27-29-30-36-37-38-43-44-46-57-58-59 |
| AMCO ENG CO                                | 10-13-19-21-31-35-53-56-63-64                        |
| AMERAC INC                                 | 16   |
| AMERICAN ALUMINUM CO                       | 11-13-21   |
| AMERICAN ELECTRIC SWITCH DIV               | 53   |
| AMERICAN LAVA CORP SUBS MINN MINING MFG    | 43-65-70   |
| AMERICAN LIGHT ALLOYS INC                  | 20   |
| AMERICAN MACH & FOUNDRY CO NEW YORK        | 10-12-13   |
| AMER MACH & FOUNDRY BUFFALO                | 13   |
| AMERICAN SILVER CO                         | 33-67-70   |
| AMERICAN STANDARD AD TECH LAB              | 30   |
| AMETEK INC HUNTER SPRING DIV               | 22-28-66-67  |
| ANCHOR ALLOYS INC                          | 67-70  |
| ANCHOR SPEC MFG CO                         | 2-5-11-13-14-21-28-29-31-53-54-56                    |
| ANCO INSTR DIV AMER NAME PLANE & MFG CO    | 53   |
| ANDERSON & SONS INC                        | 53-67  |
| ANGLER INDUSTRIES                          | 9-30-44-59-65  |
| ANDDYNE INC                                | 51   |
| ANTENNACRAFT CO                            | 67   |
| ANTI CORROSIIVE METAL PRODUCTS CO          | 38-48-55-58-59-60-70                                 |
| AOTO SWAGE PRODS INC                       | 55   |
| APAHOUSER CORP OF N E                      | 53-54-65   |
| A P M CORP                                 | 6-38-43-59   |



# PRODUCTS & MANUFACTURERS

# Hardware

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| APPLIED DEVELOPMENT CORP MONTEREY PK        | 5-8-11  | COLUMBIA METAL BOX CO                 | 11-13-21-53                         | EYELET TOOL CO                              | 37  |
| APPLIED TECHNOLOGY CORP                     | 13-21   | COMERFORD MFG CO                      | 66-67-70                            | E-Z-HOOK TEST PRODUCTS                      | 29  |
| ARCEL DAVIS MFG CO                          | 13-53   | COMMERCIAL PLASTICS CO                | 22                                  | FACTORY SERVICE CO                          | 35-56   |
| ARCH GEAR INC                               | 41  | COMMUNICATIONS PRODUCTS CO            | 2                                   | FAF INSTRUMENT CORP                         | 8-16-22-30-36-41  |
| ARCH GEAR WORKS INC                         | 7-8-9-16-20-22-30-40-41-56                        | COMPUTER LOGIC CORP                   | 21                                  | FAFNIR BEARING CO DALLAS                    | 4   |
| ARCH INSTRUMENT CO                          | 41  | CONN-CRAFT CO                         | 54                                  | FAFNIR BEARING CO NEW BRITAIN               | 4   |
| ARCON ELECTRONICS DIV OF ARCON INDUST       | 56-63   | CONNECTICUT HARD RUBBER CO            | 40                                  | FAIRBANKS CO                                | 19  |
| ARIZONA G R MFG CO                          | 41-57   | CONNOR SPRING MFG CO                  | 7-22-28-66-67-70                    | FALCON DIV GEN THERMODYNAMICS               | 30  |
| ARNOLD ENGG CO REPATH PACIFIC DIV           | 7-17  | CONSOLIDATED MOLDED PRODUCTS CORP     | 44-54-70                            | FALSTROM CO                                 | 3-7-10-11-13-18-21-31-53-56-67  |
| ARROW MACHINIST & FABRICATORS               | 13-53-67  | CONTINENTAL PRECISION PROD            | 9-37-41-46-55-58-59-65-67-70        | FARWELL METAL FABRICATING                   | 10-11-13-21-53-67   |
| ART WIRE & STAMPING CO                      | 2-7-28-37-38-55-70                                | CONTINENTAL SCREW CO                  | 60                                  | FAULTLESS CASTER CORP                       | 19-34   |
| ARTISAN METAL WORKS CO                      | 3-10-11-13-18-21-31-35-53-56                      | CONTINENTAL X RAY CORP                | 13-21                               | FEAY CO NEAL                                | 53-54   |
| ARVEY CORP                                  | 67  | CONTROL DEVICES                       | 13-31-53                            | FEDERAL MACHINE CO                          | 7-30  |
| ASSOCIATED ENG & MFG CORP                   | 42  | COOK ELECTRIC CO NUCLEDYNE DIV        | 13-53-69                            | FEDERAL SCREW PRODUCTS INC                  | 6-7-9-22-24-26-27-30-37-38-43-46-48-55-58-59-60-65-67-70                                    |
| ASSOCIATED MFG CO                           | 6-37-46-55-59                                     | COOK RESEARCH LABS                    | 16                                  | FEEDBACK CONTROLS INC                       | 41  |
| ASSOCIATED PRODUCTION CO                    | 6-7-9-22-41-46-48-55-59-65-66-67-70               | COOL FIN ELECTRONICS CORP             | 23                                  | FEINER & SONS P                             | 10-11-13-14-21-31-53-54-56  |
| ASTROMATIC DIV CONTROL CO OF AMER           | 54  | CRAIG SYSTEMS INC                     | 7-11-13-18-21-52-56                 | FELT PRODUCTS MFG CO                        | 33-39-40-70   |
| ATKINS & MERRILL INC                        | 14-31   | CROMAME INC                           | 13-18-42-53-54                      | FIDELITONE MICROWAVE INC                    | 67  |
| ATLANTIC OPTICAL MOULDING CO                | 42  | CROWN CONTROLS CORP                   | 1-2-30-36-41-52-53-57-59-67         | FIDELITY AMPLIFIER CO                       | 18  |
| ATLEE CORP                                  | 23-28   | CRYSTAL-X CORP                        | 54                                  | FISHER SPECIAL MFG CO                       | 38  |
| AUBURN MFG CO                               | 33-39-40-43-65-70                                 | CTS OF CANADA LTD                     | 59                                  | FLUIDYNE ENG CORP                           | 42  |
| AUDIO CRAFTERS                              | 10-11-12-14                                       | CUNNINGHAM INDUST INC                 | 16-41                               | FORMICA METAL PROD CO                       | 10-11-31-53   |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC         | 13-64   | CURRY ARTS                            | 12-54                               | FORWAY INDUSTRIES INC                       | 11-13-21-31-53-54-67  |
| AUGAT BROS                                  | 7-22-23-25-28-29                                  | CURTIS DEVELOPMENT & MFG CO           | 5                                   | FRANKE GEAR WORKS INC                       | 41  |
| AUTO-CONTROL LABORATORIES INC               | 53-54   | CUSTOM GEAR CO                        | 41-55-56                            | FREEMAN WASHER & STAMPING CO                | 37-67-70  |
| AUTO-SWAGE PRODUCTS INC                     | 37-55   | CUSTOM PRODUCTS CORP                  | 7-20-22-30-32-39-65-67              | GAP INSTRUMENT CORP WESTBURY                | 41  |
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| ARTISAN ELECTRONICS CORP                   | 36                             |
| ARTTED CO INC                              | 2-4-15-17-18-20-21-22-23-26-   |
|  | 31-32-34-36                    |
| ASHEVILLE-SCHOONMAKER MICA CO              | 3                              |
| ASOUTH CO S A                              | 36                             |
| ASSEMBLY PRODUCTS INC                      | 21                             |
| ASTRO SYSTEMS INC                          | 26                             |
| ATLANTIC TRANSFORMER CORP                  | 1-2                            |



# Inductors & Accessories

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| ATLAS COIL CORP                            | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37 |
| ATLAS ENG CO                               | 26  |
| AULT MAGNETICS CO                          | 18  |
| AUTOMATIC COIL CO INC                      | 2-3-4-15-17-18-20-21-22-23-24-25-26-27-31-32-33-34-36   |
| AUTOMATIC ELECTRIC CO                      | 21-25-26  |
| AUTOMATION IND INC MAGNETICS DIV           | 1-2-4-5-6-7-12-13-15-16-18-20-21-22-23-24-32-36   |
| BARKER & WILLIAMSON INC                    | 1-2-4-15-18-22-23-24-25-26-27-29-30-31  |
| BARWOOD ELECTRONICS INC                    | 1-2-38-39   |
| BELLAIRE ELECTRONICS INC                   | 15-22-25  |
| BELTRONICS CORP                            | 4-5-15-17-18-19-20-22-23-24-25-31-38  |
| BERKELEY INSTRUMENT CO                     | 26-35   |
| BERKSHIRE TRANSFORMER CORP                 | 2-29  |
| BITTERMANN ELECTRIC CO                     | 1-2-12-15-22-26-29-35-36  |
| BLACK & WEBSTER INC                        | 26  |
| BLACKBURN ELECTRIC CORP                    | 1-2-9-12-22-26-29-36-37   |
| BOOKER & WALLSTAD DIV THERMOTEC INC        | 3   |
| BREW & CO RICHARD D                        | 26-36   |
| BRIGHT RADIO LABS INC                      | 22-23   |
| BROADWAY COIL CO                           | 4-5-7-15-19-21-23-24-40   |
| BROWN ENG CO INC                           | 0   |
| BUD RADIO INC                              | 22  |
| BULOVA WATCH CO ELECT DIV                  | 1-2-15-22-26-28-29-31-35  |
| BUNDY ELECTRONICS CORP                     | 26-27-29  |
| BUNNELL & CO J H                           | 30  |
| BURMAC ELECTRONICS CO INC                  | 2   |
| BURNELL & CO INC                           | 1-2-14-15-20-26-27-29-31-35   |
| BURROUGHS CORP ELECTRONIC INSTRS DIV       | 29  |
| BUSH TRANSFORMER CORP                      | 1-2-17-18-26-29-35  |
| RUSHNELL ELECTRIC                          | 7   |
| CADDELL-BURNS MFG CO                       | 3-4-5-15-17-18-20-22-23-24-29-31-32-34-36   |
| CALBEST ELECTRONICS CO                     | 15-22-23-24-32  |
| CALEDONIA ELECTRONICS & TRANSFORMER CORP   | 1-2-12-26-29-35   |
| CALIDYNE CO INC SUB LING-ALTEC ELECTRONICS | 10-13-28  |
| CALIF MAGNETIC CONTROL CORP                | 1-2-10-13-22-26-29-35-36  |
| CALMAG DIV CALIF MAGNETIC CONT CORP        | 26-28-29-35-36  |
| CALTRON PRODUCTS CO                        | 36  |
| CAMBRIDGE THERMIONIC CORP                  | 3-15-22-23-26   |
| CAMPBELL X RAY CORP                        | 29  |
| CANADIAN MARCONI CO                        | 1-2-13-15-18-22-26  |
| CARAD CORP                                 | 1-2-13-16-26-29   |
| CAROL ELECT DIV WEECO                      | 0   |
| CARTER CO J C                              | 12-13-16-36   |
| CELCO CONSTANTINE ENG LABS CO              | 37  |
| CELCO CONSTANTINE ENG LAB CO PACIFIC DIV   | 6-9-12-26-37  |
| CENTRAL TRANSFORMER CO                     | 1-2-29-35   |
| CENTRAL TRANSFORMER CORP                   | 1-2-13-29-38-39   |
| CENTURY COIL CORP                          | 12-29-35-36   |
| CHEM ELECTRO RESEARCH INC                  | 1-2-26-29-35  |
| CHICAGO ELECTRONIC ENGG CO                 | 2   |
| CHICAGO TELEPHONE OF CALIF                 | 1-29  |
| CINEMA ENGINEERING DIV AEROVOX CORP        | 15-22-32  |
| CIRCUITDYNE CORP                           | 1-2-26-27-35  |
| CLEVELAND CONTAINER CO                     | 3   |
| CLEVELAND METAL SPEC CO                    | 20  |
| CLEVELAND METAL SPECIALTIES CO             | 20  |
| CLIPPARD INSTRUMENT LAB                    | 15-17-18-20-22-23-24-29-31-34-36  |
| CLIPPARD INSTRUMENT INC                    | 0   |
| COAST COIL CO                              | 1-2-18-26-29-35   |
| COIL COMPANY OF AMERICA                    | 1-2-10-13-21-26-29-35-36  |
| COIL ENG & MFG MARKLE                      | 21-29-36-40   |
| COIL ENG & MFG CO ROANOKE                  | 21-29-36-40   |
| COILCRAFT INC                              | 4-7-8-15-17-18-19-20-21-22-23-26-29-31-32-34-35-36  |
| COLIN CAMPBELL CO INC                      | 1-2-29-35   |
| COLMAN ELECTRONIC PRODUCTS INC             | 4   |
| COLUMBUS PROCESS CO                        | 1-7   |
| COMAR ELECTRIC CO                          | 21-36-40  |
| COMMUNICATION ACCESSORIES CO               | 1-2-20-26-29-35   |
| COMPUTER COMPONENTS INC                    | 1-2-4-5-15-18-19-20-21-22-23-24-25-29-30-31-36  |
| COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC    | 26  |
| CONTINENTAL ELECTRONICS CORP               | 1   |
| CONTINENTAL ELECTRONIC MFG CO              | 1   |
| LABS LING TEMCO-VOUGHT INC                 | 24  |
| CONTINENTAL X RAY CORP                     | 29  |
| CONTINENTOLMAG LABS                        | 26  |
| COOPER CO D C                              | 14  |
| CORRIGAN COMMUNICATIONS INC                | 2-26-29-35  |
| COSMO PLASTICS CO                          | 3   |
| COTO COIL CO                               | 5-10-12-13-21-25-29-36  |
| CP ELECTRONICS INC                         | 2-10-26-29-35   |
| CRITTENDEN TRANSFORMER WORKS SPRING ST     | 2-29-35   |
| CRITTENDEN TRANSFORMER WORKS ADEAU ST      | 2-38-39   |
| CROWN CONTROLS CORP                        | 2-12-21-29-36   |
| DACO INSTRUMENT CO                         | 36  |
| DALE ELECTRONICS INC COLUMBUS              | 1-4-15-22-32  |
| DALE ELECTRONICS INC SIOUX DV              | 4-12-15-18-20-21-22-23-26-29-31-32-36   |
| DALTRONICS INC                             | 1-2-26-35   |
| DANO ELEC CO                               | 11-21-29-36   |
| DAYTON ELECT PROD CO INC                   | 2-21-29-35-36   |
| DECCO INC                                  | 1-2-13-26-29  |
| DECOURSEY ENGG LAB                         | 26  |
| DEL ELECTRONICS CORP                       | 2-29-35   |
| DELTA COILS INC                            | 1-2-4-5-7-8-15-17-18-19-20-21-22-23-24-26-27-28-29-30-31-32-33-34-36                                  |

|   |   |
|---|---|
| DELTA ELECT CO                            | 36  |
| DELTRON CO INC VAN NUYS                   | 26-35   |
| DELUXE COILS INC                          | 36  |
| DETROIT DESIGNING & ENG CO                | 29  |
| DEVCO DIV R E PHELONCO INC                | 21-35-36  |
| DEWITT DEVELOPMENT CO                     | 15-18-19-22-29-36   |
| DIAMOND COILS INC                         | 1-2-4-14-15-19-20-23-29-31-32-40                                      |
| DIETZ DESIGN INC                          | 1-2-15-22-23-24-26-29-35  |
| DITTMORE FREIMUTH CORP                    | 1-2-3-26-36   |
| DORMEYER INDUSTRIES CHICAGO               | 29-36   |
| DORMEYER INDUSTRIES KENTLAND              | 2-29-35-36  |
| DORSETT ELECTRONICS                       | 18  |
| DOUBLE E PRODUCTS CO                      | 2-22-26   |
| DRESSER ELECT HST DIV                     | 1-2-26-29-35  |
| DURATRAN CORP                             | 13  |
| DURO MATIC PRODUCTS CO                    | 36  |
| DX RADIO PRODUCTS CO                      | 1-2-4-5-9-10-11-12-15-18-19-21-22-23-24-25-26-27-28-31-32-33-35-36-37 |
| EDO CANADA LTD                            | 26-27-28-29   |
| EISLER TRANSFORMER CO INC                 | 1-2-3-29-31-35  |
| ELASCO INC                                | 2   |
| ELECTRAN MFG CO                           | 1-2-29-36   |
| ELECTREND PRODUCTS CORP                   | 4   |
| ELECTRICAL WINDINGS INC                   | 1-2-29-36   |
| ELECTRO ASSEMBLIES INC                    | 1-2-3-4-15-18-20-22-24-29-31-36                                       |
| ELECTRO DEVELOPMENT CORP SEATTLE          | 29  |
| ELECTRO ENGG WORKS                        | 1-2-12-16-29-35   |
| ELECTRONEX INDUSTRIAL LABORATORIES        | 26  |
| ELECTRO WINDERS CO INC                    | 0-36  |
| ELECTRON ARC DIV IONICS INC               | 2-35  |
| ELECTRONIC BRAZING CO                     | 0   |
| ELECTRONIC COILS INC                      | 1-2-15-18-19-21-22-23-24-26-29-31-32-33-35-36                         |
| ELECTRONIC COMPONENTS CORP                | 2-10-26-29  |
| ELECTRONIC COMPONENTS                     | 2-5-29-35   |
| ELECTRONIC COMPUTER CORP                  | 9-11-12-34  |
| ELECTRONIC CONTROLS SYSTEMS INC           | 1-22-26-29-35   |
| ELECTRONIC TECHNOLOGY RESEARCH INC        | 35  |
| ELECTRONIC TRANSFORMERS CORP              | 1-2-5-10-13-19-25-26-28-29-33-35                                      |
| ELITE ELECTRONICS ENGRG CO                | 2-22  |
| EL-RAD MFG CO                             | 1-4-5-11-15-18-20-22-23-26-31-36                                      |
| ENDICOTT COIL CO INC                      | 19-21-36  |
| ENGINEERED PLASTICS INC                   | 3   |
| ENISNG COIL CO                            | 10-20-21-25-26-29   |
| EPCO PRODUCTS INC                         | 1-2-26-29   |
| EPCO PRODUCTS INC                         | 1-2-25-29-35  |
| EPOXY PRODUCTS DIV JOS WALDMAN & SONS     | 3   |
| ERIE RESISTOR CORP                        | 26  |
| ESPEY MFG & ELECTRONICS CORP              | 1-2-5-11-13-14-15-21-22-26-27-31-35-36                                |
| ESSEX ELECTRONICS DIV NYTRONICS INC       | 15-17-18-20-22-23-24-25-26-29-30-31-32-34-36                          |
| ESSEX ELECTRONICS OF CANADA LTD           | 2-15-22-23-26-29-31   |
| JOHN E FAST CO DIV VICTOREEN INST CO      | 2   |
| FERROKUCBE CORP OF MAER                   | 2   |
| FISHER ENGG INC                           | 1-2-15  |
| FLORIDA TRANSFORMER DIV YORK RES CORP     | 0   |
| FORRES & WAGNER INC                       | 21-22-26-31-35-36   |
| THE FOREST ELECT CO                       | 2-29-35   |
| FOSTER TRANSFORMER CO                     | 1-2   |
| FREED TRANSFORMER CO                      | 1-2-26-35   |
| GARDE MFG CO                              | 3   |
| GATES RADIO CO                            | 24  |
| GC ELECTRONICS CO DIV TETRON ELECTRONICS  | 1-2-4-9-10-11-12-15-17-18-19-22-23-24-25-29-32-33-34-37               |
| GENERAL CAPACITOR CO                      | 13  |
| GENERAL COIL PRODUCTS CORP                | 4-6-15-18-20-22-23-24-28-31-32-34-36                                  |
| GENERAL DYNAMICS TELECOMMUNICATION        | 21-25-26  |
| GENERAL ELECTRIC DIST TRANSFORMER DEPT    | 2-29  |
| GENERAL INSTRUMENT CORP NEWARK            | 2-15-22-23  |
| GENERAL INSTRUMENT CORP F W SICKLES DIV   | 2   |
| GENERAL MAGNETICS INC MINN                | 1-2-15-22-25-26-35-36   |
| GENERAL MILLS INC MINN                    | 26  |
| GENERAL RADIO CO                          | 22-26   |
| GENISTRON INC                             | 1-2-22-26   |
| GENISTRON INC BENSENVILLE                 | 1-2-5-26  |
| GEOTRONIC LABS INC                        | 1-2-13-26-29-35   |
| GERTSCH PRODUCTS INC                      | 27  |
| GPL DIV GENERAL PRECISION INC             | 37  |
| GRAND TRANSFORMERS INC GRAND HAVEN        | 1-2-5-29-36   |
| GRAND TRANSFORMERS INC BENTON HARBOR      | 1-2-5-29-36   |
| GRAYHILL HOLDTRONICS INC                  | 3   |
| GREEN RECTIFIER CO                        | 2-29-35   |
| GRIES REPRODUCER CORP                     | 3   |
| GRINNELL ELECTRONICS INC                  | 1-2-26-29-35  |
| GUDEMAN CO OF CALIF                       | 26  |
| GULTON INDUSTRIES INC METUCHEN            | 26  |
| GULTON INDUSTRIES INC CG ELECTS DIV       | 26  |
| HALL MFG CO                               | 26  |
| HANOVIA LAMP DIV/ENGLEHART INDUSTRIES INC | 14-35   |
| HEVI-DUTY ELECTRIC CO DIV BASIC PROD CORP | 35  |
| MEYER INDUSTRIES INCORPORATED             | 9-29-35   |
| LAB OF MARQUETTE CORP                     | 3   |
| H & H MACHINE CO INC                      | 3   |
| HIGHLAND DESIGN INC                       | 29  |
| HILLBURN ELECTRONIC PRODUCTS CO           | 21  |
| HINDLE TRANSFORMER CO                     | 2-14-24-29-35-38-39-40  |
| HISONIC INC                               | 20-26-35  |
| HONEYWELL CONTROLS LTD                    | 21-29   |
| HOUJIANH CO T J                           | 11-24-31  |

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| HUNT ELECTRONICS                          | 35  |
| HYDRAULIC RES ELECT DIV                   | 28  |
| HYDRO MOLDING CO                          | 3   |
| IDEAL INDUSTRIES INC SYCAMORE             | 29  |
| ILLUMITRONIC ENGG CO                      | 4-24  |
| INDUCTOR ENGG INC                         | 2-26-35   |
| INDUSTRIAL ELECTRONIC HARDWARE CORP       | 11-29   |
| INDUSTRIAL ELECTRONICS OF OHAMA INC       | 26-29   |
| INDUSTRIAL TRANSFORMER CORP               | 2-26-29   |
| INTERCONTINENTAL ELECTRONICS CORP         | 1-2-13-25-26-29-35-36   |
| INTERELECTRONICS CORP                     | 1-2-21-38-39  |
| IONICS INC ELECTRON ARC DIV               | 2-35  |
| ISOLANTITE MFG CORP                       | 3   |
| ITT KELLOGG PALO ALTO                     | 29  |
| JAMES ELECTRONIC INC                      | 1-2-3-19-20-21-25-29-35-36  |
| JARVIS ELECTRONICS CORP                   | 1-2   |
| JEFFERS ELECTRONICS DIV SPEER CARBON CO   | 22  |
| JETRONIC INDUSTRIES                       | 2-15-17-18-22-23-24-31-32   |
| JFD ELECTRONIC CORP                       | 2-4-10-15-18-20-22-23-24-26-27-29-31-36-39  |
| JOHNSON CO E F                            | 3-22-24-30-31   |
| JOHNSON ELECTRONICS INC                   | 1-2-4-5-15-20-23-24-26-27-29-31-32-35-36-38   |
| JOHNSTON FOIL MFG CO                      | 13  |
| KAPITOL MAGNETIC CORP                     | 2-26-29-33-35-37  |
| KAY-ESS CO                                | 23  |
| KELL STROM TOOL CO INC ELECT DIV          | 26  |
| KENYON TRANSFORMER CO                     | 2-29-35   |
| KLANN ORGAN SUPPLY CO                     | 21  |
| KNOPP INC                                 | 12-16-19-21-26-29-35-36   |
| KOMAK INC                                 | 20  |
| KOONTZ WAGNER ELECT CO INC                | 36  |
| KRYSTINEL CORP                            | 3   |
| KUHN ELECTRONICS INC                      | 23  |
| K V TRANSFORMER CORP                      | 1-2-29-35-36  |
| LABORATORY FOR ELECTRONICS INC            | 26-27   |
| LEACH CORP LEACH RELAY DIV                | 36  |
| LELAND AIRBORNE PRODUCTS                  | 2-3-26-27-29-35   |
| LINDBERG ENGG CO                          | 35  |
| LINELL ENGG CORP CHAS S                   | 4-15-17-18-20-22-23-24-31-36  |
| LITTON INDUSTRIES ELECTRON TUBE DIVISION  | 16-36   |
| LUMEN INC                                 | 26-35   |
| LYNCH COMMUNICATION SYSTEMS INC           | 1-2-18-25-26-29   |
| MAGNADYNE CORP                            | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34-35-36-37 |
| MAGNETIC CIRCUIT ELEMENTS INC             | 1-2-26-29-35  |
| MAGNETIC INDUSTRIES INC SUB PREC INSTR CO | 2-26-27-28-29-35  |
| MAGNETICO INC                             | 1-2-26-35   |
| MAGNETIC SYSTEMS CORP                     | 1-2-26-29-35-36   |
| MANSON LABORATORIES INC                   | 1-2-15-22-23-24-26-29-35  |
| MARINE ELECTRIC CORP                      | 1-2-29-36   |
| MASTER MOBILE MOUNTS INC                  | 4-31  |
| MATRIX ELECTRONICS CORP                   | 22-26-29-31-35  |
| MATTERN CORPORATION                       | 29  |
| MCCARRON ELECTRIC CO                      | 2-10-19-21-26-29-35-36  |
| MCCREGOR ELECTRONIC INDUSTRIES INC        | 2-29-35   |
| MEAGHER ELECTRONICS CO                    | 3   |
| MECA ELECTRONICS                          | 29-35-36  |
| MELETRON CORP                             | 36  |
| MENLO PARK ENGG                           | 36  |
| METAL SPECIALTY PRODUCTS CORP             | 1-22  |
| METROPOLITAN TELECOMMUNICATIONS CORP      | 1-2-9-15-26-29  |
| COIL WINDERS DIV                          | 1-2-9-15-26-29  |
| MICROMAG INSTRUMENT CO                    | 26  |
| MICROSECOND ELECT INC                     | 2-22-26-31-36   |
| MIDWEST COIL & TRANSF CO                  | 1-2-26-29-35-36   |
| MILLEN MFG CO JAMES                       | 3-15-18-22-23-24-31   |
| MILLER CO J W                             | 2-3-4-15-17-18-20-22-23-24-29-30-31-32-34   |
| MINIATURE ELECTRONIC COMPONENTS CORP      | 36  |
| MINNEAPOLIS-HONEYWELL AERO DIV            | 26-27-28-29-36  |
| MODELECTRIC PRODUCTS CORP                 | 15-18-21-22-29-36   |
| MOLDING ENGINEERS INC                     | 3   |
| MOLONEY ELECTRIC CO                       | 2   |
| MOREY CORP                                | 4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27-28-29-30-31-32-33-34                |
| MULTRONICS INC                            | 4-24-31   |
| MYTRON PRODUCTS INC                       | 36  |
| NATIONAL COIL CO                          | 1-3-4-5-7-10-15-17-18-19-20-22-23-24-29-31-32-33-34-36  |
| NATIONAL MOLDITE CO                       | 3   |
| NATL RADIO CO INC                         | 3-4-15-22-24-26-30  |
| NATVAR CORP                               | 8-10-23-31  |
| NICHOLS PRODUCTS CO                       | 3   |
| NORTH ELECTRIC CO                         | 21-23   |
| NORTH HILLS ELECTRONICS INC               | 15-20-22-23-24-26-31-32   |
| NOTHELFER WINDING LABS INC                | 2   |
| NYGLASS INC                               | 3   |
| NYTRONICS INC BERKELEY HTS                | 15-22-23-24-29-31   |
| NYTRONICS INC LEXINGTON                   | 2-4-18-29-30-31-32-35-36  |
| OGDEN COIL TRANSFORMER CO                 | 0   |
| OHIO CRANKSHAFT CO TOCCO DIV              | 14  |
| OHMITE MFG CO                             | 22  |
| OSBORNE TRANSFORMER CORP                  | 1-2-35  |
| OSTER MFG CO JOHN AVIONIC DIV             | 36  |
| OXFORD ELECTRIC CORP                      | 1-2-5   |
| PAECO DIV HEWLETT PACKARD CO              | 2-16-36   |
| PALO ALTO ENGG CO                         | 2-12-16-26-29-35-36   |
| PARAMOUNT PAPER TUBE CORP                 | 3   |
| PARTRIDGE TRANSFORMERS LTD                | 1-2   |
| PCA ELECTRONICS INC                       | 1-2-20-22-26  |
| PEARSON ELECTRONICS INC                   | 0-35  |
| PENN TRANSFORMER CORP                     | 7-9-11-21-29-37   |
| PERMONITE MFG CO                          | 3   |



# PRODUCTS & MANUFACTURERS

# Inductors & Accessories • Industrial Electronic Equipment

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| P & M ELECTRONICS                            | 22  |
| PHILCO CORP PHILA                            | 1-2-4-15-18-20-22-23-26-29  |
| PHILCO CORP COMMUNICATIONS & WEAPONS DIV     | 1-2-4-15-18-20-22-23-26-29  |
| PHOTOCIRCUITS CORP                           | 20  |
| PHYSIONICS INC                               | 15-18-24  |
| PICKERING CO INC                             | 19-28-36  |
| PLAS TRON CORP                               | 35  |
| POLYPHASE INSTRUMENT CO                      | 26  |
| PRECISION TRANSFORMER CORP                   | 35  |
| PRESTOLE CORP                                | 37  |
| PRINTLOID CORP DEPT E                        | 3   |
| PROFILE ELECTRONICS INC                      | 2-4-5-6-10-14-15-19-20-21-22-23-24-26-28-29-30-31-33-36                 |
| Q L C CORP                                   | 4-15-18-22-23-32  |
| QUALITY COMPONENTS INC                       | 3   |
| QUANTATRON INC                               | 35-36   |
| QUTRONIC TRANSFORMER CORP                    | 26-35   |
| RADATRON INC                                 | 29  |
| RADIO CONDENSER CO HOPESTOWN                 | 15-18-23  |
| RADIO CORP OF AMER DETROIT                   | 31  |
| RADIO SPECIALTY MFG CO                       | 15  |
| RADIO T V PRODUCTS CORP                      | 4-15-18-22-34   |
| RANDALL INC DOUGLAS                          | 21-29-36  |
| RAPID ELECTRIC CO BROOKFIELD                 | 29-35   |
| RATEL INC                                    | 4-15-17-18-22-23-29-32-34-36  |
| RAYCO ELECTRONIC MFG INC                     | 2-22-26-27-29-35  |
| RAYPAR INC                                   | 1-2-4-5-11-18-19-21-22-23-32  |
| RAYTHEON CO MICROWAVE & POWER TUBE DIVISION  | 1-2-9-10-26-29-37   |
| RDF CORP                                     | 19  |
| REOMAN ELECTRONICS CORP                      | 15-18-22-23-26  |
| REED & REESE INC                             | 1-2-4-10-11-15-21-22-25-26-28-29-36                                     |
| REGENCY ELECTRONICS INC                      | 18-26-35  |
| RELCOIL PRODUCTS                             | 15-18-21-26-31  |
| RESDEL CORP                                  | 3   |
| RESEARCH INDUSTRIAL LAB OF ELECTRONICS       | 26-35-37  |
| REUTER INC                                   | 36  |
| RF INTERONICS INC                            | 2-22  |
| RICHARDSON ALLEN CORP                        |   |
| SUB STANDARD KOLLSMAN IND                    | 35  |
| RISCO  | 1-22-26-29  |
| RIXON ELECTRONICS INC                        | 26-28   |
| ROCKER SOLENOID CO                           | 36  |
| ROGERS ELECTRONIC CORP                       | 9-11-17-34  |
| ROLA CO                                      | 1-2-5-9-11-29-37  |
| ROLLAN ELECTRIC CO                           | 1-15-20-29  |
| R S ELECTRONICS CORP                         | 22  |
| RYTRON CO INC                                | 1-2-15-20-22-26-27-29-31-35   |
| SAGE CRAFT INC                               | 15-22-23  |
| SAG HARBOR INDUSTRIES                        | 10-21-25-29-36  |
| SANDERS ASSOCIATES                           | 20  |
| SANGAMO ELECTRIC CO                          | 1-2-26-29-35-39   |
| SARTRON INC                                  | 2-21-22-26-29-35  |
| SATURN ELECTRONICS CORP                      | 1-2-3-9-10-11-16-18-20-22-26-29-33-35-36                                |
| SCHRACK ELECTRICAL SALES CORP                | 21-25   |
| SEABORD PACIFIC DIV ASSOC SPRING             | 4   |
| SEG ELECTRONICS CO INC                       | 26  |
| SEMITRONICS CORP                             | 15  |
| SEW INSULATOR CO                             | 3   |
| SICKLES F W DIV GIC                          | 2-7-11-15-18-20-22-26-31-32-33-34-35-36-37                              |
| SIGNAL TRANSFORMER CO                        | 1-2   |
| SILICONE INSULATION INC                      | 3   |
| SKINNER PREC INDUST INC POLYNOID DIV         | 36  |
| SMALLWOOD LTD S G                            | 4-11-15-17-18-20-22-23-32-34-36   |
| SNC MFG CO                                   | 2-10-26-29-35   |
| SOLA ELECT CO SOLA TRANSFORMER DV            | 2-35  |
| SOLID STATE ELECTRONICS CO                   | 26  |
| SONEX INC                                    | 26  |
| SORENSEN INDUSTRIAL ELECTRONIC CO            | 15-18-22  |
| SOUTHERN ELECTRONICS CO INC                  | 6-7-8-9-12-15-21-23-32-33-34-36   |
| SPACEDONICS & PORTABLE ELECTRIC TOOLS INC    | 10  |
| SPARTON ELECTRONICS                          | 1-2-22-26-29-31-35-36   |
| SPATCO MFG CO                                | 10-29-36  |
| SPECTRO MAGNETIC INDUSTRY                    | 1   |
| SPEER RESISTOR DIV SPEER CARBON CO           | 3   |
| SPELLMAN HIGH VOLTAGE CO INC                 | 29  |
| SPERTI FARAOAY INC                           | 3-14-21-28-36   |
| SPRAGUE ELECTRIC CO N ADAMS                  | 26-35   |
| ST CROIX PLASTICS CORP                       | 3   |
| STANCOR ELECTRONICS INC                      | 2-26-35   |
| STANDARD ELECTRIC PRODUCTS                   | 1-2-11-21-22-23-24-26-27-29   |
| STANDARD WINDING CO DIV OF OVITRON CORP      | 1-2-4-6-7-8-12-15-18-19-20-21-23-24-25-26-27-28-29-30-31-32-33-34-35-36 |
| STANLEY TRANSFORMER CO                       | 1-2-29-38-39  |
| STANWYCK WINDING CO                          | 2-4-5-15-18-20-21-22-23-24-28-29-31-32-39                               |
| STERLING TRANSFORMER CORP                    | 1-2-5-13-26-29-35   |
| STEVENS PRODUCTS INC                         | 3   |
| STEWART MFG CO O M                           | 3   |
| STONE PAPER TUBE CO DIV OF STONE STRAW CORP  | 3   |
| STONITE COIL CORP                            | 36  |
| SUMMIT COIL CO                               | 23-24   |
| SUNOSTRAND DENVER                            | 1-2-26-35   |
| SUPEREX ELECTRONICS CORP                     | 1-3-4-20-22-23-24-31  |
| SUPREME ELECTRO-MAGNETIC CO DIV OXFORD ELEC  | 1-2-5-25-29-35  |
| OXFORD ELECTRIC CORP DIV SUPREME TRANSFORMER | 1-2-5-25-29-33-35   |
| SYLVANIA ELECTRIC PRODUCTS IPSWICH           | 1-2-12-13-14-15-16-18-20-21-25-26-27-29-32-35-36                        |
| SYNTHANE CORP                                | 3   |
| SYNTRONIC INSTRUMENTS INC                    | 9-12-37   |
| TAFFET ELECTRONICS INC                       | 1-22  |
| TECHNICAL APPARATUS BUILDERS                 | 31-35-38-39   |

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| TELE-COIL CO INC                           | 1-2-3-4-5-6-7-8-9-11-12-14-15-17-19-20-21-22-23-24-25-28-29-30-31-32-33-34-36-37 |
| TELETRON CO                                | 37   |
| TELEVISION LABS INC                        | 37   |
| TEL-LABS INC                               | 1  |
| THERMADOR ELECTRICAL MFG CO                | 1-2-20-26-35-36  |
| THOR CERAMICS INC                          | 3  |
| TOPPER MFG CO INC                          | 3-17-26  |
| TOROTEL INC                                | 1-2-25-26-29-35  |
| TOROTRON CORP                              | 26-27-35   |
| TORWICO ELECTRONICS INC                    | 2-26-35  |
| TRAK ELECTRONICS COMPANY INC               | 35   |
| TRANSFORMER & ELECTRONIC SPECIALTIES       | 1-2-26-29-35-36  |
| TRANSFORMER DESIGN INC OF MILWAUKEE        | 1-2-13-26-29-35  |
| TRANSFORMER ENGINEERS                      | 1-2-8-9-26-29-35-37  |
| TRANSFORMER TECHNICIANS INC                | 1-2-26-29  |
| TRANSFORMERS INC                           | 1-2-21-26-27-29-31   |
| TRANSONIC INC                              | 1-2-18-20-26-29-39   |
| TRELCON ENGINEERING CO                     | 29   |
| TRESKO INC                                 | 1-2-26-29-35-36  |
| TRIAD TRANSFORMER CORP                     | 1-2-3-5-9-11-17-20-26-29-34-35-37  |
| TRI-DEX ELECTRONICS                        | 19-22-28   |
| TURBO JET PRODUCTS INC                     | 19-21-36   |
| U S DIELECTRIC INC                         | 22   |
| U S ELECTRONICS CORP LYNDBURST             | 1-2-4-15-17-18-19-20-21-22-25-29-30-32-34-36                                     |
| U S SCIENCE CORP                           | 28   |
| UNITED AERO PRODUCTS CORP                  |  |
| DIV AERO CHATILLON CORP                    | 19-28  |
| UNITED TRANSFORMER CORP                    | 1-2-5-10-14-18-20-21-23-24-26-27-31-35-38-39                                     |
| UNITED TRANSFORMER CORP PACIFIC DIV        | 1-2-26-29-35   |
| UNIVERSAL TOROID COIL WINDING INC          | 1-2-5-9-18-22-23-24-35-37  |
| VALOR ELECTRONICS CO                       | 1-15-20-22-23-24-26-28-29-30   |
| VALOR INSTRUMENTS INC                      | 1-2-11-12-15-20-22-23-24-26-28-30-35   |
| VANGUARD ELECTRONICS CO                    | 2-4-15-18-22-23-24-26-28-31-32   |
| VANGUARD ELECTRONIC LABS                   | 18-23-24   |
| VARI L CO                                  | 26-27-31-35  |
| VARO MFG CO                                | 1-2-26   |
| VICKERS INC ELECTRIC PRODUCTS DIV          | 35-36  |
| WABASH MAGNETICS INC                       | 1-2-5-19-20-21-22-26-27-28-29-35-36  |
| WAHNER ELECTRONICS INC                     | 5-29   |
| WAHLGREN MAGNETICS                         | 1-2-26-29-35   |
| WALDOM ELECTRONICS INC                     | 10-33  |
| WALSOCO ELECTRONICS MFG CO                 | 15-22-23   |
| WARSAW COIL CO                             | 1-2-5-15-18-20-21-32-34-36   |
| WELLS INDUSTRIES CORP                      | 28   |
| WESTLONIC CO                               | 2-14-29-35   |
| WESTINGHOUSE ELECTRIC CORP TRANSFORMER DIV | 2-28-29-35   |
| WHITE INSTRUMENT LABS                      | 26   |
| WHITewater ELECTRONICS INC                 | 3-15-22-23-28-31-32-34-36  |
| WILCO CORP                                 | 4-20-22-23-24-32   |
| WINATIC CORP                               | 21-36-40   |
| WINDSOR ELECTRONICS INC                    | 22-24  |
| WRIGHT ZIMMERMAN INC                       | 15   |
| YORK RESEARCH CORP KIP ELECTRONICS DIV     | 29   |
| Z & W MFG CORP                             | 35-36  |

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|--|-------------|
| ACCURATE ELECTRONICS CO CHICAGO              | 9           |
| ACCESSORY PROD CO DIV OF TETRON INC          | 1-26        |
| ACME ELECTRIC HEATING CORP                   | 5-13-14-16  |
| ACOUSTICA ASSOCIATES INC                     | 21-23       |
| ACOUSTICA ASSOCIATES                         | 23-24       |
| ADCOM CORP                                   | 18          |
| ADVANCE TECHNOLOGY LABS DIV AMER STANDARD    | 18-21-22    |
| ADVANCED ELECT CORP                          | 18          |
| ADVANCED MEASUREMENT INST INC                | 18          |
| AD-YU ELECTRONICS LAB INC                    | 12          |
| AEROFLEX LABORATORIES INC                    | 21          |
| AEROSPACE ELECTRONICS INC                    | 2           |
| AEROSPACE RESEARCH INC                       | 12          |
| AIRFLYTE ELECTRONICS CO                      | 18          |
| AIRPAX ELECTRONICS PACIFIC DIV               | 18          |
| AIRPAX ELECTRONICS INC PASADENA              | 18          |
| ALCAR INSTRUMENTS INC                        | 10-11-23-24 |
| ALLEGANY INSTRUMENT CO                       | 21          |
| ALLEN ELECTRIC & EQUIPMENT CO                | 0           |
| ALLSTATE ELECTRONICS INC                     | 13          |
| ALSOPE ENGRG CORP                            | 9           |
| AMERICAN AIR FILTER CO                       | 17          |
| AMERICAN AIRFRAME CORP                       | 1-2         |
| AMERICAN BOSCH CORP                          | 18          |
| AMERICAN BRASK SHOE CO RAYMOND ATCHLEY DIV   | 26          |
| AMERICAN ELECT LABS MICROWAVE & PHASING      | 18          |
| AMERICAN INSTRUMENT CO                       | 3           |
| AMERICAN MEASUREMENT & CONTROL BURLINGTON    | 1-26        |
| AMERICAN MICROWAVE & TV CORP                 | 22-27       |
| AMERICAN MISSILE PROD CO INC                 | 12-18       |
| AMERICAN PRODUCT DEVELOPMENT CO              |             |
| DIV AMERICAN DOOR & WINDOW CO INC            | 6-8-13-16   |
| AMERICAN STERILIZER SCIENTIFIC & IND DEPT    | 23          |
| AMTEL AMERICAN MICROWAVE & TELEVISION        | 22-27       |
| ANALYTIC SYSTEMS CO                          | 1-14-18-25  |
| ANNIS CO R B                                 | 3           |
| APCO ACCESSORY PRODUCTS CO                   | 26          |
| APPLIED CONTROL CORP                         | 2-19        |
| APPLIED ELECTRONICS CORP OF N J              | 18          |
| APPLIED MAGNETICS CORP                       | 12          |
| APPLIED PHYSICS CORP                         | 14-15-25    |
| APPLIED SYSTEMS CORP                         | 14          |
| AR & DA ENGG CO                              | 21          |
| ARMSTRONG WHITWORTH EQUIP                    | 18          |
| ASSEMBLY PRODUCTS INC                        | 10-19-21    |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD         | 30          |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD         | 35-53       |
| ASSOCIATED RESEARCH INC                      | 12          |
| ASTROMETRICS INC                             | 18          |
| ATELIERS DE MONTAGES ELECT                   | 15          |
| ATOMIC ACCESSORIES INC                       | 15-23       |
| AUTOMATIC CONTROL CO                         | 18          |
| AUTOMATIC TIMING & CONTROLS INC              | 19-21       |
| AUTOMATION DYNAMICS CORP                     | 18-21       |
| BALFAU ELECTRIC CORP                         | 27          |
| BARBER COLMAN CO AIRCRAFT & MISSILE PROD DIV | 1           |
| BARBOUR STOCKWELL CO                         | 1           |
| BARKSDALE VALVES                             | 26          |
| BARNES ENGINEERING CO                        | 14          |
| BAR RAY PRODUCTS INC                         | 37          |
| BARRETT ELECTRONICS CORP                     | 20          |
| BARRETT ELECT CORP WESTERN DIV               | 18          |
| BARRY ELECTRONICS CORP NEW YORK              | 29          |
| BAUSCH & LOMB INCORP                         | 14          |
| BEARING INSPECTION INC                       | 10-23       |
| BECKMAN & WHITLEY                            | 12          |
| BECKMAN INST INC                             | 14          |
| BENCO TELEVISION ASSOC LTD                   | 22          |
| THE BENDIX CORP CINCINNATI DIV               | 17          |
| BENDIX CORP THE POINER CENTRAL DIV           | 23          |
| BENDIX CORP THE SHEFFIELD CORP SUB           | 19-27       |
| B & F INSTRUMENTS INC                        | 21          |
| B I F INDUSTRIES                             | 18          |
| BISCHOF DTE ENGRAVING                        | 7           |
| BLACK LIGHT PRODUCTS INC CHICAGO             | 25          |
| BLACKSTONE CORP                              | 21-23-24    |
| BLACK ASSOC                                  | 14          |
| BLUE M ELECTRIC CO                           | 8           |
| BOONSHAFT & FUCHS INC                        | 26          |
| BRAILSFORD & CO                              | 18          |
| BRAMCO INC SUB LEDEX INC                     | 18          |
| BRIDGE ELECTRONICS CO INC                    | 18          |
| BRISTOL CO WATERBURY                         | 7           |
| BRISTOL CO LOS ANG                           | 18          |
| BRUSH INSTRUMENTS                            | 8           |
| BTU ENGG CORP                                | 8           |
| BUTCHER CO L H                               | 23          |
| BYREX CORP                                   | 21          |
| BYREX CORP                                   | 21          |
| CADOILLAC GAGE CO                            | 1-26        |
| CALIF TECHNICAL INDUSTRY DIV TETRON INC      | 19          |
| CALIFORNIA COMPUTER PRODS INC ANAHEIM        | 18          |
| CAMBRIDGE SYSTEMS INC                        | 12          |
| CAMPBELL X RAY CORP                          | 17-27       |
| CANADIAN APPLIED RESCH DV A V ROE CANADA LT4 | 12          |
| CANADIAN AVIA ELECTS                         | 18          |
| CANADIAN RESEARCH INSTITUTE                  | 5-7-12      |
| CAVITRON ELECTRON OSCILLATOR CO COSTA MESA   | 5-6-13-15   |
| CENTURY COIL CORP                            | 19          |
| CENTURY ELECT INST INC TULSA                 | 21          |
| CENTURY ELECTRONICS & INSTS INC              |             |
| SUB CENTURY GEOPHYSICAL CORP                 | 12-18-21    |
| CHANNEL INDUSTRIES INC                       | 21          |
| CHESAPEAKE INSTRUMENT CORP                   | 21          |
| CINCINNATI CLEANING & FINISHING MACHINERY CO | 14-16-23    |
| CLARE & CO P J                               | 18          |
| CLARK ELECTRONIC LABS                        | 21          |
| CLARKSON LABORATORIES INC                    | 23          |
| CLEVELAND INSTRUMENT CO                      | 19          |
| C M MFG & MACHINERY CO                       | 8           |
| COHU ELECTRONICS INC KIN TEL DIV             | 22          |

## INDUSTRIAL ELECTRONIC EQUIPMENT 2301

|                                 |    |
|---------------------------------|----|
| Actuators                       | 1  |
| Amplifiers, thyatron            | 2  |
| Balancing equipment, dynamic    | 3  |
| Barographs                      | 4  |
| Dielectric heating equipment    | 5  |
| Dryers, electronic dehydration  | 6  |
| Dynamometers                    | 7  |
| Electric furnaces               | 8  |
| Electroplating equipment        | 9  |
| Flaw locators, metal            | 10 |
| Flaw locators, non-metal        | 11 |
| Geophysical instruments         | 12 |
| Induction heating equipment     | 13 |
| Infrared equipment              | 14 |
| Ionization chambers             | 15 |
| Dvens, infrared drying          | 16 |
| Photoelectric units             | 30 |
| Precipitators, electrostatic    | 17 |
| Telemetering                    | 18 |
| Thickness equipment, electronic | 19 |
| Thickness equipment, ultrasonic | 20 |
| Transducers                     | 21 |
| TV, industrial                  | 22 |
| Ultrasonic cleaners             | 23 |
| Ultrasonic metal joining        | 24 |
| Ultra-violet equipment          | 25 |
| Valves, servo                   | 26 |
| X-ray inspection equipment      | 27 |
| Dvens, component                | 28 |
| Filter systems                  | 29 |

# Industrial Electronic Equipment

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| COLUMBIA RESEARCH LABS                       | 21           |
| COLUMBUS PROCESS CO                          | 21           |
| COMMUNICATIONS ELECTRONICS CO                | 18           |
| COMPUTER INSTRUMENTS CORP                    | 18-21        |
| COMPUTER LOGIC CORP                          | 18           |
| CONNECTICUT INSTRUMENT CORP                  | 14           |
| CONSOLIDATED AIRBORNE SYSTEMS INC            | 17           |
| CONSOLIDATED CONTROLS CORP                   | 1-26         |
| CONSOLIDATED ELECT CORP                      | 21-25        |
| CONTINENTAL SENSING INC                      | 5            |
| CONTINENTAL TECHNICAL SERVICE INC            | 18           |
| CONTINENTAL X RAY CORP                       | 27           |
| CONTROL EQUIPMENT CORP                       | 18           |
| JERVIS B WEBB CO CONTROL ENG CO DIV          | 7            |
| CONTROLMAG LABS                              | 19           |
| CONTROL SCIENCE CORP                         | 18           |
| CONTROL TECHNOLOGY CO                        | 1-2          |
| COOPER CO D C                                | 8-9-13-14-16 |
| CORDONA ENGG SERVICE                         | 2            |
| COUSINO ELECT CORP                           | 1            |
| CRAMER DIV GIANNINI CONTROLS CORP            | 13           |
| CRANE SYST & CONTRLS GROUP                   | 0            |
| CREST ULTRASONICS CORP                       | 23           |
| CROWN CONTROLS CORP                          | 1            |
| CRYONETICS CORP                              | 0            |
| CRYSTAL RESEARCH PRODUCTS                    | 3            |
| CUNNINGHAM SON & CO INC JAMES HONEYEY FALLS  | 1            |
| CUTLER HAMMER INC                            | 30           |
| DACO INSTRUMENT CO                           | 6            |
| THOMPSON RAMO WOOLDRIDGE INC DAGE DIV        | 22           |
| DALLONS LABS                                 | 23           |
| DALMO VICTOR CO DIV TETRON INC               | 26           |
| OATA CONTROL SYSTEMS INC                     | 18           |
| OATALOG DIVISION AIR LOGISTICS CORP          | 18           |
| DATA MASTER CORP THE                         | 2-18         |
| OATA SENSORS INC                             | 22           |
| OATAMETRICS INC                              | 7            |
| OATEX CORP                                   | 18           |
| DAWE INSTRUMENTS LTD                         | 3            |
| DAYTRONIC CORP                               | 19-21        |
| OBM RESEARCH CORP                            | 18           |
| DECKER CORP                                  | 3            |
| DEITZ CO S J                                 | 2            |
| OEL ELECTRONICS CORP                         | 14-17        |
| OELCON CORP                                  | 11           |
| DELSEN CORP                                  | 11-19        |
| DELTA SONICS INC                             | 23-24        |
| DEMENT LABS                                  | 25           |
| DE-TEC-TRONIC CORP                           | 2-19         |
| DIAMOND POWER SPECIALTY CORP ELECTRONIC DIV  | 22           |
| DIATRON INC                                  | 5            |
| DICE CO J W                                  | 10-19-20     |
| DIETZ CO S J                                 | 2            |
| DILLON & CO INC W C                          | 19           |
| DITTHORE FREIMUTH CORP                       | 5            |
| DON LAN ELECTRONICS CORP SUB QUANTATRON INC  | 21           |
| DORSETT ELECTRONICS                          | 18           |
| DRESSER ELECT SIE DIV                        | 18           |
| DRESSER ELECTRIC CO DETROIT                  | 9            |
| DRYOMATIC CORP                               | 6            |
| DUMONT LABS INC ALLEN B                      | 10-22        |
| DUNN ENG CORP                                | 7            |
| DYNAIR ELECTRONICS INC                       | 22           |
| DYNALECTRON CORP MATTERN DIV                 | 27           |
| DYNAPLEX CORP                                | 18           |
| DYNAPOWER SYSTEMS CORP                       | 0            |
| DYNASONICS CORPORATION                       | 23           |
| DYNEL INC                                    | 18           |
| DYNSCO DIV AMERICAN BRAKE SHOE CO            | 21           |
| EASTERN INDUSTRIES DIV OF L F E INC          | 26           |
| EATON MFG CO DYNAMIC DIV                     | 1-7          |
| ECKEL VALVE CO                               | 26           |
| EDCLIFF INSTRUMENTS                          | 25           |
| EDISON INDUST THOMAS A INST DIV              | 21           |
| EDO CANADA LTD                               | 21           |
| EOO CORP COLLEGE PT                          | 21-23        |
| EGAN LABORATORY                              | 14           |
| EISLER ENGG CO                               | 8            |
| EISLER TRANSFORMER CO INC                    | 8            |
| ELECT MECHANICAL RES INC                     | 18           |
| ELECTRICAL SERVICE CO                        | 30           |
| ELECTRO CERAMICS INC SALT LAKE               | 2            |
| ELECTRO DEVICES INC PATERSON                 | 12           |
| ELECTRODYNAMIC INSTRUMENT CORP               | 1            |
| ELECTRO KINETICS CORP                        | 1            |
| ELECTROMATION CO                             | 1            |
| ELECTROMODE                                  | 13-14        |
| ELECTRONEX INDUSTRIAL LABORATORIES           | 19           |
| ELECTRO PROD LABS INC                        | 21           |
| ELECTRO RADIATION INC                        | 14           |
| ELECTRO SEAL CORP                            | 1            |
| ELECTRO VISION LAB                           | 1-2          |
| ELECTRON CORP                                | 22           |
| ELECTRON ARC DIV IONICS INC                  | 9            |
| ELECTRON HEATING CORP                        | 0            |
| ELECTRON OHIO INC                            | 10-19        |
| ELECTRONIC ASSISTANCE CORP                   | 21           |
| ELECTRONIC CONTROL CORP                      | 2            |
| ELECTRONIC CONTROLS INC                      | 2            |
| ELECTRONICS & ORDANCE DIV AVCO CORP          | 14           |
| ELECTRONICS CORP OF AMERICA CAMBRIDGE        | 30           |
| ELION INSTRUMENTS INC                        | 21           |
| EMERSON ELECTRIC MFG CO ELECT & AVIONICS DIV | 21           |
| EMI US LOS ANG                               | 22-27        |
| EMI US LTD GENERAL COMM DIV                  | 22           |
| EMI/US NO HOLLYWOOD                          | 22           |
| ENDEVCO CORP                                 | 21           |
| ENGLEHARD HANOVIA INC                        | 14-25        |
| ENTRON INC                                   | 22           |
| EPPEL LAB INC                                | 14           |
| EPSCO INC CAMBRIDGE                          | 18           |
| EROCO ENGG CORP                              | 5-6-13       |
| ERIE ELECTRONICS DIV                         | 21-23        |
| ESS GEE INC                                  | 18           |

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| EXACT ENGG MFG INC                           | 1               |
| FARRAND OPTICAL CO INC                       | 14              |
| FEDERAL EQUIPMENT CO                         | 30              |
| FEDERAL MFG & ENG CORP TV SPECIALTY DIV      | 22              |
| FIDELITY AMPLIFIER CO                        | 2               |
| FIELD EMISSION CORP                          | 27              |
| FISCHER & PORTER CO                          | 18-21           |
| FISHER RESEARCH LAB                          | 12              |
| FLAME RESEARCH INC                           | 14              |
| FLORIDA GEARS & SYSTEMS INC                  | 1               |
| FOSTORIA CORP DEPT D2                        | 8-14-16         |
| FOSTORIA CORP OHIO                           | 8-14-16         |
| FOXBORO CO                                   | 18              |
| FRANKLIN SYSTEMS INC                         | 10-11-19        |
| GARDNER LAB INC                              | 19              |
| GEARTRONICS CORPORATION                      | 1               |
| GENERAL ATRONICS CORP ATRONIC PROD DIV       | 1               |
| GENERAL CONTRDLS CO GLENDALE                 | 1               |
| GENERAL CONTROLS CO AIRCRAFT/ELEC CONTROLS   | 1               |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 23              |
| GENERAL ELECTRIC CO SHELBYVILLE              | 8-13-14-16      |
| GENERAL ELECTRIC CO COXSACKIE                | 13              |
| GENERAL ELECT CO SPECIALTY DEVICES OPER      | 21              |
| GENERAL ELECTRODYNAMICS CORP                 | 5-13            |
| GENERAL ELECTRONIC LABS INC                  | 18              |
| GENERAL INSTR CORP HARRIS A S W DIV          | 21-23           |
| GENERAL INSTRUMENT CORP RADIO RECEPTOR DIV   | 18              |
| DEF & ENGG PRODS GRP                         | 23              |
| GENERAL KINETICS INC                         | 23              |
| GENERAL THERMOANALYTICS INC                  | 8-14-16         |
| GEOPHYSICAL INST CO INC                      | 12              |
| GEOPHYSICAL SPECIALTIES CO WAYZATA           | 12              |
| GEOPHYSICAL SPEC CO HOPKINS                  | 12              |
| GEOSCIENCE INSTRUMENTS CORP                  | 23              |
| GEOTECHNICAL CORP                            | 12-18           |
| GEOTRONIC LABS INC                           | 12              |
| GIANNINI CONTROLS CORP CONRAC DIV            | 22              |
| GIANNINI CONTROLS CORP TRANSOUCER DIV        | 21              |
| GIANNINI CONTROLS CORP NJ DIV                | 5-6-13          |
| GIROLO PROCESS EQUIP DIV                     | 1               |
| GLOBE INDUSTRIES INC                         | 2               |
| GPL DIV GENERAL PRECISION INC                | 22              |
| GREEN INSTRUMENTS INC H J                    | 9               |
| GREEN RECTIFIER CO                           | 9-16-27         |
| GREINER CO EMIL                              | 8-9             |
| GRUENBERG ELECTRIC CO INC                    | 8               |
| GUIDANCE TECHNOLOGY INC                      | 1               |
| GUIDE MFG CO                                 | 1               |
| GUIDE ELECTRONICS INC                        | 5-6-13-20-23-24 |
| GULTON INDUSTRIES INC METUCHEN               | 18-23-24        |
| GULTON INDUSTRIES INC CG ELECTS DIV          | 18              |
| HALEDY ELECT CO                              | 30              |
| HALLAMORE ELECTRONICS CO                     | 18-21           |
| HALLICRAFTERS PACIFIC DIV                    | 11              |
| HALLMAR ELECTRONICS INC                      | 21              |
| HAMILTON WATCH CO INDUSTRIAL PRODS DIV       | 12              |
| HAMMARLUND MFG CO INC MARS HILL              | 18              |
| HANOVIA LAMP DIV/ENGLEHART INDUSTRIES INC    | 14-16-17        |
| HARSHAW CHEMICAL CO                          | 14-25           |
| HARWALD CO INC                               | 11              |
| HAYES INC C I                                | 5-8-13          |
| HAZELTINE ELECTRONICS DIV/HAZELTINE CORP     | 18-21           |
| HEHN LESTER C                                | 30              |
| HEYER INDUSTRIES INCORPORATED                | 21              |
| LAB OF MARQUETTE CORP                        | 22              |
| HICKOK ELECTRICAL INSTRUMENT CO              | 8-13            |
| HIGH VACUUM FURNACE & ELECT DV               | 18              |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 1-18            |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 1-18            |
| HOOVER ELECTRIC CO                           | 6-16            |
| HOTPACK CORP                                 | 2-13            |
| HOTWATT INC                                  | 26              |
| HUNT ELECTRONICS                             | 26              |
| HYDRAULIC RES ELECT DIV                      | 21              |
| HYDROPOISE INC SUB BROOKS INST CO            | 12-21           |
| HYTECH DIV OF BISSETT BERMAN CORP            | 12-26           |
| IDEAL AEROSMITH INC DIV ROYAL INDUSTRIES     | 12-26           |
| INDIKON CO                                   | 21              |
| INDUCTION HEATING CORP                       | 19              |
| INDUSTRIAL ELECTRONICS INC                   | 21-30           |
| INDUSTRIONICS CONTROLS INC                   | 21              |
| INERTIA SWITCH INC                           | 1               |
| INFRARED INDUSTRIES INC WALTHAM              | 14-30           |
| INFRARED INDUSTRIES INC WESTERN DIV          | 14              |
| INJECTORALL CO                               | 23              |
| INSTRON ENGG CORP                            | 21              |
| INSTRUMENT DEVELOPMENT LABS INC              | 18              |
| INSTRUMENTS OF N E                           | 19              |
| INTERNATIONAL DATA SYSTEMS INC               | 18              |
| INTERNATIONAL RESEARCH & DEVELOPMENT CORP    | 3-21            |
| INTERNATIONAL RESISTANCE CO PHILA            | 21              |
| IONIC ELECTROSTATIC CORP                     | 13-17           |
| IONIC MIDWEST CORP                           | 9               |
| IONICS INC ELECTRON ARC DIV                  | 9               |
| IRCON INFRARED CONTROLS INC                  | 14              |
| IRWIN LABS INC                               | 10              |
| IT & T INDUSTRIAL PRODUCTS DIV               | 14-22           |
| JACK & HEINTZ DIV SIEGLER CORP               | 1               |
| JARVIS ELECTRONICS CORP                      | 13-21           |
| JERROLD ELECTRONICS CORP                     | 22              |
| JORDAN CONTROLS INC                          | 1               |
| JORDAN ELECTRONICS DIV VICTOREEN             | 15-21           |
| KAHLE ENGG CO                                | 8               |
| KANTHAL CORP                                 | 8               |
| KAUKE & CO INC                               | 18              |
| KELEKET X RAY OV LABS FO ELECT               | 27              |
| KELL STROM TOOL CO INC ELECT DIV             | 19              |
| KEWAUNEE SCIENTIFIC EQUIP                    | 8               |
| KIODE ULTRASONIC & DETECTION ALARMS INC      | 30              |
| KINNELECTRONICS CORP                         | 5-13            |

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|  |             |
|--|-------------|
| KISTLER INSTRUMENT CORP                      | 21          |
| KLEER-TRONICS INC                            | 5           |
| KOLLSMAN INST CORP STD KOLLSMAN IND INC      | 14          |
| KOLLSMAN INSTRUMENT CORP                     | 14          |
| SUB STANDARD KOLLSMAN IND                    | 17          |
| KOPPERS CO INC                               | 1           |
| KPT MFG CO                                   | 21          |
| KULITE BYTRON CORP                           | 21          |
| KULITE SEMICONDUCTOR PROD INC                | 7           |
| LAB CORP                                     | 16          |
| LABLINE INC                                  | 8-13        |
| LABORATORY EQUIPMENT CORP                    | 21          |
| LAFAYETTE INSTRUMENT CO                      | 18          |
| LAI I & E DIV                                | 5           |
| LA ROSE & ASSOC INC W T                      | 1-7-26      |
| LEAR INC ELECTRO-MECHANICAL DIV              | 1-26        |
| LEAR SIEGLER INC POWER EQUIP DIV             | 21          |
| LEBOW ASSOCIATES                             | 1           |
| LEDEX INC                                    | 8-21        |
| LEEDS & NORTHROP CO                          | 3           |
| LEHIGH VALLEY ELECT ENGG & MFG CO            | 18          |
| LENKURT ELECTRIC CO                          | 13          |
| LEPEL HIGH FREQUENCY LABS                    | 8-13        |
| LINDBERG ENGG CO                             | 1           |
| LING-TEMCO VOUGHT INC ELECT DIV              | 12          |
| LITTON SYSTEMS INC APPLIED SCIENCE DIVISION  | 1-18        |
| LOCKHEED ELECT CO INFORMATION TECHNOLOGY DIV | 23          |
| L & R MFG CO                                 | 1           |
| LUMEN INC                                    | 1           |
| LUNDY ELECTRONICS & SYSTEMS INC              | 1           |
| MAGNAFLUX CORP                               | 10-11-20-25 |
| MAGNETIC ANALYSIS CORP                       | 10          |
| MAGNETICS INC                                | 18          |
| MAGTROL INC                                  | 7           |
| MARKITE CORP                                 | 21          |
| MARQUETTE DIV CURTISS-WRIGHT CORP            | 26          |
| MARYLAND TELECOMMUNICATIONS INC              | 19-22       |
| MASTER APPLIANCE INC                         | 11          |
| MATTERN CORPORATION                          | 27          |
| MAYFLOWER ELECTRONIC DEVICES INC             | 5           |
| MCCULLOUGH TOOL CO                           | 12          |
| MCKENNA LABORATORIES                         | 21-23       |
| MEASUREMENT SYSTEMS INC                      | 12-14-25    |
| MECH-TRONIC EQUIPMENT CO                     | 8           |
| MECTRON CO N PLAINFIELD                      | 6           |
| MEDTRONIC INC                                | 18          |
| MELABS                                       | 18          |
| MELETRON CORP                                | 4           |
| MICRO BALANCING INC                          | 3           |
| MICRO MEASUREMENTS CORP                      | 21          |
| MICROMECH MFG CO                             | 23          |
| MICRO SYSTEMS INC                            | 21          |
| MIDWESTERN INSTRUMENTS                       | 18-21-26    |
| MILLETRON INC                                | 47          |
| MINATRON CORP                                | 21          |
| MINCO PRODUCTS INC                           | 21          |
| MINI-TOOL TECHNICAL INDUST INC               | 23          |
| MINNEAPOLIS HONEYWELL APPARATUS CONTROLS DIV | 1-21-25     |
| MINNEAPOLIS-HONEYWELL PRECISION METER DIV    | 13          |
| MINNEAPOLIS-HONEYWELL BROWN INST DIV         | 18-21       |
| MIRATEL INC ST PAUL                          | 22          |
| MKS INSTRUMENTS INC                          | 4-21        |
| MODEL ENGG & MFG INC                         | 1-5-10-26   |
| MODERN LABORATORY EQUIP CO                   | 8-16        |
| MONITOR SYSTEMS INC                          | 18          |
| MONROE ELECTRONICS INC                       | 19-21       |
| MONTEK ASSOCIATES INC                        | 1           |
| MOTOROLA INC SOLID STATE SYSTEMS DIV         | 18          |
| MRC MFG CO SUB MATERIALS RES CORP            | 13          |
| MUIRHEAD INSTRUMENTS INC                     | 19          |
| MULLARD EQUIPMENT LTD                        | 23-24       |
| MYTRON MFG CO                                | 5           |
| NATL RADIANC INC                             | 15          |
| NATL ULTRASONIC CORP SOMERVILLE              | 21-23       |
| NATIONAL ULTRASONIC CORP/NUTLEY              | 21-23       |
| NATVAR CORP                                  | 11-12       |
| NILSEN MFG CO                                | 21          |
| NORBATROL ELECTRONICS CORP                   | 13          |
| NORTH AMERICA ELECTRONICS                    | 22          |
| NORTH ATLANTIC INDUST INC                    | 12-19       |
| NORTHERN PRECISION LABORATORIES              | 18          |
| NORTHERN RADIO CO                            | 18          |
| NUCLEAR CORP OF AMER DENVER                  | 15          |
| NUCLEONIC CORP OF AMERICA                    | 15          |
| OHIO CRANKSHAFT CO TOCCO DIV                 | 8-13        |
| OHIO SEMICONDUCTORS                          | 21          |
| DIV TECUMSEN PRODS CO                        | 15          |
| OHMART CORP                                  | 3           |
| OLSEN TINIUS TESTING MACH CO                 | 12          |
| OMCO   | 19          |
| ONIC DEVICES INC                             | 9           |
| OPAD ELECTRIC CO                             | 14          |
| OPTIC ELECTRONIC CORP                        | 18          |
| ORBITRAN CO INC                              | 1           |
| OTIS ELEVATOR CO DEFENSE & INDUSTRIAL DIV    | 26          |
| OZONE METAL PRODUCTS CORP                    | 18-21       |
| PACE ENGINEERING CO                          | 18          |
| PACIFIC COMMUNICATIONS & ELECTRONICS CO      | 18          |
| PAN FAX INC                                  | 10-21       |
| PEBBLES & CO LTD BRUCE                       | 1-26        |
| PEGASUS LABS INC                             | 3           |
| PELTON DIV BALDWIN LIMA HAMILTON CORP        | 23          |
| PELTON & CRANE CO THE                        | 8           |
| PEREY EQUIP CO INC                           | 14          |
| PERKIN ELMER CORP                            | 14          |
| PERKIN-ELMER CORP 50 WILTON PL               | 22          |
| PHILCO CORP G & I DIV                        | 27          |
| PHILIPS ELECTRONIC INSTRUMENTS               | 14-25       |
| PHOENIX PRECISION INSTRUMENT CO              | 14-19       |
| PHOTOBELL CO                                 | 21          |
| PHOTOCON RESEARCH PRODUCTS                   | 18          |
| PHYSIONICS INC                               | 30          |
| PIONEER ELECTRIC & RES CO                    | 26          |
| PNEU-HYDRO VALVE CORP                        | 8           |
| POTTER ENG CO                                | 8           |



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 RESEARCH INST CO INC 8  
 RESEARCH MFG CORP 12-21  
 RESE ENGG INC 18  
 RICHARDSON LABS KENNETH 5  
 RIKER INDUSTRIES INC 18-22  
 RIL ELECTRONICS CORP 15  
 RISCO 18  
 ROBOTRON CORP 13  
 ROCKWELL ENGINEERING 1  
 ROTATING ELECTR SYSTEMS CO 27  
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 SANGAMO ELECTRIC CO 7-19  
 SCHAEVITZ ENGG 5-13  
 SCIENTIFIC ELECTRIC INC 14-19  
 SECURITY CONTROLS INC 13  
 SECURITY DEVICES LAB 9  
 SEL REX CORP 14  
 SEMITRONICS INC 21  
 SEMTRAN INSTRUMENTS INC 21  
 SENECA FALLS MACHINE CO 1  
 SENDORY INC 21  
 SERVICE ASSOCIATED INC 7  
 SERVO CONTROL DIV OILGEAR CO 26  
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 SETCHELL-CARLSON INC 22  
 SETHCO MFG CORP 29  
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 SIFCO METACHEMICAL INC 9  
 SIGMA INSTRUMENTS INC 1-18  
 SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO 7  
 SINGLETON CO 9  
 SKINNER PREC INDUST INC POLYNOID DIV 1  
 SMITH-FLORENCE INC 10  
 THE SOLARTRON ELECTRONIC GROUP LTD 21  
 SOLAR VOLT CO INC 25  
 SOLID STATE ELECTRONICS CO 18  
 SONEX INC 18  
 SOSTMAN & CO HE 21  
 SPACE CONTROL CORP 1  
 SPACE INSTRUMENTATION CORP 21  
 SPACEONICS & PORTABLE ELECTRIC TOOLS INC 1-18  
 SPEC-HEATING INC 0  
 SPEC TOOL CO 21  
 SPECTRA ELECT CORP 30  
 SPECTRAL DYNAMICS CORP OF SAN DIEGO 3-12  
 SPECTRAN ELECTRONICS CORP 12  
 SPECTROL ELECTRONICS CORP SAN GABR 1  
 SPELLMAN HIGH VOLTAGE CO INC 17  
 SPERRY PRODUCTS CO DIV HOWE SOUND CO 10-11-27  
 SPERRY UTAH CO DV SPERRY RAND CORP. 18  
 SPERTI FARADAY INC 1-21  
 STA LIT LIGHTER CO ELECTRO LAB DIV 15  
 STANDARD PRODUCT INC SUB ELECTR COMM INC 1  
 STATES ELECTRONICS CORP BLUDWORTH MARINE DIV 12-21  
 STATIKIL INC 6  
 STEWART WARNER ALEMITE & INST DIV 3  
 STOKES CORP F J 6-8-13  
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 SUMMERS & MILLS INC 12-20  
 SUNSHINE SCIENTIFIC INSTRUMENT 10-11  
 SURFACE CONDUCTION INC 22  
 SYLVANIA ELECTRIC PRODUCTS SALEM 14  
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 TABER INSTRUMENT CORP 21  
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 TALLEY CORP THE 1-26  
 TE CO THE 14  
 TECHNICAL OIL TOOL CORP 1-12-21  
 TECHNIC INC 9  
 TECHNIRI ELECTRONICS INC 19  
 TELECHROME MFG CORP 18-22  
 TELEMETRICS INC 23  
 TELERAD MFG CORP 18  
 TELETRONICS CORP 22  
 TELEVISION UTILITIES CORP DIV NORD 22  
 TELEX INC 21  
 TEXAS INSTRUMENTS INC APPARATUS DALLAS 12-18  
 TEXAS INSTRUMENTS INC APPARATUS HOUSTON 12-14  
 THERMATRON DIV WILCOX & GIBBS 5  
 THERMOLYNE CORP 8  
 TRANSITEL INTERNATIONAL CORP 18  
 TRANS METRICS INC 21

TRENT INC 8  
 TREPAC CORP OF AMERICA 1-18  
 TRIMETAL WORKS INC 8  
 TRINITY EQUIPMENT CORP 6  
 TROXLER ELECTRONICS LAB INC 12  
 U S CONTROLS INC N Y 5-13  
 US CONTROLS INC BROOKLYN 5-13  
 U S SCIENCE CORP 21  
 ULMER CO THE DIV MICROTRON INDUSTRIES INC 13  
 ULTRASONIC INDUSTRIES INC 23  
 ULTRA-VIOLET PRODUCTS INC 25  
 UNIT PROCESS ASSEMBLIES INC 19  
 UNITED AERD PRODUCTS CORP 7-19-21  
 DIV AERD CHATILLDN CORP 12-18  
 UNITED ELECTRODYNAMICS 10-18  
 UNITED ENGRS ELECTRO NUCLEAR UNSTRS DIV 18  
 UNIVERSAL INDUSTRIAL EQUIPMENT CORP 9  
 UNIVERSAL INSTRUMENTS CORP 16  
 UNIVERSAL MATCH CO UNDYNAMICS DIV 1  
 UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT 1  
 UTAH RADIO CORP 14  
 VACUUM SPEC INC 8-13  
 VARIAN ASSDC PALD ALTO 12  
 VARO MFG CO 14  
 VECTDR MFG CO SO HAMPTON 18  
 VECTROL ENGG DIV SPRAGUE ELEC CO 2  
 VENNOR ELECTRONICS LTD 21  
 VINSON ENGG & SALES CORP 19-21  
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 VOLTRON PRODUCTS 18-21  
 VUE TRONICS INC DV OF PRESCOTT CO 22  
 WALTHAM ELECTRONICS CORP 18  
 WASHINGTON TECHNOLOGICAL ASSDC INC 12  
 WATKINS-JOHNSON CO APPL ENGRG 18  
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 WESTERN DESIGN & ELECT 1  
 WESTINGHOUSE ELEC CORP ASTROELECTRONICS DEPT 25  
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 WESTREX CO DIV OF LITTON SYS INC 12  
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 WINDSOR ELECTRONICS INC 1-13-14-22  
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 Asphalt..... 2  
 Ceramic..... 3  
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 Compounds, antistatic..... 5  
 Compounds, encapsulation..... 6  
 Compounds, impregnating..... 7  
 Compounds, mica..... 8  
 Compounds, phenolic molding..... 9  
 Cork..... 10  
 Dielectrics..... 11  
 Dielectrics, ceramic..... 12  
 Dielectrics, gas..... 13  
 Dielectrics, glass..... 14  
 Dielectrics, liquid..... 15  
 Dielectrics, mica..... 16  
 Dielectrics, plastic..... 17  
 Enamel..... 18  
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 Fabric, impregnated..... 20  
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 Mica..... 26  
 Mica, glass bonded..... 27  
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 ANCHOR ALLOYS INC 6-7-24-32-41  
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 CRANE PACKING CO 32  
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 DBM RESEARCH CORP 3-7-11-12-17-32-37  
 DEBELL & RICHARDSON INC 17-32  
 DENNISON MFG CO 1-29-39-40  
 DIAMONITE PRODUCTS MFG CO 3-28  
 DIELECTRIC MATERIALS CO 4-11-17-32-40  
 DILETRIX CORP 17-32-40  
 DIXON CORP 4-20-32-33-39-40  
 DODGE FIBERS CORP 4-6-7-11-17-18-32-37-41  
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 EATON MFG CO DYNAMIC DIV 1-2-10-23-24  
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|   |                                |
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| ELECTRO CERAMICS INC SALT LAKE              | 27-29-30-33-35-38-39-40        |
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| ELECTRO TECHNICAL PRODUCTS                  |                                |
| DIV SUN CHEMICAL CORP                       | 11-20-39-40                    |
| ELECTRO-THERMO CERAMICS INC                 | 3-12-28-34-38                  |
| ELECTRONATICS CORPORATION                   | 4-6-7-8-11-12                  |
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| EMMCO PLASTICS CORP ANDOVER                 | 32-33                          |
| ENFAB INC                                   | 24                             |
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| ERIE ELECTRONICS DIV                        | 3-11-12-38                     |
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| FISHER & CROME                              | 33                             |
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| FULLER CO H B LINDEN                        | 4-5-6-18-35                    |
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| FURANE PLASTICS INC HEMPSTEAD               | 4-6-7-11-17-                   |
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| GARLOCK ELECTRONIC PRODUCTS                 | PRODS PALMYRA                  |
|   | 1-11-17-32-33-40               |
| GARNER T H CO                               | 23                             |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV | 4-5-6-7-17-18-19-20-21-22-29-  |
|   | 30-32-33-40                    |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS   | 4-5-6-7-15-17-18-19-22-29-30-  |
|   | 32-33-35-36-40                 |
| GENERAL BOX CO                              | 32-33                          |
| GENERAL ELECTRIC CO RECEIVING TUBE DEPT     | 3                              |
| GENERAL ELECTRIC COMPANY CHEM MATERIAL DEPT |                                |
|   | 9-32-41                        |
| GENERAL ELECTRIC CO WATERFORD               | 4-6-7-11-15-                   |
|   | 17-32-41                       |
| GENERAL ELECTRIC LAMINATED PRODUCTS DEPT    | 33                             |
| GENERAL PLASTICS CORP                       | 4-20-33-40                     |
| GLAODING MCBEAM & CO LOS ANG                | 3-28                           |
| GLADDDING MCBEAM & CO MONROVIA              | 12                             |
| GLASPLY CORP                                | 32-33                          |
| GRANER T H CO                               | 23                             |
| GREEN RECTIFIER CO                          | 4-6-35                         |
| GULTON INDUSTRIES INC METUCHEN              | 3-12                           |
| HALEX CORP DETROIT                          | 11-17                          |
| HALOGEN INSULATOR & SEAL CORP               | 17-32                          |
| HARDMAN CO H V                              | 6-7-36                         |
| HARHALO CO INC                              | 5                              |
| HAVEG INDUSTRIES INC                        | 40                             |
| HAYNES LABS INC C W                         | 4-6-7-18                       |
| HILDEBRAND JOHN CO                          | 32                             |
| HINCHMAN MFG CO INC                         | 32                             |
| HI TEST CHEMICAL CORP                       | 2-4-6-7-31                     |
| HUGHES AIRCRAFT CO ELECT PROD DIV           | 37                             |
| HURON INDUSTRIES                            | 5                              |
| HUSE-LIBERTY MICA CO                        | 26                             |
| HYSOL CANADA LTD                            | 4-6-7-17                       |
| HYSOL CORP DELEAN                           | 4-6-7-17-32-35-41              |
| HYSOL OF CALIF DIV                          | 6-16-32-37-41                  |
| INCELOID CO INC                             | 32                             |
| IND ELEC RUBBER CO                          | 32-36-37                       |
| INDIANA GENERAL CORPORATION KEASREY         | 3-38                           |
| INSL X PRODUCTS CORP                        | 4-7-11-18-35-36-37             |
| INSULATING FABRICATORS OF NE INC            | 17-22-33                       |
| INSULATING FABRICATORS INC RUTHERFORD       | 30-                            |
|   | 32-33                          |
| INTEGRATED MICA CORP                        | 11-16-26-27                    |
| IRVAN FERROMAGNETICS CORP                   | 3-11-12-38                     |
| ISOCHEM RESINS CO                           | 4-6-7-32-35-36-41              |
| ISOLANTITE MFG CORP                         | 3-12-38                        |
| ITT FEDERAL LABS NUTLEY                     | 3-11-12-28                     |
| JANSA WOODWORKING CORP                      | 21                             |
| JFD ELECTRONIC CORP                         | 14-23                          |
| JOCLIN MFG CO                               | 9-11-17-30-32-35-39-40-41      |
| JOHNS-MANVILLE                              | 0                              |
| KEASBEY & MATTISON CO                       | 1                              |
| KOPPERS CO INC                              | 31-32-35                       |
| KRESSLIK PROD INC                           | 19                             |
| LAMINATED SHEET PRODUCTS CORP               | 17-21-22-25-                   |
|   | 30-32-33                       |
| LA MOREE C D                                | 4-6-8-11-16-17-25-26-27-33-37- |
|   | 39-40                          |
| LAPMASTER DIV CRANE PACKING CO              | 28-40                          |
| LAPP INSULATOR CO RADIO SPECIALTIES DIV     | 3-                             |
|   | 34-38                          |
| LEED INSULATOR CORP                         | 17-22-26-30-32-33              |
| LONG INC THOMAS J                           | 22-24-29-30-32-33              |
| LOUTHAN MFG CO DIV FERRO CORP               | 3                              |
| MAAS & WALDSTEIN CO                         | 18                             |
| MACALLEN CO INC                             | 26                             |
| MAGNETIC SHIELD DIV PERFECTION MICA CO      | 10-                            |
|   | 21-26-27                       |
| MAJESTIC EXTRUDERS INC                      | 32                             |
| MALLINCKRODT CHEMICAL WORKS ST LOUIS        | 37                             |
| MANNING PAPER CO JOHN A                     | 29                             |
| MANSOL CERAMICS CO                          | 3                              |
| MARBLETT CORP                               | 4-6-7-11-17-24-30-32-35        |
| MARBON CHEMICAL DIV BORG-WARNER CORP        | 32-35                          |
| MARYLAND CERAMIC & STEATITE CO INC          | 3-32-38                        |
| MATERIALS FOR ELECTRONICS CO                | 3-28                           |
| MCILLAN COMPANIES                           | 16-25                          |
| MESA PLASTICS CO                            | 6-32-41                        |
| METACHEM RESINS CORP MEREKO PRODS DIV       | 4-6-                           |
|   | 7-32-35                        |

|  |                                |
|--|--------------------------------|
| MICA INSULATOR DIV MINNESOTA MINING MFG CO   | 4-16-17-20-25-26-27-32-33-40   |
| MICACRAFT PRODUCTS INC                       | 26                             |
| MICARTA FABRICATORS INC                      | 33                             |
| MICHIGAN PANELYTE MOLDED PLASTICS DIV        |                                |
| ST REGIS PAPER CO                            | 0                              |
| MICRO-CIRCUITS CO                            | 5                              |
| MID-CONTINENT ENGINEERING                    | 36-37                          |
| MIDLAND INDUSTRIAL FINISHES CO               | 4-6-18                         |
| MILLEN MFG CO JAMES                          | 34-38                          |
| MINERALS & INSULATION CO                     | 16-17-25-26-27-30-             |
|  | 32-33                          |
| MINISINK RUBBER CO INC                       | 4-36                           |
| MINNEAPOLIS-HONEYWELL CERAMIC LAB            | 3                              |
| MINN MINING & MFG CO ELECT PRODS DIV         | 4-6-9-                         |
|  | 16-40                          |
| MINN MINING & MFG CO IRVINGTON DIV           | 0-32                           |
| MINN MINING MFG CO CHEMICAL DIV              | 4-7-11-13-                     |
|  | 15-17-32-35-36                 |
| MINNESOTA MINING & MFG CO ST PAUL            | 3-4-6-7-                       |
|  | 8-12-16-18-20-25-26-27-29-32-  |
|  | 33-35-38-39-40-41              |
| MINOR RUBBER CO                              | 36                             |
| M & O PLASTICS PRODUCTS                      | 0                              |
| MOLDED FIBRE GLASS BODY CD                   | 0                              |
| MOLDED FIBER GLASS CO                        | 24                             |
| MOLDING ENGINEERS INC                        | 17-32-41                       |
| MOLECULAR DIELECTRICS INC                    | 27                             |
| MOREY CORP                                   | 16-26                          |
| MOSINEE PAPER MILLS CO                       | 29                             |
| MOTOROLA INC SOLID STATE SYSTEMS DIV         | 17-23                          |
| MOXNESS PRODUCTS INC                         | 17-32-36-39-40                 |
| MULTI FLEX SEALS INC                         | 36                             |
| MYCALEX CORP OF AMERICA                      | 26-27                          |
| MYKROY INC                                   | 14-16-17-23-24-25-34           |
| NARROW FABRIC CO                             | 24-40                          |
| NATIONAL BERYLLIA CORP                       | 3-12-28                        |
| NATIONAL CERAMIC CO                          | 3-34                           |
| NATIONAL ELECT COIL DIV MCGRAW EDISON CO     | 25-26                          |
| NATIONAL ENGG PRODUCTS INC                   | 4-6-32                         |
| NATIONAL VACUUM PLATERS INC                  | 7-32                           |
| NATIONAL Vulcanized FIBRE CO YORKLYN         | 21-                            |
|  | 22-29                          |
| NATL Vulcanized FIBRE CO KENNET SO           | 17-22-                         |
|  | 25-33                          |
| NEW ENGLAND LAMINATES CO                     | 24                             |
| NEW ENGLAND TAPE CO                          | 4-6-17-32                      |
| NEW HERMES ENGRAVING MACHINE CORP N Y        | 33                             |
| NOPCO CHEMICAL CO PLASTICS DIV               | 3                              |
| NORPLEX FABRICATORS INC                      | 4                              |
| NORRICH PLASTICS CORP                        | 4-17-22-30-32-41               |
| NORTHERN PLASTICS CORP                       | 20-33                          |
| NYGLASS INC                                  | 6                              |
| OPTICAL COATING LAB INC                      | 11                             |
| OPTICS FOR INDUSTRY                          | 23                             |
| PACIFIC UNIVERSAL PROD CORP                  | 23                             |
| PANEL ENG CORP                               | 32-33                          |
| PANELYTE DIV ST REGIS PAPER CO               | 9-17-20-25-                    |
|  | 32-33-41                       |
| PAPER PRODUCTS MINNESOTA MINING & MFG CO     | 29                             |
| PARABAM INC                                  | 25                             |
| PARK ELECTROCHEMICAL CORP                    | 20-25-33                       |
| PENN FIBRE SPECIALTY CO                      | 21-22-29-30-32-33              |
| PERFECTION MICA CO MAGNETIC SHIELD DIV       | 21-                            |
|  | 25-26-32                       |
| PERMONITE MFG CO                             | 32                             |
| PHOENIX PRECISION INSTRUMENT CO              | 23                             |
| PHYSICAL SCIENCES CORP                       | 6-12                           |
| PLASTIC FACTORS INC                          | 29                             |
| PLASTICS & RESINS DIV SHELL CHEMICAL CO      | 17-                            |
|  | 32-35                          |
| PLASTICS STAMPING CO                         | 22-25-32-33                    |
| PLYMOUTH RUBBER CO                           | 40                             |
| POLYMICA & INSULATION CO INC                 | 16-26                          |
| PORCELAIN PRODUCTS CO                        | 34                             |
| H K PORTER CO INC DELTA STAR ELECTRIC DIV    | 34                             |
| PRECISION METAL PRODUCTS CO                  | 33                             |
| PRECISION PAPER TUBE CO CHICAGO              | 29-30-32-                      |
|  | 33                             |
| PRESSTITE DIV AMER MARIETTA                  | 1-2-6-10-11                    |
| PRINTED ELECT CORP                           | 28                             |
| PYLE-NATIONAL CO                             | 4-7-9-11-32-36-37-41           |
| QUELOR INC                                   | 4-6-17-32-41                   |
| RAIATION RESEARCH CORP WESTBURY              | 17                             |
| RAYBESTOS-MANHATTAN INC BRIDPORT             | 1-4-6-7-                       |
|  | 9-35-41                        |
| RAYBESTOS-MANHATTAN INC PASSAIC              | 1-32-33-                       |
|  | 36-37-40                       |
| RAYBESTOS-MANHATTAN INC PLASTIC PRODUCTS DIV | 17-32                          |
| RAYCHEM CORP                                 | 17-32-41                       |
| RAYCLAD TUBES INC                            | 6-32                           |
| RAYTHEON CO MICROWAVE & POWER TUBE DIVISION  | 3                              |
| REICHHOLD CHEMICALS INC                      | 30-32-33-35                    |
| REID ENTERPRISES                             | 32                             |
| RELIANCE MICA CO INC                         | 26                             |
| RESDEL CORP                                  | 32                             |
| RICHARDSON CO MELROSE PK                     | 33                             |
| RICHARDSON CO N BRUNSWICK                    | 11-17-21-30-32-                |
|  | 33                             |
| RIEGLER PAPER CORP                           | 11-17-33                       |
| ROBERTSON ELEC CO INC                        | 6                              |
| ROBERTS TOLEDO RUBBER CO                     | 36                             |
| ROGERS CORP                                  | 29-33                          |
| ROSENTHAL ISOLATORS GMBH OF SELB W GERMA     | 11-16-17-21-22-23-24-25-26-27- |
|  | 33                             |
| ROSS METALS CO MILTON                        | 6                              |
| ROSTONE CORP                                 | 1-17-24-32                     |
| RUBBER TECK INC                              | 36                             |
| RUSSELL REINFORCED PLASTICS CORP             | 32-33                          |
| SATELLITE CORP OF AMERICA                    | 33                             |
| SAUERISEN CEMENTS CO                         | 2-6-7                          |
| SAYRE ELECTRONICS                            | 3-6-28-30-32-34-38-41          |
| SCHENECTADY VARNISH CANADA LTD               | 4-7-18-35                      |

|   |                       |
|---|-----------------------|
| SCHENECTADY VARNISH CO                      | 4-6-7-35              |
| SCHRACK ELECTRICAL SALES CORP               | 3                     |
| SCHWEITZER DIV P J KIMBERLY CLARK CORP      | 29                    |
| SCHWEITZER INC PETER J DIVN                 | 29                    |
| SCIENTIFIC ELECTRONIC LABS INC              | 23-41                 |
| SEMICON ASSOCIATES INC                      | 3                     |
| SEMICON OF CALIF INC                        | 3-4-6                 |
| SEMI ELEMENTS INC                           | 17-28-32-37           |
| SHAMBAN & CO W S CULVER CITY                | 17-32-33              |
| SILICONE INSULATION INC                     | 32-33                 |
| SILLOCKS MILLER CO                          | 17-21-22-32-33        |
| SOLAR VOLT CO INC                           | 17-21                 |
| SOUTHERN PLASTICS CO                        | 17-32                 |
| SPARTA MFG CO                               | 17-20-32-33           |
| SPATCO MFG CO                               | 4                     |
| SPAULDING FIBRE CO INC LOS ANG              | 22-29-33              |
| SPAULDING FIBRE CO N ROCHESTER              | 21-29-33-41           |
| SPECTRA-STRIP WIRE & CABLE CORP             | 4-5                   |
| SPRUCE PINE MICA CO                         | 11-16-17-26-27-32-33  |
| STAR PORCELAIN CO                           | 3-12-34-38            |
| STEVENS PAPER MILLS INC                     | 29                    |
| STEVENS PRODUCTS INC                        | 25-33                 |
| STEWART MFG CO D H                          | 3-38                  |
| SUN CHEMICAL CORP ELECTRO TECH PROD DIV     | 20-                   |
|   | 39                    |
| SYLVANIA ELECTRIC PRODUCTS IPSWICH          | 3                     |
| SYNOR PRODUCTS CO                           | 3                     |
| SYNTHANE CORP                               | 30-32-33              |
| TAYLOR FIBRE CO NORRISTOWN                  | 22-33                 |
| TECHNICAL CERAMICS & LAVA CORP              | 3-5                   |
| TECHNICAL DYNAMICS DIV JAMIESON IND INC     | 3                     |
| TECHNICRAFT CO                              | 6-7-32-35             |
| THOR CERAMICS INC                           | 3-6-32-33-34-35-38-41 |
| TITANIUM ALLOY MFG NIAGARA FALLS            | 12                    |
| TRA-CON RESIN SYSTEMS DIV                   | 4-6-7-11-17-32-       |
|   | 35-41                 |
| TRANS-TECH INC                              | 11                    |
| TRIMOUNT PLASTIC CO                         | 32                    |
| U S DIELECTRIC INC                          | 11-17-32-33           |
| U S RUBBER CO                               | 1-33-35-36            |
| UNION CARBIDE CORP SILICONES DIV            | 4-6-17-20-            |
|   | 41                    |
| UNION CARBIDE PLASTICS CO                   | 6-7-30-32-35-41       |
| UNITED CONDENSER CORP                       | 28-30-31-33           |
| VARFLEX CORP                                | 24                    |
| VIRGINIA PLAK COMPANY                       | 32-33                 |
| WABER ELECTRONICS INC                       | 24                    |
| WALSICO ELECTRONICS MFG CO                  | 4-18-20-33            |
| WARREN WIRE CO                              | 20                    |
| WASHINGTON PORCELAIN CO                     | 34                    |
| WATERBURY COS INC                           | 32                    |
| WESTERN FELT WORKS                          | 21-36                 |
| WESTERN GOLD & PLATINUM CO                  | 28                    |
| WESTINGHOUSE ELECTRIC CORP BENOLITE MICARTA | 6-7-15-18-19-20-35-40 |
| WESTINGHOUSE ELECTRIC CORP MICARTA DIV      | 17-                   |
|   | 20-33                 |
| WESTLAKE PLASTICS CO                        | 32-33                 |
| WILMINGTON FIBRE SPECIALTY CO               | 22-33                 |
| WISCONSIN PORCELAIN CO                      | 3-34                  |
| WRIGHT & SONS CO WM E                       | 39-40                 |
| X PANDO CORP                                | 6                     |
| ZOPHAR MILLS INC                            | 4-6-7-31              |

INSULATORS 2500

|   |    |
|---|----|
| Insulating washers & grommets . . . . . | 1  |
| Insulators, bead . . . . .              | 2  |
| Insulators, bearing . . . . .           | 3  |
| Insulators, ceramic . . . . .           | 4  |
| Insulators, coupling . . . . .          | 5  |
| Insulators, fabricated . . . . .        | 6  |
| Insulators, feed-through . . . . .      | 7  |
| Insulators, glass . . . . .             | 8  |
| Insulators, glass bonded mica . . . . . | 9  |
| Insulators, laminated . . . . .         | 10 |
| Insulators, mica . . . . .              | 11 |
| Insulators, molded . . . . .            | 12 |
| Insulators, plastic . . . . .           | 13 |
| Insulators, power line . . . . .        | 14 |
| Insulators, R-F . . . . .               | 15 |
| Insulators, rods . . . . .              | 16 |
| Insulators, sheets . . . . .            | 17 |
| Insulators, sleeve . . . . .            | 18 |
| Insulators, standoff . . . . .          | 19 |
| Insulators, strain . . . . .            | 20 |
| Insulators, thermo couple . . . . .     | 21 |
| Insulators, tower . . . . .             | 22 |

|                                       |              |
|---------------------------------------|--------------|
| ACCURATE ELECTRONICS CORP ELYRIA      | 6-10         |
| AC SPARK PLUG ELECT DIV GMC           | 4            |
| ADEC INC                              | 19           |
| ADVANCED VACUUM PRODUCTS INC          | 4-7-19       |
| AEROLITE ELECTRONICS CORP             | 6-7-10-13-19 |
| A H B ELECTRONIC PARTS INC            | 7-12-13-19   |
| AIRCONDUCTORS                         | 13-16-17     |
| ALITE DIV U S STONWARE CO             | 4-7          |
| ALLEGHENY PLASTICS INC                | 13           |
| AMATON ELECTRONIC HARDWARE CO INC     | 1-3-4-5-     |
|                                       | 6-7-13-19    |
| AMERICAN CYANAMID CO FORMICA DIVISION | 10           |

# PRODUCTS & MANUFACTURERS

# Insulators • Kits

|   |                                |  |   |  |  |
|---|--------------------------------|--|---|--|--|
| AMERICAN ELECTRIC CABLE CO                  | 8-12-13-21                     | IRVAN FERROMAGNETICS CORP                    | 4   | SEMICON OF CALIF INC                         | 4  |
| AMERICAN INSULATOR CORP                     | 13                             | ISOLANTITE MFG CORP                          | 1-2-4-5-7-19-20                                 | SERVICE ASSOCIATED INC                       | 2-21   |
| AMERICAN MICA INSULATION CO                 | 11                             | JACKSON BROS LONDON LTD                      | 19  | SHAMBAN & CO W S CULVER CITY                 | 13   |
| AMERLINE CORP                               | 13-20                          | JAN HARDWARE MFG CO                          | 5-12-19   | SHEFFCO MFG CORP                             | 1  |
| ANCHOR PLASTICS CO                          | 13                             | JFD ELECTRONIC CORP                          | 19  | SILICONE INSULATION INC                      | 1-2-6-9-11-13-17                               |
| ANGLER INDUSTRIES                           | 19                             | JOCLIN MFG CO                                | 6-7-12-13-19                                    | SINGLETON CO                                 | 13   |
| ANTENNA-CRAFT CO                            | 13                             | JOHNSON CO E F                               | 4-7-12-13-16-19                                 | SMITH INC HERMAN H                           | 1-4-19   |
| APAHOUER CORP OF N E                        | 13-19                          | JOHNSON CO E F                               | 5-7-15-19                                       | SMITH THERMOTRONICS INC                      | 21   |
| APPROVED PLASTICS CO                        | 12-13                          | JONES ELECTRONICS HIRAM                      | 7-13-19   | SOUTHERN PLASTICS CO                         | 13   |
| ARLIN MFG CO                                | 13                             | JONES OPTICAL WORKS A D                      | 4-8   | SPARTA MFG CO                                | 13   |
| ARMEL ELECTRONICS INC                       | 7-11-12-13-19                  | KALPA SCIENTIFIC LABORATORIES INC            | 7-12-13   | SPAULDING FIBRE CO INC LOS ANG               | 10-13-16-17                                    |
| ASHEVILLE-SCHOONMAKER MICA CO               | 1-6-10-11-17-18                | KOPP GLASS INC                               | 8   | SPAULDING FIBRE CO TONAWANDA                 | 1-6-10-16-17                                   |
|   |                                | LAMINATED SHEET PRODUCTS CORP                | 1-6-10-13-16-17                                 | SPAULDING FIBRE CO N ROCHESTER               | 1-6  |
|   |                                | LA MOREE C D                                 | 1-2-6-11  | SPENCE CORP ADAM                             | 6-12-18  |
| ATLANTIC OPTICAL MOULDING CO                | 2-3-6-8-12                     | LAPHAM HICKEY STEEL CORP                     | 0   | SPERTI FARADAY INC                           | 6  |
| AUBURN MFG CO                               | 1-6-13-15                      | LAPP INSULATOR CO RADIO SPECIALTIES DIV      | 4   | SPRUCE PINE MICA CO                          | 6-9-10-11-13                                   |
| BACON INDUSTRIES                            | 6-12-13                        | LEED INSULATOR CORP                          | 6-7-14-15-16-19-20-22                           | ST CROIX PLASTICS CORP                       | 12-13  |
| BAER CO N S                                 |                                | LONG INC THOMAS J                            | 1-10-11-12-13-16-17                             | STANDARD PLASTICS CO INC                     | 12-13-19                                       |
| BESTCRAFT PRODUCTS CO                       | 6-13-20                        | LOUTHAN MFG CO DIV FERRO CORP                | 6-13  | STAR PORCELAIN CO                            | 1-2-4-7-12-16-18-19-20-21-22                   |
| B G CORP THE                                | 4-7-19-20-21                   | LOUTHAN PLANT REFRACTORIES DIV FERRO CORP    | 4   | STAVER CO                                    | 1  |
| BIRMA MFG CO INC                            | 10-13                          |  | 1-4-6   | STEVENS PRODUCTS INC                         | 10-12-13                                       |
| BLINN CO DELBERT                            | 7-11-13-19                     | LYN TRON INC                                 | 7-12-13-19                                      | STEWART MFG CO D M                           | 1-2-4-6-7-15-19-20-21                          |
| BONNY MFG CORP                              | 1-3-6-7-13-16-17-18-19         | MAJESTIC EXTRUDERS INC                       | 1-2-13-18                                       | STRAT-O-SEAL MFG CO                          | 7  |
| BOONTON MOLDING CO INC                      | 13                             | MALCO MFG CO                                 | 7-13  | SUPERIOR STEATITE & CERAMIC CORP             | 1-2-4-12-13-16-21                              |
| BORDEN CHEMICAL CO DIV COMPTON              | 18                             | MARCH DYNAMICS INC                           | 6   | SYNTHANE CORP                                | 1-6-10-13-16-17-18-19                          |
| BUDD CO POLYCHEM DIV                        | 1-6-9-10-11-12-13-17           | MARKEL & SONS LFRANK                         | 13  | TAURUS CORP                                  | 7-13-19  |
| CANNON ELECTRIC CO PHOENIX                  | 6-10-12-13                     | MATERIALS FOR ELECTRONICS CO                 | 4-21  | TECHNICAL OIL TOOL CORP                      | 3-6-18   |
| ELECTRONICS DIV CARBORUNDUM CO              | 4-6-7-19-20-21                 | MCCORMICK SELPH ASSOC                        | 7   | TELCO ELECTRONICS MFG COMPANY                | 7-13-19  |
|   |                                | MICA CORP                                    | 10-13-17  | TELEGRAPH CONDENSER CO                       | 1-4-7-16-17-18-19                              |
| CARBORUNDUM CO THE REFRACTORIS DIV          | 4-6-7-19-20-21                 | MICA INSULATOR DIV MINNESOTA MINING MFG CO   | 13-16-17-18                                     | THOR CERAMICS INC                            | 1-2-3-4-5-6-7-10-11-12-13-16-17-18-19-20-21-22 |
| CARVIL TECHNICAL CERAMICS INC               | 4-7-8-18-19                    | MICROMOLD PRODUCTS CORP                      | 1-13-17-18                                      | TRA-CON RESIN SYSTEMS DIV                    | 13   |
| CENTRALAB DIV GLOBE UNION HOPKINS           | 4-7-12-16-19                   | MID-CONTINENT ENGINEERING                    | 12  | TRI-DEX ELECTRONICS                          | 6-10   |
| CENTRALAB DIV GLOBE-UNION INC               | 2-14-21                        | MILLEN MFG CO JAMES                          | 4-5-7-12-15-19                                  | TRI-POINT INDUSTRIES INC                     | 7-10-13-16-18-19                               |
| CENTRALAB DIV GLOBE UNION                   | 2-3-4-7-14-16-19-21            | MINERALS & INSULATION CO                     | 1-4-6-9-10-11-12-13-14-17                       | TRONEX INC                                   | 7  |
| BREHEN ST                                   | 21                             | MINNEAPOLIS-HONEYWELL CERAMIC LAB            | 4   | U S DIELECTRIC INC                           | 10-13  |
| CERAMASEAL INC                              | 7-19                           | MINNEAPOLIS-HONEYWELL BROWN INST DIV         | 21  | U S PLASTIC MOLDING CORP                     | 12-13  |
| CFI CORP                                    | 1-4                            | MINN MINING & MFG CO ELECT PRODS DIV         | 1-4   | UCINITE CO DIV UNITED CARR FASTENER CORP     | 7-12-13  |
| CIRCON COMPONENTS CORP                      | 1                              | MINNESOTA MINING & MFG CO ST PAUL            | 4-10-11-12-16-17-18                             | UNI SEAL INC                                 | 8  |
| CLEVELAND FABRICATING CO                    | 1                              | MODULAR ELECTRONICS INC                      | 13  | UNMANCO INCORP                               | 1-6-10-11-13-17                                |
| CLOWES CERAMICS CORP                        | 1-4-19-21                      | MOLDED INSULATION CO PHILA                   | 12-13   | VARFLEX CORP                                 | 13-18  |
| COLUMBIAN ROPE CO                           | 18                             | MOLDED INSULATION CO CONSHOHOKEN             | 12-13   | VERITRON WEST INC                            | 2-4-7-8  |
| COMPONENTS FOR RESEARCH INC                 | 6-7-12-13-15-19-22             | MOLECULAR DIELECTRICS INC                    | 6-9-12-16-17                                    | VICTORY MICA MFG CO INC                      | 11   |
|   |                                | MONADNOCK MILLS                              | 1   | WADE ELECTRIC PRODUCTS CO                    | 12-13  |
| CONSOLIDATED CERAMICS & METALIZING CORP     | 4                              | MOREY CORP                                   | 6-11  | WALSCO ELECTRONICS MFG CO                    | 7  |
| CONSOLIDATED ELECT CORP                     | 4                              | M & T MOULDING CO                            | 12-13   | WARREN COMPONENTS DIV EL-TRONICS INC         | 7-12-13  |
| CONSOLIDATED MOLDED PRODUCTS CORP           | 12-13                          | MYKROY INC                                   | 1-2-4-6-7-9-11-12-13-14-15-16-17-18-19-20-21-22 | WATERBURY COS INC                            | 13   |
| CONSTANTIN CO L L                           | 7                              | NATIONAL BERYLLIA CORP                       | 1-2-4-6-7-16-18-19-21                           | WECKESSER                                    | 1  |
| CONTINENTAL SENSING INC                     | 4-21                           | NATIONAL CERAMIC CO                          | 4-7-15-19-20                                    | WELSH CO INC WM H                            | 6-10-12-13                                     |
| COORS PORCELAIN CO                          | 4-7-21                         | NATIONAL ELECT COIL DIV MCGRAW EDISON CO     | 18  | WESTERN COIL & ELECTRICAL CO                 | 12-13-19                                       |
| COSMO PLASTICS CO                           | 1-12-13                        | NATIONAL GASKET & WASHER MFG CO              | 1-6-10-11-12-13-18                              | WESTERN GOLD & PLATINUM CO                   | 4  |
| CRYSTAL-X CORP                              | 6-10-13-17-18                  | NATL RADIO CO INC                            | 4-5-7-15-19-20                                  | WESTERN SKY INDUSTRIES                       | 1  |
| CULBERTSON PRODUCTS INC                     | 4-8-19                         | NATIONAL TEL TRONICS CORP                    | 6-18-19   | WESTINGHOUSE ELECTRIC CORP MICARTA DIV       | 3-10-12-13-16-17-18                            |
| DAYTON AIRCRAFT PRODUCTS INC                | 4-7-8-12-13-15-20              | NATL VULCANIZED FIBRE CO KENNET SQ           | 1-6-10-13                                       | WESTLAKE PLASTICS CO                         | 13   |
|   |                                | NICHOLS PRODUCTS CO                          | 5-10-13   | WHITSO INC                                   | 7-12-13-19                                     |
| DIAMONITE PRODUCTS MFG CO                   | 4                              | NON-METALLICS INC                            | 1-6-12-13                                       | WILMINGTON FIBRE SPECIALTY CO                | 1-10-13-16-17-19                               |
| DIELECT INC                                 | 0                              | NORPLEX FABRICATORS INC                      | 1-6-10  | WIND TURBINE CO                              | 4-7-15-19-20-22                                |
| DIELECTRIC MATERIALS CO                     | 13-18                          | NORRICH PLASTICS CORP                        | 1-2-3-5-6-7-10-16-18-19                         | WISCONSIN PORCELAIN CO                       | 4-7-20   |
| DITTMORE FREIMUTH CORP                      | 7-19                           | NORTHERN PLASTICS CORP                       | 13  |  |  |
| DU-CO CERAMICS CO                           | 4-21                           | NORTON CO NEW PRODS DEPT                     | 4-21  | <b>KITS 2600</b>                             |  |
| ELECTRAMATIC INC                            | 19-20                          | NU-LINE INDUSTRIES                           | 1-8-12-13-15                                    | Kits, amateur radio                          | 15   |
| ELECTRICAL INSULATION CO INC                | 6-10-13-17                     | OHIO BRASS CO                                | 14  | Kits, antenna, home                          | 1  |
| ELECTRICAL REFRACTORIES CO                  | 2-4-21                         | OPTICS FOR INDUSTRY                          | 8   | Kits, breadboard                             | 2  |
| ELECTRO CERAMICS INC SALT LAKE              | 4-7-19                         | PARK ELECTROCHEMICAL CORP                    | 10-17   | Kits, citizens band                          | 16   |
| ELECTRO-DEVELOPMENT CO                      | 12                             | PENN FIBRE SPECIALTY CO                      | 1-6-10-13-16-17                                 | Kits, communication                          | 3  |
| ELECTRO-THERMO CERAMICS INC                 | 4                              | PERFECTION MICA CO MAGNETIC SHIELD DIV       | 11-17-18  | Kits, computer                               | 4  |
| ELECTRONIC MOLDING CORP                     | 7-12-13-19                     | PERMALI INC                                  | 6-8-10-12-13-14-16-17-19-20-22                  | Kits, educational                            | 17   |
| ELJAY CORP                                  | 6-10-12-13                     | PERMONITE MFG CO                             | 6-13  | Kits, electro mechanical assembly            | 5  |
| EMERSON & CUMING INC WESTERN DIV            | 15                             | PHYSICAL SCIENCES CORP                       | 4-7-21  | Kits, electronic                             | 6  |
| EMERSON PLASTICS CORP                       | 1-2-3-6-10-11-12-13            | PLASTIC FACTORS INC                          | 12  | Kits, geiger counter                         | 7  |
| EMCO PLASTICS CORP ANDOVER                  | 6-13                           | PLASTICRAFT PRODUCTS CO                      | 1-6-10-13-19                                    | Kits, Hi-Fi                                  | 8  |
| ENGELHARD INDUSTRIES INC                    | 21                             | PLASTICS STAMPING CO                         | 13  | Kits, modification                           | 9  |
| ENGINEERED PLASTICS INC                     | 6-10-13-16-17-18-19            | PLASTIGAGE CORP                              | 13-16-20  | Kits, radio control                          | 10   |
| EPOXY PRODUCTS DIV JOS WALDMAN & SONS       | 6-13-17-18                     | POLYMICA & INSULATION CO INC                 | 11  | Kits, receiver                               | 11   |
|   |                                | PORCELAIN PRODUCTS CO                        | 14-20-22  | Kits, speaker enclosure                      | 12   |
| ELECTRONICS DIV ERIE RESISTOR CORP          | 4-12-13                        | H K PORTER CO INC DELTA STAR ELECTRIC DIV    | 4-14-19-20-22                                   | Kits, test equipment                         | 13   |
| EXCELLEX ELECTRONICS INC                    | 10-12-13                       | PRECISION METAL PRODUCTS CO                  | 4-6-10-12-13-19                                 | Kits, transmitter                            | 14   |
| FISCHER & PORTER CO                         | 8                              | PRECISION PAPER TUBE CO CHICAGO              | 6-10-13-15-18                                   |  |  |
| FISHER & CROME                              | 1-6-10-13-16-17                | PRECISION PAPER TUBE CO HARTFORD             | 10-11-13  | AEROLITE ELECTRONICS CORP                    | 2  |
| FORD RADIO MICA CORP                        | 11                             | PRINTED ELECT CORP                           | 4   | AIRTRONIX DEVELOPMENT CORP                   | 8  |
| FORM-IT PRODUCTS INC                        | 1-12-13                        | PRODELIN INC                                 | 6-13  | ALAN ELECTRONICS                             | 2-6  |
| FORMICA CORP                                | 10-12-13-16-17                 | PYLE-NATIONAL CO                             | 13  | ALDEN PRODUCTS CO                            | 1  |
| FRENCHTOWN PORCELAIN CO                     | 4                              | PYLON CO INC                                 | 1-7-13-18                                       | ALERT PRODUCTS INC                           | 9  |
| FUSITE CORP                                 | 7-8-19                         | QUALITY COMPONENTS INC                       | 7-12-13   | ANTENNA-CRAFT CO                             | 1  |
| GARDE MFG CO                                | 7-12-13-19                     | RAYBESTOS-MANHATTAN INC PLASTIC PRODUCTS DIV | 13  | APPLIED DEVELOPMENT CORP                     | 2-4  |
| GARLOCK ELECTRONIC PRODUCTS PRODS PALMYRA   | 6-7-13-16-17-18-19             | RAYTHEON CO MICROWAVE & POWER TUBE DIVISION  | 13  | APPLIED DEVELOPMENT CORP MONTEREY PK         | 2-4  |
| GARLOCK ELECTRONIC PRODUCTS PRODS CAMDEN    | 7-13                           | RED DEVIL MFG CO                             | 6   | ARGONNE ELECT MFG CORP                       | 0  |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV | 1-6-12-13-17-19-20             | RED SEAL ELECTRIC CO                         | 10-12-13  | ARGOS PRODUCTS CO                            | 12   |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS   | 1-7-10-12-13-15-16-17-18-19-20 | BELANCE MICA CO INC                          | 1-10-11   | ARKAY INTERNATIONAL INC                      | 2-3-4-5-6-8-9-10-11-13                         |
| GENERAL ELECTRIC CO INSULATOR DEPT          | 4-7-14-16-19                   | RESISTOFLEX CORP SOUTHWESTERN DIV            | 13-14-15-16-17-18-19                            | ASSEMBLY PRODUCTS INC                        | 5  |
| GLADDING MCREAM & CO LOS ANG                | 4                              | RICHARDSON CO N BRUNSWICK                    | 1-6-10-13-16-17-18                              | ATLANTIC INSTRUMENTS & ELECTRONICS INC       | 2-4-6  |
| GLADDING MCREAM & CO MONROVIA               | 4                              | ROCKWELL PRODUCTS CORP                       | 1   | BARKER & WILLIAMSON INC                      | 9  |
| GLASPLY CORP                                | 10-12-13-16-17-18              | ROHN MFG CO                                  | 20-22   | BROOKS RADIO & TV CORP                       | 6  |
| GOE ENGG CO                                 | 4-7-12-18-19                   | ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA    | 1-9-10-11-12-13-16-17-18                        | BUDD ELECTRONICS A DIV OF THE BUDD CO        | 9  |
| GRIES REPRODUCER CORP                       | 1-12                           | ROSS METALS CO MILTON                        | 12-13-18-19                                     | CANADIAN APPLIED RESCH DV A V ROE CANADA LT4 | 10   |
| HALEX CORP DETROIT                          | 14                             | ROSS CO MILTON                               | 13-20   | CANOGA ELECT CORP                            | 9  |
| HALOGEN INSULATOR & SEAL CORP               | 13                             | ROSTONE CORP                                 | 12-13-19-20                                     | CAROL ELECT DIV WECO                         | 9-13   |
| HERMETIC PACIFIC CORP                       | 7-8-19                         | RUBBERCRAFT CORP CALIFORNIA                  | 12-16-17  |  |  |
| HERMETIC SEAL CORP PASADENA                 | 4-8                            | SAYRE ELECTRONICS                            | 1-2-4-6-7-13-16-17-18-19-20-21-22               |  |  |
| HERMETITE CORP                              | 8-19                           | SEALLECTRO CORP                              | 1-7-19  |  |  |
| HINCHMAN MFG CO INC                         | 12-13                          |  |   |  |  |
| HOBSON BROS                                 | 12                             |  |   |  |  |
| HUSE-LIBERTY MICA CO                        | 11                             |  |   |  |  |
| HY GAIN ANTENNA PRODUCTS CO                 | 15-20                          |  |   |  |  |
| IE MFG                                      | 19-20                          |  |   |  |  |
| ILLUMITRONIC ENGG CO                        | 13                             |  |   |  |  |
| IND ELEC RUBBER CO                          | 1-12-13                        |  |   |  |  |
| INDIANA GENERAL CORPORATION KEASBEY         | 2-4-7-20                       |  |   |  |  |
| INDUSTRIAL DEVICES INC                      | 18-19-20                       |  |   |  |  |
| INMANCO INCORPORATED                        | 12-13                          |  |   |  |  |
| INSACO INC                                  | 1-6-10-11-13-17                |  |   |  |  |
| INSULATING FABRICATORS OF NE INC            | 5                              |  |   |  |  |
| INSULEX CO                                  | 10-13-19                       |  |   |  |  |
| INTEGRATED MICA CORP                        | 11                             |  |   |  |  |



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|--|-----------------------------|
| CENTRAL COIL CORP                            | 6-10                        |
| CENTRAL ELECTRONICS INC                      | 3-11-13-14                  |
| CERTIFIED RADIO LABS                         | 6-11                        |
| CIRCUIT STRUCTURES LAB                       | 2                           |
| CLEAR BEAM ANTENNA CORP                      | 1                           |
| COLMAN ELECTRONIC PRODUCTS INC               | 9                           |
| COMPONENTS CORP                              | 4                           |
| COMPTON CORP                                 | 4                           |
| COMPUTER LOGIC CORP                          | 2-4                         |
| CONNECTICUT ELECTRONIC PROD                  | 2-6                         |
| CONSOLIDATED ELECT CORP                      | 6                           |
| CONSOLIDATED WIRE & ASSOCIATED COS           | 1                           |
| CONTROL LOGIC INC                            | 4                           |
| COOK ELECT CO WIRECORP DIV                   | 9                           |
| DAYTON AIRCRAFT PRODUCTS INC                 | 1                           |
| OI-AN CONTROLS INC                           | 2-4                         |
| DIGITAL ELECTRONICS INC                      | 4                           |
| DYNACO INC                                   | 8                           |
| DYNALECTRON CORP MATTERN DIV                 | 5-6                         |
| EALING CORP                                  | 2-6                         |
| EASTERN SPECIALTY CO                         | 13                          |
| EDUCATIONAL ELECTRONICS CO                   | 2-5-6-11                    |
| ELECTRAMATIC INC                             | 1-3-14                      |
| ELECTRO MECHANICAL CORP                      | 9                           |
| ELECTRONIC INSTRUMENT CO INC                 | 6-8-12-13-14                |
| ELECTRONIC MEASUREMENTS CORP N Y             | 8-13                        |
| ELECTRONIC TRAINING AIDS CO                  | 2                           |
| ENGINEERED ELECTRONICS CO                    | 4                           |
| EPSCO INC CAMBRIDGE                          | 4                           |
| FAE INSTRUMENT CORP                          | 2-5-9                       |
| FEDERAL MFG & ENGG CORP                      | 7                           |
| FISHER RADIO CORP                            | 8-11-12-13                  |
| FOURJAY INDUSTRIES                           | 12                          |
| FRONTIER ELECT CO                            | 3-4-9                       |
| GAP INSTRUMENT CORP WESTBURY                 | 5                           |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV  | 1-6                         |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 1-3-14                      |
| GENERAL ELECTRIC LAB INC                     | 2                           |
| GOOD ELECTRONICS CORP                        | 6-9                         |
| GRAY GAINER ELECTRONICS                      | 10-11-13-14                 |
| GRAY MFG CO                                  | 8                           |
| GREGORY MAGNETIC INDUST INC                  | 9                           |
| HALLETT MFG CO                               | 9                           |
| HALLCRAFTERS CO CHICAGO                      | 3-6-9-11-13-14              |
| HAYDON CO A W WATERBURY                      | 5                           |
| HEATH CO SUB OF DAYSTROM INC B HARBOR        | 2-3-4-5-6-7-8-9-11-12-13-14 |
| HEATH CO DIV OF DAYSTROM INC ST JOS          | 1-8-11-12-13-14             |
| HELDOR MFG CORP                              | 14                          |
| HI LO MFG CORP                               | 1                           |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 3-6-9-13-14                 |
| HY GAIN ANTENNA PRODUCTS CO                  | 1                           |
| IE MFG                                       | 1                           |
| INDUSTRIAL ELECTRONICS OF OMAHA INC          | 7                           |
| INTERNATIONAL ELECTRIC INDUSTRIES INC        | 2-3-4-5-6-9                 |
| INTL ELECTRIC INDUSTRIES INC N Y             | 2                           |
| JAMES ELECTRONIC INC                         | 9                           |
| JERROLD ELECTRONICS CORP                     | 1                           |
| JFD ELECTRONIC CORP                          | 1                           |
| JOHNSON CO E F                               | 14                          |
| KARG LABS INC                                | 8-11-13                     |
| KARLSON ASSOCIATES INC                       | 12                          |
| KEIL ENGG PRODUCTS CORP                      | 6                           |
| KNIIGHT ELECTRONICS CORP                     | 1-2-3-5-6-8-9-11-13-14      |
| LANCE ANTENNA MFG CORP                       | 1                           |
| LEHIGH VALLEY ELECT ENGG & MFG CO            | 13                          |
| LINK DIV GENERAL PRECISION INC               | 9-13                        |
| MAGNAFLUX CORP                               | 13                          |
| MANSON LABORATORIES INC                      | 9                           |
| MATERN CORPORATION                           | 5-6-9                       |
| METROTEK ELECTRONICS INC                     | 3-6-10-11-14                |
| MICRO-CIRCUITS CO                            | 6                           |
| MICRO LECTRIC INC                            | 5                           |
| MODEL ENGG & MFG INC                         | 9                           |
| MOSLEY ELECTRONICS INC                       | 1                           |
| NATIONAL ELECTRONICS LAB                     | 2                           |
| NESHAMINY ELECT CORP                         | 8                           |
| NUCLEAR CORP OF AMER DENVER                  | 2-7                         |
| ONEIDA ELECTRONICS INC                       | 6                           |
| OXFORD ELECTRIC CORP                         | 6-8                         |
| PACO ELECTRONICS CO INC                      | 2-3-5-6-8-11-12-13-14       |
| PARTRIDGE TRANSFORMERS LTD                   | 8                           |
| PERFECT COMPONENTS INC                       | 5                           |
| P & H ELECTRONICS                            | 3-14                        |
| PHILMORE MFG CO INC                          | 1-3-6-14                    |
| PIC DESIGN CORP SUB OF BENRUS WATCH CO INC   | 2-4-6                       |
| POWER TRONIC SYSTEMS INC                     | 4-6-9-13                    |
| PRECISION METAL PRODUCTS CO                  | 2                           |
| PREMMCO INC OF NORTHERN CALIF                | 2                           |
| RCA ELECTR TUBE DIV INDIANAPLS               | 13                          |
| RCA ELECTR TUBE DIV MARION                   | 13                          |
| RCA ELECTR TUBE DIV HARRISON                 | 13                          |
| RCA ELECTR TUBE DIV WOODBRIDGE               | 13                          |
| RCA ELECT TUBE DIV CINN                      | 13                          |
| RCA ELECTR TUBE DIV LANCASTER                | 13                          |
| REEVES INSTRUMENT CORP                       | 2-5                         |
| RENFREW ELECTRIC CO LIMITED                  | 6-10                        |
| R H ELECTRONICS CO                           | 3-11-14                     |
| RIMAK ELECT INC                              | 6                           |
| ROBINAIR MANUF CORP                          | 13                          |
| SCOTT INC H H                                | 8                           |
| SERVO CORP OF AMERICA                        | 2-5                         |
| SERVO SYSTEMS CO                             | 5                           |
| SORENSEN INDUSTRIAL ELECTRONIC CO            | 3-6-13-14                   |
| STRATOCON CORP                               | 9                           |
| SUPEREX ELECTRONICS CORP                     | 2-6-11                      |
| TALLEY CORP THE                              | 5                           |
| TECH-MASTER CORP                             | 8-11                        |
| TECHNICAL OIL TOOL CORP                      | 5                           |
| TECHNIQUES INC                               | 2                           |
| TRANSOATA INC                                | 3-5-6                       |

|  |        |
|--|--------|
| TRANSVISION INC                          | 6      |
| TRI ACRE ELECTRONICS                     | 2      |
| TRICRAFT PRODUCTS CORP                   | 1      |
| UCINITE CO DIV UNITED CARR FASTENER CORP | 2-6    |
| UNIVERSAL SCIENTIFIC CO INC              | 5-6-13 |
| UNIVERSITY LOUDSPEAKERS INC              | 2-3-6  |
| VANGUARD ELECTRONIC LABS                 | 12     |
| VIDEO INDUSTRIES CO                      | 3      |
| WABER ELECTRONICS INC                    | 6-8-12 |
| WALSICO ELECTRONICS MFG CO               | 1-2    |
| WANG LABS INC                            | 2-4    |
| WARD PRODUCTS CORP                       | 1      |
| WELEX ELECTRONICS CORP                   | 9      |
| WINTRONICS INC                           | 6-8    |
| WORNER ELECTRONIC DEVICES                | 6      |

**LIGHTING EQUIPMENT & ACCESSORIES 2700**

|                          |    |
|--------------------------|----|
| Accessories & supplies   | 1  |
| Cold cathode             | 2  |
| Consoles control         | 2  |
| Dimmers                  | 4  |
| Gobos                    | 5  |
| Lamps, infrared          | 6  |
| Lamps, inspection        | 7  |
| Lamps, ultraviolet       | 8  |
| Lighting, emergency      | 9  |
| Lighting, preset panels  | 10 |
| Lighting, tower          | 11 |
| Lighting, TV             | 12 |
| Lights, arc              | 13 |
| Lights, dial             | 14 |
| Lights, flood            | 15 |
| Lights, glow             | 16 |
| Lights, neon test        | 17 |
| Lights, signal           | 18 |
| Lights, spot             | 19 |
| Meters, light            | 20 |
| Panelboard, lighting     | 21 |
| Power supplies, lighting | 22 |
| Scoops                   | 23 |
| Strobe lighting          | 24 |
| Studio lightrigging      | 25 |

|   |                                 |
|---|---------------------------------|
| ABTRONICS INC                             | 24                              |
| AEROLITE ELECTRONICS CORP                 | 14-18                           |
| AERONAUTICAL ELECT CO                     | 14-16-21                        |
| AEROSONIC MARINE INC                      | 21                              |
| ALDEN SYSTEMS CO                          | 7                               |
| AMERICAN CYSTOSCOPE MAKERS INC            | 7                               |
| AMERICAN ELECTRIC CABLE CO                | 22                              |
| AMERICAN ELECTRONICS INC FULLERTON        | 22                              |
| AMER SPEEDLIGHT CORP                      | 14                              |
| AMERICAN TOWER CO                         | 12                              |
| AMEY CORP                                 | 11                              |
| ANGLO CORP                                | 2-8-16-18-24                    |
| ANCHOR SPEC MFG CO                        | 3-21                            |
| APPLIED PHYSICS CORP                      | 15-19-21                        |
| ARCEL DAVIS MFG CO                        | 3-4-21-22                       |
| ASTROMATIC DIV CONTROL CO OF AMER         | 3-9-14-21-22                    |
| ATOCON CORP                               | 1                               |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC       | 24                              |
| AUTOMATIC SWITCH CO                       | 1-9-11                          |
| AUTO TEST INC CHICAGO                     | 24                              |
| BEATTIE-COLEMAN INC                       | 24                              |
| BEGEN CO W                                | 1-7                             |
| BELLOWS VALVIAR                           | 21                              |
| BERGEN LABS INC                           | 4-22                            |
| BETTS & BETTS CORPORATION                 | 1                               |
| BLACK LIGHT EASTERN CORP                  | 1-7                             |
| BLACK LIGHT PRODUCTS INC CHICAGO          | 7-8                             |
| BLOWERS INC                               | 7-15                            |
| BRIGHT STAR BATTERY                       | 19                              |
| BUD RADIO INC                             | 3                               |
| BUNYON ELECTRONICS CORP                   | 9                               |
| BURTON MFG CO TRANS ELECTRONIC DIV        | 7-8                             |
| CARLING ELECTRIC INC                      | 14                              |
| CARMA MANUFACTURING CO                    | 18-21                           |
| CATON INDUSTRIES                          | 7                               |
| CENTRAL COIL CORP                         | 10-18-21                        |
| CENTRAL ENGG CO                           | 3-21-22                         |
| CENTURY LIGHTING INC N Y                  | 1-3-4-5-10-12-13-15-19-21-23-25 |
| CENTURY LIGHTING INC MIAMI                | 4-19                            |
| CERBERUS AG WERK ELEKTRONENTECHNIK        | 18                              |
| CHADWICK-HELMUTH CO                       | 24                              |
| CHICAGO MINIATURE LAMP WORKS              | 2-6-9-10-14-16-18-21-24         |
| CHRISTIE ELECTRIC CORP                    | 22                              |
| CIRCON COMPONENTS CORP                    | 14-21                           |
| CONTROL SWITCH DIV CONTROLS AMER FOLCROFT | 21                              |
| CUTLER METAL PRODUCTS CO                  | 3                               |
| DAISLEY CO INC RAY                        | 3                               |
| DALE ELECTRONICS INC COLUMBUS             | 4                               |
| DALLONS LABS                              | 8                               |
| DAY-RAY PRODUCTS INC                      | 4-7                             |
| DAYSTROM INC WESTON INSTRUMENTS DIV       | 20                              |

|   |   |
|---|---|
| DELTA ELECT CO                            | 9   |
| DEMENT LABS                               | 8   |
| DIALIGHT CORP                             | 14-16-17-18-21  |
| DRAKE MFG CO                              | 4-12-14-16-18-20-21-22  |
| DRY SCREEN PROCESS INC                    | 13  |
| DRYOMATIC CORP                            | 18  |
| DYNALECTRON CORP MATTERN DIV              | 21  |
| EAGLE ELECTRIC MFG CO                     | 7-14-19   |
| EAGLE ELECTRIC MFG CO INC                 | 1-6-7-14  |
| EDER INSTRUMENT CO INC                    | 1   |
| ELECTRAMATIC INC                          | 14  |
| ELECTROL SPECIALTIES CO                   | 22  |
| ELECTRO PHYSICS CO                        | 20  |
| ELECTRON ARC DIV IONICS INC               | 3-13-21-22-24   |
| ELECTRONIC BRAZING CO                     | 24  |
| ELECTROSONIC ENGINEERING CO               | 1-21  |
| EMARCO CORP                               | 1   |
| ERICSON MFG CO                            | 1-7   |
| ESPEY MFG & ELECTRONICS CORP              | 4-22  |
| E-Z WAY TOWERS INC                        | 11  |
| FLEXO INTERNATIONAL CORP                  | 0   |
| FOSTORIA CORP DEPT D2                     | 3   |
| FOSTORIA CORP OHIO                        | 6-7   |
| GAMMA SCIENTIFIC INC                      | 20  |
| GASSER METAL PRODUCTS                     | 3   |
| GATES & CO GEO W                          | 1-8-22  |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS | 14  |
| GENERAL ELECTRIC CO MINIATURE LAMP DEPT   | 7-8-9-14-15-16-18-19-21   |
| GENERAL ELECT CO LOW VOLT SWITCHGEAR DIV  | 9   |
| GENERAL ELECT CO WIRING DEVICE DEPT       | 4   |
| GENERAL ELECT CONTROL INC                 | 1   |
| GENERAL RAILWAY SIGNAL CO                 | 18  |
| GORDON ENTERPRISES                        | 12-22-24-25   |
| GRAPHICS INC POTEAU                       | 18-21   |
| GRAY GAINER ELECTRONICS                   | 1   |
| GREEN RECTIFIER CO                        | 4-22  |
| GROVER PHOTO PROD                         | 5-15  |
| GUIDE LAMP DIV                            | 3-19  |
| HACKER INSTRUMENTS INC                    | 22  |
| HANOVA LAMP DIV/ENGLEHART INDUSTRIES INC  | 6-7-8-13-19-22  |
| HARRIS MFG CO INC                         | 4   |
| HERZOG MINIATURE LAMP WORKS               | 7-14  |
| HICO CORP                                 | 24  |
| HIGH VACUUM FURNACE & ELECT DV            | 3   |
| HOFFMAN ENG CORP                          | 9   |
| HUDSON LAMP CO                            | 9-14-16-20-21   |
| HUGHEY & PHILLIPS                         | 11  |
| HUNT ELECTRONICS                          | 4-25  |
| IDEAL INDUSTRIES INC SYCAMORE             | 1   |
| ILLUMINATED CONTROLS INC                  | 3-21  |
| INDUSTRIAL DEVICES INC                    | 14-16-17  |
| INTERLECTRIC DIV EL TRONICS               | 0   |
| INTL ELECTRIC INDUSTRIES INC N Y          | 7   |
| IONICS INC ELECTRON ARC DIV               | 3-13-21-22-24   |
| ITI ELECTRONICS INC                       | 9   |
| JETA INC                                  | 22  |
| JOHNSON CO E F                            | 14  |
| KAY ELECTRIC CO PINLITE DIV               | 6-8-14-19-20  |
| KEMLITE LABS INC                          | 2-8-9-11-18-24  |
| KIRKLAND CO H R                           | 14-18-21  |
| KLIEGL BROS UNIV ELEC STAGE LIGHTING CO I | 1-3-4-5-9-10-12-15-19-21-23                                       |
| KOLTON ELECTRIC MFG CO                    | 21  |
| KOPP GLASS INC                            | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25 |
| KORRY MANUF CO                            | 14-18   |
| KULKA ELEC CORP                           | 1   |
| LABLINE INC                               | 4   |
| LAFAYETTE INSTRUMENT CO                   | 24  |
| LAVELLE AIRCRAFT CORP                     | 3   |
| LEECRAFT MFG CO INC                       | 18-21   |
| LUMINATOR INC                             | 21  |
| LUXO LAMP CANADA LTD                      | 7-21  |
| LUXO LAMP CORP PORT CHESTER               | 7-12-19   |
| LUXO LAMP CORP SAN FRAN                   | 1-7   |
| MAGNAFLUX CORP                            | 7-8   |
| MAGNETICS INC                             | 4   |
| MARCO INDUSTRIES CO                       | 14-21   |
| MCALISTER INC J G                         | 1-12  |
| MILLER-TROJAN CO INC                      | 20  |
| MINI-TOOL TECHNICAL INDUST INC            | 1   |
| MISKELLA INFRARED CO                      | 0-6   |
| MOLE-RICHARDSON CO                        | 4-5-12-13-15-19-23-25   |
| MONROE INDUSTRIES INC                     | 10-21   |
| MORSE INSTRUMENT CO                       | 15  |
| MOULIC SPECIALTIES CO                     | 2   |
| MURRAY MFG CORP                           | 21-22   |
| NATIONAL CINE EQUIPMENT INC               | 12-19-23  |
| NATURAL LIGHTING CORP                     | 4-12-15-19-23-25  |
| N Y MFG & GENERAL SUPPLY CO               | 7-10-14   |
| NICAD DIV GOULD NATIONAL BATTERIES INC    | 9   |
| NORTH HILLS ELECTRONICS INC               | 1-4-22  |
| O & S RESEARCH INC                        | 3   |
| OXFORD ELECTRIC CORP                      | 14-16   |
| PANEL ENG CORP                            | 21  |
| PANELIT INC DIV INFORMATION SYS INC       | 10-18   |
| PANOB CORP                                | 21  |
| PEK LABS INC                              | 6-8-22-24   |
| PELTON & CRANE CO THE                     | 2-7   |
| PHOTO-RESEARCH CORP                       | 20  |
| PLASTIC PROCESS DIV MONAONOCK MILLS       | 1   |
| PREMIER METAL PRODUCTS CO                 | 3   |
| PROVIDENCE BASE PLANT                     | 1   |
| PYLE-NATIONAL CO                          | 9-15  |
| RADIANT LAMP CORP                         | 5-15-19   |
| REGGO INC                                 | 22  |
| RESEARCH INC                              | 6   |
| RETICO INC                                | 9   |
| RICHAROSON ALLEN CORP                     | 22  |
| SUB STANDARD KOLLSMAN IND                 | 3   |
| RIESTER & THESMACHER CO                   | 1   |
| ROCKWELL PRODUCTS CORP                    | 15-19   |
| ROOALE MFG CO                             | 11  |
| ROHN MFG CO                               | 11  |
| ROSTAN CORP                               | 11  |



# PRODUCTS & MANUFACTURERS

# Services, Industrial • Shielding

|   |                   |
|---|-------------------|
| PLASTOFILM INC                            | 13                |
| PLATRONICS INC                            | 2-10-14           |
| PLUG IN INSTRUMENTS INC                   | 3-8-13            |
| POLYCO INC                                | 8                 |
| POLY KOTE INC                             | 14                |
| POLYTRONICS CO                            | 6-17              |
| PRECISE DIE & STAMPING CO                 | 7                 |
| PRECISE INST PARTS CO                     | 7                 |
| PRECISION ELECTROPLATING CO               | 14                |
| PREC METHODS & MCH DV TEXTRON INC         | 7-8-9             |
| PRECISION SENSORS INC                     | 1-18              |
| PRECISION TRANSFORMER CORP                | 1-8-18            |
| PRECISION TUBE CO                         | 7                 |
| PREMIER METAL PRODUCTS CO                 | 7                 |
| PRESSED STEEL TANK CO                     | 7                 |
| PRESTOLE CORP                             | 7                 |
| PRESTO ELECTRONIC METAL PROD CO INC       | 1-2-7-7           |
| PRINTED ELECT CORP                        | 16-21             |
| PRINTLOID CORP DEPT E                     | 12                |
| PROFILE ELECTRONICS INC                   | 5-8               |
| PROJECTS UNLIMITED INC                    | 4                 |
| PROTECTION EQUIPMENT CO INC MPLS          | 1-4-16            |
| PRY WELDING & MFG INC                     | 1-7               |
| QOS CORP                                  | 1-7-8             |
| RADIAPHONE CO                             | 1-5-7-8-16        |
| RADIO CORP OF AMER DETROIT                | 11                |
| RADIO SPECIALTY MFG CO                    | 1-7               |
| RAM METER INC                             | 1-8-15-17         |
| RAMYR MFG CO                              | 8                 |
| RAVEN INDUSTRIES INC                      | 1-4-11-16         |
| RAYTHEON CO                               | 15-17-18          |
| RECTICO INC                               | 13                |
| RED OEVIL MFG CO                          | 7                 |
| REF MFG CORP                              | 9                 |
| REGENCY ELECTRONICS INC                   | 1-13              |
| REMINGTON RAND UNIVAC ST PAUL             | 3                 |
| RENWELL ELECTRONICS CORPORATION           | 3                 |
| REPUBLIC AVIATION CORP                    | 1-6-7-8-10        |
| RESEARCH DEVELOPMENT MFG INC              | 7                 |
| RESEARCH INST CO INC                      | 7-8               |
| REUTER INC                                | 1-7-8-11          |
| RHEEM SEMICONDUCTOR CORP                  | 1-4-13            |
| RHO ENG CO                                | 4                 |
| RICHARDSON CO MELROSE PK                  | 8                 |
| RICHFIELD COINED PRODUCTS CO              | 7                 |
| RIESTER & THESMACHER CO                   | 7                 |
| RIVERBANK LABS ENGG DEPT                  | 15                |
| RIXON ELECTRONICS INC                     | 1-4-7             |
| ROBERTSON ELEC CO INC                     | 1-4-7-14-16       |
| ROBERTSON INSTRUMENT CO                   | 17                |
| ROBINAIR MANUF CORP                       | 1-2-7-12-15-16-21 |
| ROBINSON TECHNICAL PRODUCTS INC           | 10                |
| ROCKWELL ENGINEERING                      | 10                |
| RODE INC                                  | 7                 |
| ROHDEN MFG CO INC                         | 7-8               |
| ROHN MFG CO                               | 7                 |
| ROLOCK INC                                | 21                |
| RONAN & KUNZL INC                         | 1-7-21            |
| RONDO OF AMERICA INC                      | 13                |
| ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA | 13                |
| ROSS METALS CO MILTON                     | 4-14              |
| FOTOTEST LABS INC                         | 18                |
| ROWE INDUSTRIES                           | 1-5               |
| ROYSON ENGRG CO                           | 7                 |
| RUE PRODUCTS                              | 4                 |
| SARATOGA PLASTICS INC                     | 0                 |
| SARGEANT & WILBUR HEAT TREATING CORP      | 2-9-16            |
| SATELLITE CORP OF AMERICA                 | 8                 |
| SAVAGE-ROWE PLATING CO INC                | 0-14              |
| SCHAFFER AIR INDUSTRIES                   | 1-7               |
| SCIENTIFIC ELECTRONIC LABS INC            | 2-9-10-14-21      |
| SCIOTO SIGN CO                            | 12                |
| SEABOARD PACIFIC DIV ASSOC SPRING         | 7                 |
| SEAL-A-METIC CO DIV OF FILTERS INC        | 2-10              |
| SELECTIONS LTD                            | 14                |
| SEL REX CORP                              | 12                |
| SEMI-ALLOYS INC                           | 2-7-8-12-14-16    |
| SEMICON OF CALIF INC                      | 7-21              |
| SERVICE ASSOCIATED INC                    | 15                |
| SERVOMECHANISMS INC EL SEGUNDO            | 15                |
| SERVWELL PRODUCTS CO                      | 7-16              |
| S-HAMBA & CO W S FT WAYNE                 | 7-8               |
| S-HAW INSULATOR CO                        | 5-13              |
| SHELTERED WORKSHOPS INC                   | 1-7-8-13-16       |
| SHIPLEY CO INC                            | 12                |
| SIFCO METACHEMICAL INC                    | 12-14             |
| SILKCOCKS MILLER CO                       | 4-5-6-8           |
| SIMMONS PRECISION PRODS TARRYTOWN         | 2-3-7-9-12-14-20  |
| SIMS CASTING CORP                         | 7                 |
| SINCLAIR MFG CO                           | 2-7-9-10-12-16    |
| SINGER METRICS DIV SINGER MFG CO          | 15-17-18          |
| SITTLER CORP                              | 1-2-16            |
| SKYRON CORPORATION                        | 1-7-21            |
| SLOCOMB CO J T                            | 2-7-21            |
| SOLAR VOLT CO INC                         | 4                 |
| SOLITRON DEVICES INC                      | 4-10              |
| SOMERS BRASS CO                           | 7                 |
| SOUTHORTH MACH CO                         | 7                 |
| SFARTA MFG CO                             | 7                 |
| SFATCO MFG CO                             | 1-4-12            |
| SFAULDING FIBRE CO INC MILTON             | 8                 |
| SPEC-PLATING INC                          | 0-14              |
| SPECIALTY AUTOMATIC MACHINE CORP          | 7                 |
| SPECIFIC PLATING CORP                     | 14                |
| SPINRAFT INC                              | 7-21              |
| ST CROIX PLASTICS CORP                    | 1                 |
| ST JOE MACHINES INC                       | 1-7               |
| STANDARD AUTO CORP                        | 7-9               |
| STANDARD METALS CORP                      | 22                |
| THE STANDARD PRODUCTS CO                  | 1-2-7-9-12-16-21  |
| STANDARD WINDING CO DIV OF OVITRON CORP   | 1-8               |
| STAR-A ELECTRIC MFG CO INC                | 1                 |
| STAVER CO                                 | 7-8               |

|  |                                   |
|--|-----------------------------------|
| STEVENS PRODUCTS INC                         | 8                                 |
| STONE CITY PRODUCTS CO                       | 7                                 |
| STRAFCO CORP                                 | 1-7-16                            |
| STYROFORMICS                                 | 13                                |
| SULLIVAN INDUSTRIES INC                      | 8-12                              |
| SUNAIR ELECT INC                             | 1-4                               |
| SUNDSTRAND DENVER                            | 3                                 |
| SUNSHINE SCIENTIFIC INSTRUMENT               | 1-15-17-18                        |
| SYLVANIA ELECTRIC PROD INC PARTS DIV         | 21                                |
| SYNTHANE CORP                                | 8                                 |
| SYSTEMATICS OF MO INC                        | 3                                 |
| TAFFET ELECTRONICS INC                       | 2-7                               |
| TE CO THE                                    | 3                                 |
| TECHNICAL DIL TOOL CORP                      | 1-5-6-7-8-9-11                    |
| TECHNICRAFT CO                               | 7-8                               |
| TECHRON CORP                                 | 5-8                               |
| TECHTROMATIC                                 |                                   |
| TEKTRONIX INC BEAVERTON                      | 15-17                             |
| TELETRAY ELECT SYSTEMS INC                   | 1                                 |
| TELKOR INC                                   | 1-5-6-7                           |
| TICKLE ENGG WORKS ARTHUR                     | 7-21                              |
| TOPPER MFG CO INC                            | 4                                 |
| TORNGREN CO C W                              | 7                                 |
| TORRINGTON CO THE SPECIALTIES DIV            | 7                                 |
| TORWICO ELECTRONICS INC                      | 4                                 |
| TRA-CON RESIN SYSTEMS DIV                    | 4                                 |
| TRANSISTOR ELECTRONICS CO                    | 1                                 |
| TRI ACRE ELECTRONICS                         | 1                                 |
| TRICON MFG CO                                | 1-2-21                            |
| TRICRAFT PRODUCTS CORP                       | 1-2-7-8-13-16-20                  |
| TRINITY EQUIPMENT CORP                       | 1-2-10-11-12-13-15-16-18-19-20-21 |
| TRIONICS CORP                                | 18                                |
| TRI-TRONICS LAB INC                          | 14                                |
| TROTT ELECTRONICS INC                        | 7-13-15-17-18                     |
| TROXLER ELECTRONICS LAB INC                  | 1-4-8                             |
| TRUTONE ELECTRONICS INC                      | 1                                 |
| U S ENG CO                                   | 7-8                               |
| U S INDUSTRIES INC AUTOMATION DIV            | 1-7-8                             |
| UCINITE CO DIV UNITED CARR FASTENER CORP     | 1-7                               |
| ULMER CO THE DIV MICROTRON INDUSTRIES INC    | 4-16-18                           |
| ULTRA CARBON CORP                            | 4-12                              |
| ULTRA ELECTROFORMING MFG CO                  | 8                                 |
| UNIFORM TUBES INC                            | 7-8                               |
| UNITED AERO PRODUCTS CORP                    | 14                                |
| DIV AERO CHATILLON CORP                      | 7                                 |
| UNITED DATA CONTROL INC                      | 15-17                             |
| UNITED MFG CO DIV UMC ELECTRONICS            | 7                                 |
| UNITED STATES GASKET CO                      | 7-8                               |
| UNITED TESTING LABS                          | 11-15-17-18                       |
| UNITED WIRE & SUPPLY CORP                    | 2-16                              |
| UNIVERSAL INSTRUMENTS CORP                   | 1-7-9-13-18                       |
| UNIVERSAL MATCH CO UNDYNAMICS DIV            | 1-4-7                             |
| UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT   | 1-4-7                             |
| UNIVOX CORP N Y                              | 1-16                              |
| UTILITIES SERVICE CO                         | 7                                 |
| VACUUM APPARATUS CO                          | 18                                |
| VALPEY CRYSTAL CORP                          | 8                                 |
| VALUE ENG PROD INC                           | 1-13                              |
| VANGUARD ELECTRONIC LABS                     | 7                                 |
| VERITRON WEST INC                            | 2-12-16                           |
| VIBRATION ENGINEERING PLANT                  | 7                                 |
| VIDEON CORP                                  | 1-16-17                           |
| VIRGINIA PLAK COMPANY                        | 8                                 |
| WAHLGREN MAGNETICS                           | 4-10                              |
| WALKTERT CO                                  | 1-4-16-21                         |
| WALLIN OPTICAL SYSTEMS INC                   | 3                                 |
| WARREN COMPONENTS DIV EL-TRONICS INC         | 4-10                              |
| THE WATERS CORP                              | 1                                 |
| WELDEX DIVISION                              | 7-21                              |
| WELEX ELECTRONICS CORP                       | 1-7-10-15-17-18-20                |
| WELLS INDUSTRIES CORP                        | 1-2-4-7-8-13-16-21                |
| WELTRONIC CO                                 | 1-7-21                            |
| WERNER CO INC R O                            | 7-12-21                           |
| WESTERN ARC WELDING INC                      | 7                                 |
| WESTERN COIL & ELECTRICAL CO                 | 1-5-6-13                          |
| WHITING & DAVIS CO                           | 7-8                               |
| WILCOX ELECTRIC CO INC                       | 1-7                               |
| WILCOX PRODUCTS CO                           | 0                                 |
| WILKINSON CO                                 | 22                                |
| WILKS PRECISION INST CO INC                  | 1-2-5-6-7-8-9-11-16-21            |
| WILTRON CO                                   | 10                                |
| WIND TURBINE CO                              | 7                                 |
| WINOSOR ELECTRONICS INC                      | 1-7-8-18                          |
| WINTRONICS INC                               | 1                                 |
| WINZEN RESEARCH INC                          | 1                                 |
| WOODWORTH METAL FAB DIV SHELburne INDUSTRIES | 7                                 |
| WRIGHT METALCOATERS INC                      | 12-14-16                          |
| WYETH ENG INC                                | 18                                |
| YORK RESEARCH CORP KIP ELECTRONICS DIV       | 1-4-15-18                         |
| ZACHARIAS CO ROBERT                          | 14                                |
| ZEUS ENG G CO INC                            | 18                                |
| ZIMNEY CORP                                  | 5-7-8-21                          |

|  |                    |
|--|--------------------|
| Radiation shielding                          | 10                 |
| Rubber shielding                             | 11                 |
| Screen shielding                             | 12                 |
| Screen rooms                                 | 13                 |
| Sheer on screen shielding                    | 14                 |
| Solid shielding                              | 15                 |
| Transformer shielding                        | 16                 |
| Tube shielding                               | 17                 |
| Wire shielding                               | 18                 |
| ACE ENGG & MACHINE CO INC                    | 3-12-13-15         |
| AFROJET-GENERAL NUCLEONICS                   | 10                 |
| AERONCA MFG CORP                             | 3-10               |
| AINSLIE CORP                                 | 9-16-17            |
| AIRCRAFT & ELECT SPEC                        | 7-11               |
| AIRCRAFT & ELECT SPEC                        | 7-18               |
| A K MFG CO INC                               | 18                 |
| AMERICAN ELECTRIC CABLE CO                   | 18                 |
| ARNOLD ENG G CO                              | 9-16-17            |
| ASTROMATIC DIV CONTROL CO OF AMER            | 5                  |
| ATLEE CORP                                   | 17                 |
| ATOMIC ACCESSORIES INC                       | 10                 |
| ATOMIUM CORP                                 | 10                 |
| AUBURN MFG CO                                | 3-11               |
| BARBER COLMAN CO AIRCRAFT & MISSILE PROD DIV | 9                  |
| BARNES METAL PRODUCTS CO                     | 2-16-17            |
| BAR RAY PRODUCTS INC                         | 8-10               |
| BELMONT SMELTING & REFINING WORKS            | 1-8-10             |
| THE BIRTCORP CORP INDUSTRIAL DIV             | 17                 |
| BRAUN TOOL & INSTRUMENT CO INC               | 17                 |
| BREEZE CORPS                                 | 7-8-17-18          |
| BREW & CO RICHARD D                          | 6-10               |
| BROOKS & PERKINS INC                         | 6-10               |
| CANADIAN RADIUM URANIUM DV CANRAD PRES IND   | 8                  |
| CHESTER CABLE CORP                           | 18                 |
| COLUMBIA WIRE & SUPPLY CO                    | 18                 |
| CORN HARD RUBBER CO                          | 10-11              |
| CONNECTICUT HARD RUBBER CO                   | 11                 |
| CONSOLIDATED WIRE & ASSOCIATED COS           | 18                 |
| CONTROL SCIENCE CORP                         | 12                 |
| CONTROLS FOR RADIATION INC                   | 10                 |
| COOK ELECTRIC CO NUCLEDYNE DIV               | 8                  |
| COOL FIN ELECTRONICS CORP                    | 6-17               |
| CO-OPERATIVE INDUSTRIES INC                  | 7-18               |
| CORDO CHEMICAL CORP                          | 8                  |
| DALMO VICTOR CO DIV TEXTRON INC              | 9                  |
| DANIELS INC C R                              | 6                  |
| DAVIDOFF CHARLES                             | 10                 |
| DBM RESEARCH CORP                            | 8-10-12-13-15      |
| DIELECTRIC MATERIALS CO                      | 17-18              |
| EISLER TRANSFORMER CO INC                    | 16                 |
| ELORE COMPONENTS INC                         | 1-3-9              |
| ELECTRONIC TECHNOLOGY RESEARCH INC           | 17                 |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 8                  |
| EMERSON & CUMING INC                         | 10-12-15           |
| EMERSON & CUMING INC WESTERN DIV             | 3-10-11-13-15      |
| EONETICS                                     | 16-17              |
| ESPEY MFG & ELECTRONICS CORP                 | 2-9-13-16          |
| AMERICAN SMELTING REFINING CO                | 8                  |
| FILMOHM CORP                                 | 5-8                |
| FILTRON CO INC WESTERN DIV                   | 13-15              |
| GENERAL ATRONICS CORP ELECT TUBE & INST      | 4                  |
| HALLETT MFG CO                               | 2-3-7-8-9-12-15-18 |
| HEXCEL PRODUCTS INC EASTERN DIV              | 12                 |
| IERC DIV INTERNL ELECT RESCH CORP            | 3-9-17             |
| INSO ELECT PROD INC                          | 18                 |
| INTL ELECTRONIC RESEARCH CORP                | 3-6-9-17           |
| INTL ELECT RESCH CORP                        | 17                 |
| IRVAN FERROMAGNETICS CORP                    | 4                  |
| ISTOPE SPEC CO                               | 8-10               |
| JAN HARDWARE MFG CO                          | 1-2-9-16-17        |
| JOHNSTON FOIL MFG CO                         | 8-10               |
| KELEKET X RAY DV LABS FO ELECT               | 10                 |
| KEVAUNEE SCIENTIFIC EQUIP                    | 8-10               |
| KULITE TUNGSTEN CO                           | 10                 |
| KUPFRIN MFG DIV ROBINSON TECH PRODS INC      | 2                  |
| LANDSVERK ELECTROMETER CO                    | 10                 |
| LIBBEY OWENS FORD GLASS CO LIBERTY MIRROR DV | 5-6                |
| LINDGREN & ASSOC ERIK A                      | 12-13              |
| LIVINGSTON ELECT CORP                        | 17                 |
| MAGNETIC METALS CO                           | 1-9-16-17          |
| MAGNETIC SHIELD DIV PERFECTION MICA CO       | 1-2-9-11           |
| MALLORY METALLURGICAL CO                     | 10                 |
| MARLETTE CORP                                | 10                 |
| MCMILLAN COMPANIES                           | 10-13              |
| MELABS                                       | 4                  |
| ELECTRONICS DIV METAL TEXTILE CORP           | 3-6-7-16-17-18     |
| METEX ELECTRONICS                            | 3-11-17-18         |
| METHODE MFG CO                               | 17                 |
| MICRO-CIRCUITS CO                            | 1-3-5              |
| MID-CONTINENT ENGINEERING                    | 11                 |
| MILLEN MFG CO JAMES                          | 1-2-9-17           |
| MOORE & CO SAMUEL                            | 18                 |
| MUTER CO                                     |                    |
| NATIONAL MOLOITE CO                          | 2-4                |
| NEW ENG ELECT WORKS INC                      | 18                 |
| NUCLEAR-CHICAGO CORP                         | 8                  |
| NUCLEONIC CORP OF AMERICA                    | 8-10               |
| OLYMPIC PRODUCTS CO INC                      | 16                 |
| PERFECTION MICA CO MAGNETIC SHIELD DIV       | 1-2-9-15-16-17-18  |
| PRECISION TUBE CO                            | 18                 |
| PYRAMID SCRFEN CORP                          | 12                 |
| RADIATION INSTRUMENT DEVELOPMENT LAB INC     | 10                 |

|                         |   |
|-------------------------|---|
| <b>SHIELDING 3200</b>   |   |
| Cathode ray shielding   | 1 |
| Coil shielding          | 2 |
| Electrostatic shielding | 3 |
| Ferrite shielding       | 4 |
| Glass R-F shielding     | 5 |
| Heat shielding          | 6 |
| Ignition shielding      | 7 |
| Lead shielding          | 8 |
| Magnetic shielding      | 9 |

Shielding • Sound Recording Equipment • Sound Systems

|   |                          |
|---|--------------------------|
| RADIATION MATERIALS INC                     | 18                       |
| RAYCHEM CORP                                | 18                       |
| REYNOLDS DIV NATIONAL STANDARD CO           | 12                       |
| RIEGLER PAPER CORP                          | 18                       |
| RIMAK ELECT INC                             | 1-2-7-8-9-12-14-15-16-17 |
| SETTER BROS INC                             | 8-10-15                  |
| SHIELDING INC                               | 2-12-13-14-15            |
| SOHOT DIV OF THERMOLAB CORP                 | 6                        |
| SPECTRA-STRIP WIRE & CABLE CORP             | 3                        |
| STAVER CO                                   | 2-8-10-16-17             |
| SWIFT TEXTILE METALLIZING & LAMINATING CORP |                          |
| TECHNICAL WIRE PRODUCTS INC                 | 13                       |
| TECHNIT SALES CO                            | 3-7                      |
| TELCON METALS TELCON WORKS                  | 3-7-12-14                |
| TOPATRON INC                                | 1-9-12-16-17             |
| TOPPER MFG CO INC                           | 3-13-14-15               |
| TROXLER ELECTRONICS LAB INC                 | 11                       |
| UNIFORM TUBES INC MICRO DELAY DIV           | 8-10                     |
| VECTOR MANUFACTURING CO HOUSTON             | 18                       |
| WATERMAN PRODUCTS CO                        | 18                       |
| WEBCOR INC LAMINATION DIV                   | 1                        |
| YORK CO INC OTTO H                          | 2-16                     |
| ZIPPERTUBING CO                             | 12                       |
|   | 3-5-6-9-18               |

SOUND RECORDING

|                               |             |    |
|-------------------------------|-------------|----|
| <b>EQUIPMENT</b>              | <b>5900</b> |    |
| Brushes, record               | 1           | 1  |
| Clothes, record cleaning      | 2           | 2  |
| Compensators                  | 3           | 3  |
| Editing blocks                | 4           | 4  |
| Equalizers, record            | 5           | 5  |
| Filters, needle scratch       | 6           | 6  |
| Heads, magnetic film stripe   | 7           | 7  |
| Heads, magnetic tape playback | 8           | 8  |
| Heads, magnetic wire playback | 9           | 9  |
| Needles                       | 10          | 10 |
| Players, magnetic tape        | 11          | 11 |
| Players, magnetic wire        | 12          | 12 |
| Pickups, binaural             | 13          | 13 |
| Pickups, capacity             | 14          | 14 |
| Pickups, ceramic              | 15          | 15 |
| Pickups, crystal              | 16          | 16 |
| Pickups, dynamic              | 17          | 17 |
| Pickups, magnetic             | 18          | 18 |
| Pickups, photoelectric        | 19          | 19 |
| Pickups, reluctance           | 20          | 20 |
| Pickups, resistance           | 21          | 21 |
| Record changers               | 22          | 22 |
| Record pads                   | 23          | 23 |
| Record players, home          | 24          | 24 |
| Record players, transcription | 25          | 25 |
| Record racks                  | 26          | 26 |
| Record presses                | 27          | 27 |
| Records, blank                | 28          | 28 |
| Records, sound effects        | 29          | 29 |
| Records, test                 | 30          | 30 |
| Tape indexes                  | 31          | 31 |
| Tape, magnetic                | 32          | 32 |
| Tape, prerecorded             | 33          | 33 |
| Tapes, test                   | 34          | 34 |
| Turntables                    | 35          | 35 |
| Wire, magnetic recording      | 36          | 36 |

|   |                       |
|---|-----------------------|
| ACOUSTIC RESEARCH INC                       | 35                    |
| ADC PRODUCTS DIV OF MAGNETIC CONTROLS       | 6                     |
| ALDSHIR MANUFACTURING CO INC                | 1-2-10-15-16-17-18-20 |
| ALMA ENGINEERING                            | 5                     |
| AMERICAN CONCERTONE                         | 8-11                  |
| AMERICAN GELOSO ELECT INC                   | 32                    |
| AMPEX CORP REDWOOD CITY                     | 8-11                  |
| AMPEX MAGNETIC TAPE PRODUCTS                | 31-32-34              |
| ANTREX CORP                                 | 32-33                 |
| APPLIED MAGNETICS CORP                      | 7-8-9                 |
| APW CO                                      | 18                    |
| ARNOLD ENG G CO                             | 32                    |
| ARVIN INDUSTRIES INC                        | 24                    |
| ATLANTIC RESEARCH CORP                      | 15                    |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC         | 1-2-30-31-34          |
| AUDIOTRONICS CORP                           | 24-25                 |
| AUTOCRAT ELECTRONICS CO                     | 24                    |
| AUTOMATIC TAPE CONTROL INC                  | 0                     |
| BACH AURICON INC                            | 7-8-19                |
| BEAU ELECTRONICS INC                        | 11                    |
| BELL SOUND DIV THOMPSON RAMO WOOLDRIDGE INC | 33                    |
| BENDIX COMPUTER DIV THE BENDIX CORP         | 5                     |
| BERNCO ENGINEERING CORP                     | 33                    |
| BIRMINGHAM SOUND REPRODUCERS LTD            | 16-22-24-35           |

|  |                           |
|--|---------------------------|
| BURGESS BATTERY CO   | 32                        |
| BYREX CORP   | 21                        |
| CALIFONE CORP  | 24-25-35                  |
| CAMERA MART INC  | 8-18                      |
| CANADIAN ASTATIC LTD   | 10-15-16-32               |
| C B C ELECTRONICS CO   | 23                        |
| CENTRALAB DIV GLOBE UNION  | 15                        |
| CLEARSTONE REPRODUCTION CORP                                       | 10                        |
| CO ENGINEERING CO  | 11                        |
| COLUMBIA RECORDS   | 5-29-30                   |
| COMPONENTS CORP  | 27-30-35                  |
| CONLEY ELECTRONICS CORP  | 33                        |
| CONSOLIDATED ELECT CORP  | 32                        |
| CONTROL INDICATING CORP  | 21                        |
| COUSINO ELECT CORP   | 11-32                     |
| OBM RESEARCH CORP  | 32                        |
| DIAMOND TOOL ENGG CO   | 10                        |
| DOCKENDORFF & CO INC   | 35                        |
| DUOTONE CO   | 1-2-10-16                 |
| DURAMIC PRODUCTS INC   | 15                        |
| DYNACO INC   | 18-20                     |
| EDUCATIONAL ELECTRONICS CO   | 24                        |
| ELECTRAMATIC INC   | 1-2-15-16-23-30-31-34-36  |
| THE ELECTRO NUCLEAR SYS CORP                                       | 8                         |
| ELECTRO PRODUCTS LABS INC  | 17-18                     |
| ELECTRO-SONIC LABS   | 1-15-17-24                |
| ELECTRO VISION LAB   | 11                        |
| ELECTRO VOICE INC  | 10-13-15                  |
| ELECTRON ENTERPRISES   | 24                        |
| ELECTRONIC APPLICATIONS INC  | 11-17-25-35               |
| ELECTRONIC INSTRUMENT CO INC                                       | 22                        |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO                             | 8-11                      |
| FAIRCHILD RECORDING EQUIPMENT CO                                   | 5-13-17-18-23-24-25-30-34 |
| FEN-TONE CORP  | 16-17-18                  |
| FERRO DYNAMICS CORP  | 32                        |
| FIDELITONE MICROWAVE INC   | 1-2-8-10-32-36            |
| FORT WAYNE METALS INC  | 36                        |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV                        | 36                        |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS                          | 1-2-15-16-23-30-31-34-36  |
| GIANNINI CONTROLS CORP TRANSDUCER DIV                              | 21                        |
| GIANNINI CONTROLS CORP NJ DIV                                      | 21                        |
| GLASER STEERS CORP   | 24                        |
| GRAY MFG CO  | 5-25                      |
| GREENE CO L CHARLTON   | 24-25                     |
| GREENTREE ELECTRONICS CORP   | 32-33                     |
| GREGORY MAGNETIC INOUST INC  | 7-8                       |
| GULTON INDUSTRIES INC METUCHEN                                     | 15                        |
| HAMILTON ELECTRONICS CORP  | 24-25                     |
| HARWALD CO INC   | 11                        |
| HEATH CO SUB OF DAYSTROM INC                                       | 11                        |
| IDAHO MARYLAND MINES CORP MAGNETICS DIV                            | 7-8                       |
| IDEAL AEROSMITH INC DIV ROYAL INDUSTRIES                           | 35                        |
| INTERNATION AUDIO STYLUS CORP                                      | 10                        |
| IRVAN FERROMAGNETICS CORP  | 7-8-18                    |
| ITA ELECTRONICS CORP   | 35                        |
| JAMES ELECTRONIC INC   | 18                        |
| JENSEN INDUSTRIES INC  | 10-16                     |
| KEN-DEL PRODUCTIONS INC  | 33                        |
| KINELOGIC CORP   | 11                        |
| KIRSCH MUSIC CORP  | 23-26                     |
| LABELLE INDUSTRIES INC   | 11                        |
| LANGEVIN DIV OF SONOTEC INCORP                                     | 5                         |
| L E E INC  | 11                        |
| LESA COSTRUZIONI ELETTROMECCANICHE SPA                             | 16-22-24-35               |
| LITTON SYSTEMS INC APPLIED SCIENCE DIVISION                        | 33                        |
| LIVINGSTON AUDIO PRODUCTS CORP                                     | 32                        |
| MAGNASYNCF MFG CO  | 4-5-7-8                   |
| MAGNE HEAD DIV GENERAL INST CORP                                   | 7-8                       |
| MAGNE-TRONICS INC  | 33                        |
| MAICO ELECTRONICS INC DYNAMU MAGNETRONICS DIV                      | 7-8                       |
| MAICO ELECTRONICS INC ENG DIV METROPOLITAN TELECOMMUNICATIONS CORP | 18-20                     |
| COIL WINDERS DIV   | 7-8                       |
| MICHIGAN MAGNETICS INC   | 7-8                       |
| MICRO SYSTEMS INC  | 21                        |
| MIDWESTERN INSTRUMENTS   | 8-11                      |
| MINNEAPOLIS-HONEYWELL HELAND DIV                                   | 8                         |
| MINNESOTA MINING & MFG CO ST PAUL                                  | 32-34                     |
| MINNESOTA MINING & MFG CO HUTCHINSON                               | 32                        |
| MOTOROLA INC QUINCY  | 24                        |
| MOVIOLA MFG CO   | 4                         |
| MURA CORP THE  | 8-15                      |
| NESOR ALLOY PRODUCTS CO  | 36                        |
| NORTHMOOR RECORDING  | 33                        |
| NORTON ASSOC INC   | 7-8-9                     |
| NORTRONICS CO INC MPLS   | 7-8-34                    |
| NUCLEAR PROD INC   | 1                         |
| PACIFIC ELECTRODEVICES   | 11                        |
| PACIFIC MERCURY ELECT INC  | 24                        |
| PACIFIC TRANSDUCER CORP  | 30                        |
| PANPA ELECT CORP   | 7-8                       |
| PANSTIEHL CHEMICAL CORP  | 1-2-10                    |
| PHOTO-TRONIC PRODUCTS CORP   | 11                        |
| PICKERING CO INC   | 7-8-13-18-20-35           |
| PRODUCTS & INDUSTRIAL ENGRG CORP                                   | 24                        |
| PROTECTION EQUIPMENT CO INC MPLS                                   | 11                        |
| RCA ELECTRN TUBE DIV INDIANAPLS                                    | 32-33                     |
| RCA ELECTRN TUBE DIV MARION  | 32-33                     |
| RCA BRDST & COMM PRODS DIV CAMDEN                                  | 32-35                     |
| RCA ELECTRN TUBE DIV HARRISON                                      | 32-33                     |
| RCA ELECTRN TUBE DIV WOODBRIDGE                                    | 31-32-33                  |
| RCA ELECT TUBE DIV CINN  | 32-33                     |
| RCA ELECTRN TUBE DIV LANCASTER                                     | 32-33                     |
| RCA BRDST & COMM PRODS DIV MEADOW LANOS                            | 32-35                     |
| RADIO MFG ENGG INC   | 15-16                     |
| RANGERTONE INC   | 8-34                      |
| RECORDED PUBLICATIONS LABS   | 33                        |
| RECORDIO CORP  | 11-24                     |
| RECOTON CORP   | 1-2-10                    |
| REEVES SOUNDRAFT CORP  | 31-32-33                  |

PRODUCTS & MANUFACTURERS

|   |                    |
|---|--------------------|
| REIGNER RECORDING LIBRARY                 | 33                 |
| REK O KUT COMPANY INC                     | 3-5-11-18-24-25-35 |
| RHEEM CALIFONE CORP                       | 24                 |
| ROBINS INDUSTRIES CORP                    | 2-8                |
| ROBINSON RECORDING LABS                   | 25-35              |
| SANGAMO ELECTRIC CO                       | 7-8-11-18          |
| SHURE BROS                                | 5-8-17-18          |
| SOLAR VOLT CO INC                         | 8                  |
| SONOTONE CORP ELSMFORD                    | 8-15-16            |
| SONY CORP                                 | 7-8-11-32          |
| STANCIL-HOFFMAN CORP                      | 7-8-11             |
| TANDBERG OF AMERICA INC                   | 7-8-11-27-32       |
| TAPE ATHON                                | 11                 |
| TRANSCRIBER CO                            | 10                 |
| U S RECORDING CO                          | 25                 |
| ULTRAUDIO DIV OBERLINE INC                | 5                  |
| UNITED DATA CONTROL INC                   | 11-33              |
| UNITED TRANSFORMER CORP                   | 5                  |
| VANITY FAIR ELECTRONICS                   | 24                 |
| WABER ELECTRONICS INC                     | 23                 |
| WEBCOR INC                                | 22-24              |
| WESTREX CO RECORDING EQUIP DIV LITTON SYS | 15                 |

SOUND SYSTEMS 6000

|                                 |    |
|---------------------------------|----|
| Alarms                          | 1  |
| Amplifiers, power               | 2  |
| Carillons, electronic           | 3  |
| Carrier current systems         | 4  |
| Dictating machines              | 5  |
| Hearing aids                    | 6  |
| Home sound systems              | 7  |
| Intercommunications             | 8  |
| Megaphones, electronic          | 9  |
| Musical equipment electronic    | 10 |
| Musical instruments, electronic | 11 |
| Paging systems                  | 12 |
| Preamplifiers, P.A.             | 13 |
| Public address systems          | 14 |
| Public address systems, mobile  | 15 |
| Speaker systems, marine         | 16 |
| Telephone systems               | 17 |
| Telephones, sound powered       | 18 |
| Theater sound systems           | 19 |

|   |                         |
|---|-------------------------|
| AC SPARK PLUG ELECT DIV GMC                 | 2-12                    |
| ADEC INC                                    | 8                       |
| AEROSPACE ELECTRONICS INC                   | 2-8-12-13-14            |
| AIRCRAFT & ELECT SPEC                       | 3                       |
| AIRTRONIX DEVELOPMENT CORP                  | 2-7-14                  |
| ALMA ENGINEERING                            | 7-19                    |
| ALTEC LANSING CORP                          | 1-2-7-12-13-14-16-17-19 |
| AMERICAN AIRFRAME CORP                      | 2-8-9                   |
| AMERICAN CONCERTONE                         | 5                       |
| AMERICAN DISTRICT TELEGRAPH CO              | 1                       |
| AMERICAN ELECTRIC CABLE CO                  | 1                       |
| AMERICAN GELOSO ELECT INC                   | 5-8                     |
| AMERICAN SOUND PROD INC                     | 6                       |
| AMPEX CORP REDWOOD CITY                     | 19                      |
| AMPLIFIER CORP OF AMER                      | 12                      |
| AMPLIVOX LTD                                | 6-17                    |
| ANDREA RADIO CORP                           | 8                       |
| ANTREX CORP                                 | 1-7-8-9-12-14-15-17     |
| APEL CO SUB RAYTHEON CO                     | 17                      |
| APPLIED CONTROL CORP                        | 2-8-13-14-15            |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD        | 4                       |
| ASTROMETRICS INC                            | 7                       |
| AUDAX INC                                   | 16                      |
| AUDIO EQUIPMENT CO PORT WASHINGTON          | 2-6-8-9-10-13-14-15-16  |
| AUDIVOX INC                                 | 6                       |
| AUREX CORP                                  | 6                       |
| AUTH ELECTRIC CO                            | 1-7-8-17                |
| BALDWIN PIANO CO                            | 10-11                   |
| BELL SOUND DIV THOMPSON RAMO WOOLDRIDGE INC | 14-15                   |
| BERNCO ENGINEERING CORP                     | 5                       |
| BLISS ELECTRONIC CORP                       | 8-17                    |
| BOULEVARD ELECTRONICS INC                   | 2-8-13-14-15            |
| BOY-MAR ELECTRICAL SERVICE CO               | 1                       |
| BRIGHT RADIO LABS INC                       | 18                      |
| BUDELMAN ELECTRONICS CORP                   | 12-15-17                |
| CALBEST ELECTRONICS CO                      | 7-8                     |
| C B C ELECTRONICS CO                        | 8                       |
| CENTRAL ELECTRONICS INC                     | 6                       |
| CENTROL ENG CO                              | 1                       |
| CENTURY PROJECTOR CORP                      | 2-19                    |
| CERBERUS AG WERK ELEKTROENTECHNIK           | 1                       |
| CHALCO ENGINEERING CORP                     | 2-8-12-13-14-15         |
| COGNITRONICS CORP                           | 12                      |
| COMMERCIAL RADIO SOUND CORP                 | 1-12-13-14-15-16-17     |
| COMMUNICATIONS ELECTRONICS CO               | 2-7-8-12-13-14-15       |
| CONTINENTAL ELECTRONICS CORP BROOKLYN       | 8-18                    |
| COOK ELECT CO WIRECOM DIV                   | 8                       |
| CP ELECTRONICS INC                          | 2-10                    |
| DATA SENSORS INC                            | 8                       |
| DELCON CORP                                 | 1                       |
| DICON CORP                                  | 1                       |
| DICTAPHONE CORP BRIDGEPORT                  | 5                       |



# PRODUCTS & MANUFACTURERS

# Sound Systems • Speakers & Accessories • Studio Broadcast Equipment

|  |                   |
|--|-------------------|
| DOSS ELECTRONIC RES INC                      | 10                |
| DOTY ACOUSTICAL ELECTRONIC LABS              | 6-8-12            |
| DYNACO INC                                   | 2                 |
| DYNAMU MAGNETRONICS CORP DIV MAICO ELECT INC | 6                 |
| ELECTRICAL PRODUCTS RESEARCH & DEV CO INC    | 1-8-19            |
| ELECTRO MECHANICAL CORP                      | 1-8-18            |
| ELECTROSPACE CORP                            | 17                |
| ELECTRON ENTERPRISES                         | 10                |
| ELECTRONIC APPLICATIONS INC                  | 12-13-19          |
| ELECTRONIC APPLICATIONS INC                  | 14-19             |
| ELECTRONIC COMMUNICATION EQPT CO             | 12-14             |
| ELECTRONIC ENGG CO                           | 2-8-12-17         |
| ELECTRONIC INSTRUMENT CO INC                 | 2                 |
| ELECTRONIC INTL CO                           | 2                 |
| ELECTRONIC SYSTEMS                           | 1-7-8-10          |
| EMERSON ELECTRIC ST LOUIS                    | 7                 |
| EMERSON-RITTENHOUSE CO INC                   | 8                 |
| EPRAD INC                                    | 1-8-14            |
| ERIC ELECTRONICS INC                         | 2-7-8-10-12-14    |
| EXECUTONE INC                                | 7-8-12-14-16      |
| FIRE CONTROL CO INC                          | 1                 |
| FISHER RADIO CORP                            | 2                 |
| FLUSH WALL RADIO CO                          | 2-7-8-12-14       |
| FOX CO THOMAS T                              | 2                 |
| FYR-FYTER ELECTRONIC & ALARM CORP            | 1-2-12-14-15      |
| GAI-TRONICS CORP                             | 1-2-8-12-13-14-17 |
| GENERAL DYNAMICS TELECOMMUNICATION           | 17-18             |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 2-                |
| GENERAL TEL & ELECT LEICH ELECT CO           | 12-13-14-15-17    |
| GODFREY MFG CO                               | 8                 |
| GRAY GAINER ELECTRONICS                      | 11                |
| GRAY MFG CO                                  | 5-7               |
| HAMILTON ELECTRONICS CORP                    | 2-9-12-13-14-15   |
| HEATH CO SUB OF DAYSTROM B HARBOR            | 2-8-13-14         |
| HEATH CO DIV OF DAYSTROM INC ST JOS          | 2-7-11-14         |
| HOME INDUSTRIES INCORPORATED                 | 2                 |
| LAB OF MAQUETTE CORP                         | 2                 |
| HOME ELECT MFG CO                            | 8                 |
| HOWARD CRYSTAL HOLDERS INC                   | 9                 |
| INDUSTRIAL ELECTRONICS OF OMAHA INC          | 2-12              |
| INTERNATIONAL BUSINESS MACH LEXINGTON        | 5                 |
| ITI ELECTRONICS INC                          | 9                 |
| ITT KELLOGG COMM SYSTEMS DEPT                | 1-8-12-17         |
| JETRONIC INDUSTRIES                          | 9                 |
| JOHNSTON HEARING AID MFG CO                  | 6                 |
| KAHLBERG BROS CO                             | 1                 |
| KARLSON ASSOCIATES INC                       | 7-10-12-14-15-19  |
| KAY-TOWNES ANTENNA CO                        | 0                 |
| KINSMAN MFG CO INC                           | 2-10-11           |
| KLEER-TRONICS INC                            | 7-12-15           |
| KLIPSCH & ASSOCIATES                         | 12-14             |
| LAKE MFG CO                                  | 2-8-12-13-14      |
| LANGEVIN DIV OF SONOTEC INCORP               | 13                |
| LAUREM RADIO MFG CO                          | 6                 |
| LEE ELECTRIC INC                             | 1                 |
| LEHIGH VALLEY ELECT ENGG & MFG CO            | 12                |
| LESA COSTRUZIONI ELETTROMECCANICHE SPA       | 14-15             |
| LOGE ELECTRONICS INC                         | 8-14-15           |
| LORAIN COUNTY RADIO CORP                     | 16                |
| MAGNASYNCF MFG CO                            | 13-19             |
| MAGNAVOX JEFFERSON CITY                      | 7                 |
| MAGNAVOX URBANA                              | 10                |
| MAGNECORD DIV MIDWESTERN INSTRUMENTS INC     | 2                 |
| MAICO ELECTRONICS INC                        | 6                 |
| MAICO ELECTRONICS INC DYNAMU MAGNETRONICS OV | 6                 |
| MAICO ELECTRONICS INC ENG DIV                | 6                 |
| MAJOR ELECTRONICS CORP                       | 2-10-13           |
| MARINE ELECTRIC CORP                         | 1-2-8-12-13-14-16 |
| MCGOHAN INC DON                              | 2                 |
| MCINTOSH LABS INC                            | 2                 |
| MCMARTIN INDUSTRIES INC                      | 2-12-13-14-15     |
| MEAGHER ELECTRONICS CO                       | 2-7-8-14          |
| MEASUREMENT ENGG LTD                         | 2-15-16-18        |
| MELROY MASTER MFG CO                         | 7                 |
| MELROY ELECTRONIC MFG CO                     | 7-8-12            |
| METROTEK ELECTRONICS INC                     | 18                |
| MICRO SONIC INDUSTRIES INC                   | 6                 |
| MILES REPRODUCER CO                          | 5-17-18           |
| MINNEAPOLIS ELECT                            | 6                 |
| MIRATEL INC ST PAUL                          | 1                 |
| MOHAWK ELECTRONICS CORPORATION               | 15                |
| MOSLER RESEARCH PROD INC                     | 1                 |
| MOTIOGRAPH INC                               | 2-8-19            |
| MOTOROLA DAHLBERG CO                         | 6-8               |
| MP ENGINEERING CO                            | 7-14-19           |
| MURA CORP THE                                | 6                 |
| MYERS & SONS INC E A                         | 6                 |
| NEWCOMB AUDIO PROO CO                        | 2-12-13-14-15     |
| NICHOLS & CLARK INC                          | 6                 |
| NICHOLS ELECTRONICS                          | 3                 |
| NORTHROP CORP                                | 1-17              |
| NUTONE INC                                   | 7-8               |
| ONEIOA ELECTRONICS INC                       | 2-7-8-12-13-14-15 |
| OTARION LISTENER CORP                        | 6                 |
| PACIFIC MERCURY ELECT INC                    | 11                |
| PACIFIC MERCURY TV MFG CORP                  | 10                |
| PANELLIT INC DIV INFORMATION SYS INC         | 1-12              |
| PANTHER ELECTRONICS INC                      | 2-8               |
| PARTRICK & WILKINS CO                        | 1                 |
| PEARCE SIMPSON CO                            | 16                |
| PERMA-POWER CO                               | 14-15             |
| PERMOFLUX DIV                                | 16                |
| PORT O VOX CORP                              | 14-15             |
| PRATT ALBERT                                 | 2                 |
| PRESCRIPTION HEARING AID CO INC              | 6                 |
| PROJECTS UNLIMITED INC                       | 6                 |
| PROTECTION EQUIPMENT CO INC HOPKINS          | 1-3-10            |
| PROTECTION EQUIPMENT CO INC MPLS             | 1-2-3-12-13-14    |
| PYE CANADA LTD                               | 14                |

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| PYRAMID SCREEN CORP                          | 6                  |
| RACON LOUDSPEAKER INC                        | 16                 |
| RADIAPHONE CO                                | 2-8                |
| RCA BRDCST & COMM PRODS DIV CAMDEN           | 2-8-12-14-16-17-19 |
| RCA BRDCST & COMM PRODS DIV MEADOW LANDS     | 2-                 |
| RADIO MFG ENGG INC                           | 11                 |
| RANGERTONE INC                               | 19                 |
| RA TONE ELECTRONIC SALES CO                  | 2-8                |
| RECORDIO CORP                                | 7                  |
| REK O KUT COMPANY INC                        | 2-7-12-13-15       |
| REMLER CO                                    | 2-4-16             |
| RI TONE PRODS INC                            | 8                  |
| ROESCH COMMUNICATIONS DOUGLAS                | 2-9-12-13-14       |
| ROYAL INDUSTRIES                             | 10-16              |
| ROYAL COMMUNICATION SYSTEMS                  | 12-14              |
| SCHINDLERS                                   | 2-7-14             |
| SCHIRMER-NATIONAL ALARM CORP                 | 1                  |
| SCHLIEBUS ELECTRONIC INSTRUMENT OC           | 1-7-12             |
| SCHRACK ELECTRICAL SALES CORP                | 17                 |
| SCOTT INC H H                                | 1-2-7-10-13        |
| SECODE CORP                                  | 17                 |
| SEEBURG CORP                                 | 10                 |
| SMITH-MEEKER ENGG CO                         | 12-14              |
| SONEX INC                                    | 2                  |
| SONOTONE CORP ELMSFORD                       | 6                  |
| SONTENSEN INDUSTRIAL ELECTRONIC CO           | 7-8-17             |
| SOUNDScriber CORP                            | 5                  |
| SPECIAL INSTRUMENTS LABORATORY INC           | 14-15              |
| SPERTI FARAOAY INC                           | 1-2-8-12           |
| SPIVEY INC JAMES S                           | 12                 |
| STANDARD ELECTRIC TIME CO                    | 12-14-17           |
| STEPHENS TRU-SONIC INC                       | 7-16-19            |
| TALKING DEVICES CO                           | 8                  |
| TALKMASTER INC                               | 8                  |
| TANDBERG OF AMERICA INC                      | 7                  |
| TELETRAY ELECT SYSTEMS INC                   | 8                  |
| TRUTONE ELECTRONICS INC                      | 2-7-12-14          |
| U S RECORDING CO                             | 2                  |
| U S SCIENCE CORP                             | 2                  |
| ULTRAUDIO DIV OBERLINE INC                   | 2-12-13-14         |
| ULTRAVOIC PRODUCTS                           | 2-12-13-14         |
| ULTRONICS INC                                | 1-2-8-12-14-15     |
| UNIVERSITY LOUDSPEAKERS INC                  | 9-12-14            |
| VARI CORP                                    | 6                  |
| VINCO ELECTRONICS CORP                       | 2-12-13-14-15      |
| WABER ELECTRONICS INC                        | 1                  |
| WATERS CONLEY CO INC                         | 11                 |
| WEATHERS INDUSTRIES DIV ADVANCE INDS         | 7                  |
| WEBCOR ELECTRONICS                           | 7                  |
| WELEX ELECTRONICS CORP                       | 1                  |
| WESTERN APPARATUS                            | 13                 |
| WESTERN ELECTRIC CO OKLA                     | 17                 |
| WESTLAB INC                                  | 8-12-17-19         |
| WHEELER ELECTRONIC CORP SUB SPERRY RAND CORP | 18                 |
| WINTRONICS INC                               | 1-2-7-10-11-14     |
| WOODLAND ELECTRONICS CO INC                  | 2                  |
| WORNER ELECTRONIC DEVICES                    | 1-8                |
| WURLITZER CO TONAWANDA                       | 10-11              |

## SPEAKERS & ACCESSORIES 6100

|                            |    |
|----------------------------|----|
| Crossover networks         | 1  |
| Drivers, PM                | 2  |
| Horns, audio               | 3  |
| Materials, sound absorbent | 4  |
| Speakers, ceramic          | 5  |
| Speakers, crystal          | 6  |
| Speakers, electrodynamic   | 7  |
| Speakers, electrostatic    | 8  |
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| CARBONNEAU INDUSTRIES INC                   | 5-10-13-14-15-16-17              |
| C B C ELECTRONICS CO                        | 1                                |
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 ELECTRO-TEC CORP W CALDWELL 3-24-25-30  
 ELECTRO TEC CORP VIRGINIA DIV 16  
 ELECTRONIC CONTROLS INC 18-22-23-33  
 ELECTROPOT INC 20-25

ELGIN MICRONICS DIV ELGIN NAT WATCH CO 16-20-25-28-29-32  
 ELLISON DRAFT GAGE CO 19-35  
 ELMWOOD SENSORS INC 9-19-27-31  
 EMARCO CORP 14  
 ENGELMANN MICROWAVE CO 2  
 EPSCO INC CAMBRIDGE 30-32  
 ESCO GROUP DIV ELECTRONIC SPECIALTY CO 0  
 ESPEY MFG & ELECTRONICS CORP 5-34  
 ESSEX MFG CO ST LOUIS 7-16-19-25-33  
 E-T-A PRODUCTS CO OF AMERICA 1  
 ETCHING CORP OF CALIF  
 DIV ALLEGRI TECH INC 20  
 FANSTEEL METALLURGICAL CORP 22-27-29-33  
 FARMER ELECTRIC PRODUCTS CO 13  
 FEDERAL ANTI CAPACITY SWITCH CORP 0  
 FENWAL INC 31  
 FERRANTI ELECT INC 35-38  
 F & F ENTERPRISES INC CHICAGO SWITCH DIV 1-3-10-11-13-16-20-22-23-25-26-28-29  
 FIDELITY AMPLIFIER CO 32  
 FISHER AKIN CO 4-21-28  
 FREBANK CO 19-35  
 FREDERICKS CO 3  
 FURNAS ELECTRIC CO 7-13-19-22-23  
 F X R INC WOODSIDE 38  
 G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV 10-26-33  
 GC ELECTRONICS CO DIV TETRON ELECTRONICS 3-10-22-26-27-33  
 GENERAL COMMUNICATION CO 2-9-16-23-25-38  
 GENERAL CONTROL CO 3-4-11-18-22-33  
 GENERAL CONTROLS CO AIRCRAFT/ELEC CONTROLS 14-19-26-27  
 GENERAL CONTRDLS CO OF CANADA LTD 39  
 GENERAL DYNAMICS TELECOMMUNICATION 3-10-11-22-28  
 GENERAL ELECTRIC CIRCUIT PROTECTIVE 1-12  
 GENERAL ELECT CD WIRING DEVICE DEPT 14-22-23-27-33  
 GENERAL ELECTRIC CO INDUSTRY CONTROL DEPT 13-22-23  
 GENERAL MILLS INC MINN 20-23  
 GENERAL RAILWAY SIGNAL CO 11-21-25  
 GENERAL TIME CORP ELECTR SYS DIV 25-28  
 GIANNINI CONTROLS CORP TRANSDUCER DIV 19  
 GIANNINI CONTROLS CORP CRAMER DIV 32  
 GIANNINI CONTROLS CDRP NJ DIV 19-28  
 GLASSCO INSTRUMENTS CD 19  
 G M MFG CO 14  
 GORDOS CORP 14-35  
 GORHAM ELECT DIV GORHAM MFG CO 38  
 GRAPHIK CIRCUITS DIV CINCH MFG CORP 20  
 GRAYHILL INC 2-16-20-22-25-27-29  
 GREENLEAF DIV OF SYSTRON DDNNR CORP 28  
 GUARDIAN ELECTRIC MFG CO 1-3-16-21-22-26-27-28-29  
 GUARDIAN ELECTRIC MFG CO OF CALIF INC 16-23-25-27-29  
 GULTON INDUSTRIES INC METUCHEN 31  
 GULTON INDUSTRIES INC WEST INSTRUMENT CORP 31  
 GUNNAR LABS 1-2-3-4-10-22  
 G-V CONTROLS INC 31-32  
 HAMLIN INC 9-13-14-16-29-35  
 HARRIS MFG CO INC 7-19-20-25  
 HART MFG CO 25-26-27-33  
 HAYDON CO A W WATERBURY 32  
 HAYDON SWITCH INC 9-13-16-18-19-22-23-26-27-29-33  
 HEALY-RUFF CO 23  
 HEINEMANN ELECTRIC CO 1  
 HENSCHEL CORP 19  
 HEYER INDUSTRIES INCORPORATED  
 LAB OF MARQUETTE CORP 3-25  
 HOBBS CORP JOHN W DIV STEWART-WARNER CORP 18-19  
 HONEYWELL CONTROLS LTD 13-14-16-19-27-29  
 HOPAX ELECTRIC INC 1  
 HUGHES AIRCRAFT CO ELECT PROD DIV 32  
 HURLETRON INC WHEATON ENG DIV 21-32  
 IE MFG 12  
 I H MFG CO 26  
 ILLUMINATED CONTROLS INC 19  
 IMC MAGNETICS CORP PHOENIX 22  
 IMPERIAL ELECT INC 31  
 INDUSTRIAL DEVICES INC 31  
 INDUSTRIAL ELECTRONIC ENGINEERS INC 22  
 INDUSTRIAL ELECTRONIC HARDWARE CORP 22  
 INERTIA SWITCH INC 9-16-27  
 INSTRUMENT DEVELOPMENT LABS INC 24-30  
 INSTRUMENTS INC 13  
 INTERNATIONAL DATA SYSTEMS INC 30  
 ITT KELLOGG 4  
 JAI DINGER MFG CO 22-27-31  
 JAMES ELECTRONIC INC 2  
 JAN HARDWARE MFG CO 10  
 JANCO CORP 9-13-16-18-19-25-27-29  
 JAVEX ELECTRONICS 25  
 JAY-EL PRODUCTS INC 22  
 J B L INSTRUMENT CO 3-5-12-25-27  
 JENNINGS RADIO MFG CORP SAN JOSE 2-35  
 JFD ELECTRONIC CORP 12  
 JO-BELL PRODUCTS INC 7  
 JOHNSON CO E F 27  
 J-V-M DIVISION FIDELITONE MICROWAVE INC 2-38  
 KALPA SCIENTIFIC LABORATORIES INC 35  
 KANE ENGINEERING LABORATORIES 6-38  
 KAY ELECTRIC CO 33  
 KIDDE & CO WALTER 19  
 KINETICS CORP 2-3-9-18-19-21-22-23-28-30-32  
 KIRKLAND CO H R 22  
 KOLTON ELECTRIC MFG CO 12  
 KORRY MANUF CO 16-22

KRAUTER-WEBER TOOL CO 9  
 KULKA ELEC CORP 27-33  
 LAKE CITY INC SUB OF CONTROLS CO OF AMERICA 32  
 LANES INDS CDRP DIV CORNELL DEEP DRAWING CO 7-19  
 LANGEVIN DIV OF SONOTEC INCORP 3-4-10-11-25-28  
 LEAR ROMEC DIV LEAR INC 19  
 LEDEX INC 5-16-23-25-27-28-29  
 LEEDS & NDRTHRUP CO 5-11-12-22-25-27-33  
 LEXTRA LABS INC 9-23  
 THE LEWIS ENGINEERING CO 25  
 LICON DIV ILLINOIS TOOL WORKS 13-16-18-22-25-27-29-33  
 LICON SWITCH & CONTROL 9-13-15-18-21-27-29-33  
 LIND INSTRUMENTS INC 29-30  
 LINEMASTER SWITCH CORP 0  
 LINK DIV GENERAL PRECISION INC 20  
 LIQUIDOMETER CORP 7  
 LITTELFUSE INC 3  
 LITTON INDUSTRIES ELECTRON TUBE DIVISION 7  
 LUMATRON ELECTRONICS INC 2  
 LUMINATOR INC 20-22  
 LUNDY ELECTRONICS & SYSTEMS INC 25  
 MACK ELECTRIC DEVICES INC 3-9-14-18-35  
 MACK ENGINEERING 15  
 MAGNAVOX CO LOS ANG 25-30  
 MAKEPEACE DIV D E ENGLEHARD INDUSTRIES INC 25  
 MARCO INDUSTRIES CO 22-25  
 MARKITE CORP 24-30  
 MASON ELECTRIC CORP 1-9-15-22-25-27-28-30-33  
 MAUREY INSTRUMENT CORP 16-25-26-28-29  
 MCCOY ELECTRONICS CO 25-28  
 MCDONNELL & MILLER INC 7  
 MCGILL MFG CO ELECTRICAL DIV 3-22-33  
 MECA ELECTRONICS INC DOVER 2  
 MECHANICAL PRODUCTS INC 1  
 MECTRON CO N PLAINFIELD 2  
 MEXTRON DIV CALIF GENERAL INC 27  
 MELABS 30-38  
 MELETRON CORP 9-13-19-22-27-29-35  
 MEL-RAIN CORP 1  
 MERCURY CONTACTS INC 14  
 MERIDIAN METALCRAFT INC 38  
 METHODE MFG CORP 20  
 MICARTA FABRICATORS INC 20  
 MICRODOT INC PASADENA 2  
 MICROMEGA CORPORATION 38  
 MICROVAE ASSOCIATES INC 38  
 MILLI SWITCH CORP FRANKFORT 9-13-16-18-22-25-27-29-33  
 MILLI-SWITCH CORP GLADWYNE 9-13-16-18-22-27-29-33  
 MINITEC 29-31  
 MINNEAPOLIS-HONEYWELL MICRO SWITCH DIV 3-4-9-13-14-16-18-21-22-25-26-27-29-30-31-33  
 MINNEAPOLIS HONEYWELL APPARATUS CONTROLS DIV 19-35  
 MINNEAPOLIS-HONEYWELL DRDANCE DIV 7-9-13-19-31  
 MINNEAPOLIS-HONEYWELL BROWN INST DIV 25  
 MODEL ENGG & MFG INC 3-25  
 MODERN INDUSTRIES INC 32  
 MOLDED INSULATION CO PHILA 27  
 MONITOR CONTROLLER 7-12-13-17-22-23-27  
 MOSSMAN INC DDNALD P 11-22  
 MUIRHEAD & CO LTD 11-25  
 MUIRHEAD INSTRUMENTS INC 5-11-25-28  
 MULTRONICS INC 10-12  
 MURRAY MFG CORP 1-12-26-32-33  
 MUTER CO 1-15-16-23-26-27-31  
 MY-T-GRIP CO INC 0  
 MYTRON PRODUCTS INC 25  
 NETWORK INDUSTRIES INC 22-27-33  
 NEWARK CONTROLS CO 7-8-19-35  
 NEY CO J M  
 NORTH ATLANTIC INDUSTRIES INC 5-25  
 NORTH ELECTRIC CO 3-4-9-11-20-28  
 NORTHERN PRECISION LABORATORIES 3-16-25-29-30  
 NRK MICROWAVE DIV COOK ELECT CO 38  
 NUCLEAR CORP OF AMER DENVER 35  
 OAK MFG CO 11-16-20-22-25-26-27-29-36  
 OHMITE MFG CO 3-25  
 OIL RITE CORP 17  
 O & S RESEARCH INC 22  
 OTTO CONTROLS 9-13-16-18-20-22-25-27-29  
 PACIFIC SCIENTIFIC CO 25  
 PANELLIT INC DIV INFORMATION SYS INC 14  
 PARKER METAL GOODS CO 39  
 PEARSON INC 3-11-16-18-22-23-27  
 PENTA LAB INC 35  
 PERMA-POWER CO 23  
 P & H ELECTRONICS 2  
 PHILA SCIENTIFIC GLASS CO 3-9-14-18-29-35  
 PHOTOCIRCUITS CORP 20  
 PHOTOCOON RESEARCH PRODUCTS 19  
 PHOTO - CRYSTALS 3-9-14-23-32  
 PIONEER PATENTS & PRODUCTS CO 22-33  
 PLANAUTICS CORP 1-2-3-9-18-21-22-23-24-25-26-28-30-31-32-34  
 PLUG IN INSTRUMENTS INC 21  
 PORG INDUSTRIES INC 9-16-17-25-29  
 POLLAK CORP JOSEPH 3-9-11-16-17-18-22-23-25-26-27-29-33  
 POLY-SCIENTIFIC CORP 0  
 PRD ELECTRONICS INC 38  
 PRECISION LINE INC 25  
 PRECISION METAL PRODUCTS CO 20  
 PRECISION SENSORS INC 7-8-9-19-32-35  
 PRECISION SENSORS INC 19



Switches • Test Equipment—Bridges & Decade Boxes

|  |                             |
|--|-----------------------------|
| PRECISION SPECIALTIES INC                  | 25                          |
| PRECISION THERMOMETER & INST CD            | 31                          |
| PRINCETON DIV ELECTRO MECHANICAL RESCH INC | 30                          |
| PRINTED ELECT CORP                         | 20                          |
| PYLE-NATIONAL CO                           | 1-12                        |
| QUALITY STAMPING CO                        | 10-32-33                    |
| QUANTATRON INC                             | 2-23-38                     |
| RCA BRDST & COMM PRODS DIV CAMDEN          | 2                           |
| RCA BRDST & COMM PRODS DIV MEADOW LANDS    | 2                           |
| RADIO SWITCH CORP                          | 25                          |
| RBM DEVELOPMENT CORP                       | 3-9-16-26                   |
| RECORA CO                                  | 16-19-29                    |
| REED RESEARCH INC                          | 9-13-23-26-27               |
| RESITRON LABS INC                          | 21-35                       |
| REUTER INC                                 | 25                          |
| REVERE CORP OF AMERICA                     | 7-9                         |
| RHODES INC M H                             | 32                          |
| ROANWELL CORP                              | 15-22                       |
| ROBERTSHAW CONTROLS CD ACRO DIV            | 13-16-18-27-29              |
| RODALE MFG CO                              | 12-14-22-27-33              |
| RONAN & KUNZL INC                          | 3-9                         |
| ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA  | 25                          |
| ROSS CO MILTON                             | 13-16-17-27                 |
| ROWAN CONTROLLER CO RED BANK               | 1-17-22                     |
| ROYAL MCBEE INST DEVELOP LAB               | 25                          |
| RUCKELSHAUS LABORATORIES INC JOHN G        | 20-25                       |
| SAGE LABORATORIES INC                      | 2-38                        |
| SANDERS ASSOCIATES                         | 2                           |
| SANGAMO ELECTRIC CO                        | 1-31                        |
| SARGENT ELECTRIC CORP                      | 33                          |
| SCHRACK ELECTRICAL SALES CORP              | 16-22-27-28                 |
| SCHUTTE & KOERTING CO                      | 7                           |
| SCIENTIFIC ELECTRONIC LABS INC             | 14-31                       |
| SEAELECTRIC SWITCH & RELAY CORP            | 1-3-4-13-19-25-29           |
| SEAELECTRO CORP                            | 4-28                        |
| SECODE CORP                                | 25                          |
| SECURITY CONTROLS INC                      | 13                          |
| SERVOMECHANISMS INC EL SEGUNDO             | 19                          |
| SERVONIC INSTRUMENTS INC                   | 19                          |
| SHALLCROSS MFG CO                          | 5-9-16-20-25-28-29          |
| SIGHTMASTER CORP                           | 31                          |
| SIGMA INSTRUMENTS INC                      | 1-25                        |
| SINGER METRICS DIV SINGER MFG CO           | 17-22-25                    |
| SINGER METRICS SENSITIVE RES DIV           | 25                          |
| SIVERS LAB                                 | 38                          |
| SKYRON CORPORATION                         | 10                          |
| SLATER ELECTRIC INC                        | 9-14-27-33                  |
| SLIP RING CO OF AMERICA                    | 25                          |
| SLOAN CO THE                               | 16-18-22-27                 |
| SMITH INC HERMAN H                         | 3-11-22-26-33               |
| SOHOT DIV OF THERMOLAB CORP                | 31                          |
| SPARTON ELECTRONICS                        | 9-16-20-27-29               |
| SPEC-SWITCH INC                            | 5-11-20-21-22-27-33         |
| SPECTROL ELECTRONICS CORP SAN GABR         | 24-25                       |
| SPEIDEL CORP PRESSURE CONT GRP             | 19-32-35                    |
| SPERRY MICROWAVE ELECT INC                 | 38                          |
| SPERTI FARADAY INC                         | 3-18-22-25                  |
| STACKPOLE CARBON CO ST MARYS               | 26                          |
| STACO INC STANDARD ELECT PRODS DIV         | 3-4-5-7-13-19-22-23-25-28   |
| STANDARD ELECTRIC PRODUCTS                 | 5-17-25-34                  |
| STEPPER MOTOR DIV LAND AIR INC             | 9-28                        |
| STEVENS MFG CO                             | 31                          |
| SUBMINATURE INST CORP                      | 16-17-20-24-25-29           |
| SWITCHCRAFT INC                            | 10-11-15-16-22-29           |
| SYLVANIA ELECTRIC PRODUCTS IPSWICH         | 1                           |
| TABET MFG CO                               | 3-20                        |
| TAMAR ELECTRONICS INC                      | 23                          |
| TANN CONTROLS CO DIV TANN CORP             | 9-13-27                     |
| TAPCO GROUP THOMPSON RAMO WOOLDRIDGE INC   | 2-38                        |
| SQUARE D CO COMM CONTROL DIV               | 3-4-5-7                     |
| TECHNICAL DEVELOPMENT CO                   | 7                           |
| TECHNICAL LABS                             | 1-2-3-5-9-20-23-25-26-27-32 |
| ELECTRO INDUSTRIES CORP                    | 9                           |
| TELEX INC                                  | 22                          |
| TELONIC INDUSTRIES INC                     | 2                           |
| TENSOR ELECT DEVELOP CO                    | 3                           |
| THERMOCAL DIV OF JAMIESON LABORATORIES     | 9-18                        |
| THERMO ELECTRIC CO                         | 11-22-25                    |
| TORRES ENGG CO INC                         | 9-13-15-16-18-22-27-29-33   |
| TORSTON BALANCE CO                         | 29-33                       |
| TOUCH-PLATE MFG CORP                       | 22-23                       |
| TRANSCO PRODUCTS INC                       | 2                           |
| TRANSISTOR ELECTRONICS CO                  | 16-22-29                    |
| TRANS METRICS INC                          | 19                          |
| TRIMM INC                                  | 10-11-22                    |
| TRI-VI-TRON INC                            | 2-9-16                      |
| TUNG SOL ELECTRIC INC NEWARK               | 35                          |
| TURBO MACHINE CO                           | 38                          |
| TUTTLE ELECTRIC PRODUCTS INC               | 25                          |
| UCINITE CO DIV UNITED CARR FASTENER CORP   | 3-                          |
| 5-10-15-16-18-20-22-25-26-27-29-30         |                             |
| ULANET CO GEORGE                           | 31                          |
| UNIMAX SWITCH MAXSON ELECT CORP            | 13-22-27-29-33              |
| UNISON ELECTRONICS                         | 25                          |
| UNITED ELECTRIC CONTROLS CO                | 1-13-19-27-31-35            |
| UNIVERSAL CIRCUIT CONTROLS                 | 10-11-13-22-25-28-31        |
| UNIVERSAL MATCH CO UNDYNAMICS DIV          | 9                           |
| UNIV MATCH CORP ARMA DIV AVNC & ELECT DEPT | 9                           |
| UNIVERSAL RELAY CORP                       | 1-4-19-27-28-31-32          |
| UNIVOX CORP LOS ANG                        | 2                           |
| VALVEROE LABS                              | 31                          |
| WARPER ELECTRONICS INC                     | 1                           |
| WADE ELECTRIC PRODUCTS CO                  | 18-22-26-33                 |
| WALSCO ELECTRONICS MFG CO                  | 26-27-33                    |

|   |              |
|---|--------------|
| ELECTRO MEC DIV OF WALTHAM PRE INSTR CO     | 20-          |
| 24-25-30                                    |              |
| WARREN COMPONENTS DIV EL-TRONICS INC        | 3            |
| WAVELINE INC                                | 38           |
| WESTERN DIV PENN CONTROLS INC               | 13-27-31     |
| WESTINGHOUSE ELECT CORP APPARATUS DIV       | 17           |
| WESTINGHOUSE ELECTRIC CORP STANDARD CONTROL | 1-7-12-19-22 |
| WILCDLATOR CO                               | 31           |
| WILSON & CO G C                             | 32           |
| WINTERBURN MFG CO                           | 3-23         |
| WOOD ELEC CORP                              | 1            |

TEST EQUIPMENT  
BRIDGES & DECADE BOXES 3300

|                           |    |
|---------------------------|----|
| Attenuators, decade       | 1  |
| Bridges, audio            | 2  |
| Bridges, bolometer        | 3  |
| Bridges, capacitance      | 4  |
| Bridges, conductivity     | 5  |
| Bridges, impedance        | 6  |
| Bridges, inductance       | 7  |
| Bridges, megohm           | 8  |
| Bridges, resistance       | 9  |
| Bridges, R-F              | 10 |
| Bridges, standing wave    | 11 |
| Bridges, strain gauge     | 12 |
| Bridges, synchro          | 13 |
| Bridges, temperature      | 14 |
| Bridges, thermistor       | 15 |
| Bridges, VHF              | 16 |
| Bridges, wein             | 17 |
| Bridges, wheatstone       | 18 |
| Decade boxes, capacitance | 19 |
| Decade boxes, inductance  | 40 |
| Decade boxes, resistance  | 41 |

|  |   |
|--|---|
| AEROSPACE RESEARCH INC                       | 11  |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC    | 3   |
| ALFORD MFG CO                                | 10-11   |
| AMERICAN AIRFRAME CORP                       | 6-9-18-19-40-41                                       |
| AMERICAN ASTRO-SYSTEMS                       | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-40-41 |
| AMSTRO CORPORATION                           | 9   |
| ANADIX INSTRUMENT S INC                      | 12  |
| ANGSTROM PRECISION INC                       | 9-18-41   |
| ARRA RESEARCH ASSOCIATES                     | 5-17-25-34  |
| ASSOCIATED RESEARCH INC                      | 8   |
| ASTROLAB INC                                 | 1   |
| ASTRO SYSTEMS INC                            | 13  |
| ELECTRONICS DIV BALDWIN HAMILTON CORP        | 12  |
| BARNES DEVELOPMENT CO                        | 4-5-6-7-8-9-18-41                                     |
| BARNETT INST CO                              | 4-9   |
| BELL INC F W                                 | 9   |
| BENSON LEHNER G B LTD                        | 9   |
| B & F INSTRUMENTS INC                        | 12-14   |
| BIDDLE CO JAMES G                            | 9   |
| BINARY ELECTRONICS INC                       | 8-9-18  |
| B & K INSTRUMENTS INC OF BRUEL & KJAER       | 4-6-7   |
| BLACKBURN ELECTRONIC CORP                    | 41  |
| BON DE ELECTRONIC LABS INC                   | 15  |
| BOONTON ELECTRONICS CORP                     | 4-6-7-10  |
| BOONTON RADIO CORP                           | 6-10-16   |
| BRUNO NEW YORK INDUSTRY CORP                 | 10-15   |
| BULOVA WATCH CO ELECT DIV                    | 40  |
| BURNELL & CO INC                             | 40  |
| CALIF TECHNICAL INDUST DIV TEXTRON INC       | 6-8   |
| CAMBRIDGE INSTRUMENT CO INC                  | 4-7-9-18-19-40-41                                     |
| CANADIAN RESEARCH INSTITUE                   | 8-9   |
| CAROL ELECT DIV WEECO                        | 7   |
| CARMA MANUFACTURING CO                       | 5   |
| CENTRAL COIL CORP                            | 9-18-19-40-41   |
| CENTURY ELECT INST INC TULSA                 | 12  |
| C E S ELECTRONIC PRODUCTS INC                | 4   |
| CINEMA ENGINEERING DIV AEROVOX CORP          | 1-19-40-41  |
| CLAROSTAT MFG CO                             | 41  |
| CLEGG LABS DIV CLEGG INC                     | 6   |
| CLOUGH BRENGL E CO                           | 2-4-7-9   |
| COAST COIL CO                                | 40  |
| CAMPAGNIE GENERALE OE METROLOGIE             | 6   |
| COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC      | 6-7   |
| CONRAD CARSON ELECTRONICS INC                | 8-41  |
| CONSOLIDATED AIRBORNE SYSTEMS INC            | 1-9-14  |
| CONSOLIDATED RESISTANCE CO OF AMERICA        | 9-18-41   |
| CONTROL INDICATING CORP                      | 9-14  |
| CURTISS-WRIGHT CORP ELECTRONICS DIV          | 4-6-7-9   |
| DATASCAN INC                                 | 4-8   |
| DAVEN CO                                     | 1-41  |
| DAWE INSTRUMENTS LTD                         | 19-41   |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 3   |
| DFCKFR CORP                                  | 4   |
| DELTA DESIGN INC C O NON LINEAR SYSTEMS INC  | 14  |

PRODUCTS & MANUFACTURERS

|                                      |                                      |
|--------------------------------------|--------------------------------------|
| DELTA ELECTRONICS INC ALEXANDRIA     | 6                                    |
| DIAMOND ANTENNA & MICROWAVE CORP     | 1                                    |
| DICE CO J W                          | 9                                    |
| DMETER MFG CO                        | 1-9-18-41                            |
| DYNAMICS INST CO                     | 8-9-18                               |
| DYTRONICS CD                         | 4-6-17                               |
| EALING CORP                          | 1-6-9-18-19-41                       |
| ELECTRO INSTRUMENT INC               | 4-6-7-9-19                           |
| ELFCTRO SCIENTIFIC IND INC           | 4-6-7-9-13-18-19-41                  |
| ELECTRONANTICS CORPORATION           | 1                                    |
| ELECTRONIC APPLICATIONS INC WILTON   | 4                                    |
| ELECTRONIC APPLICATIONS INC STAMFORD | 4                                    |
| ELECTRONIC INSTRUMENT CO INC         | 4-9                                  |
| ELECTRONIC MEASUREMENTS CORP N Y     | 4                                    |
| ELECTRONIC PROCESS CORP SAN CARLOS   | 14                                   |
| EPIC INC                             | 4-7-9-41                             |
| EPPLEY LAB INC                       | 14-18                                |
| ERDCO ENGG CORP                      | 4                                    |
| ESPEY MFG & ELECTRONICS CORP         | 7-9                                  |
| FIDELITY AMPLIFIER CO                | 41                                   |
| FLUIDYNE ENGG CORP                   | 12                                   |
| FLUKE MFG CO INC JOHN                | 6                                    |
| FREED TRANSFORMER CO                 | 6-7-19-40                            |
| FURZELL LABS LTD                     | 4                                    |
| GB COMPONENTS INC                    | 9-18-41                              |
| GENERAL MICROWAVE CORP               | 3-10-15                              |
| GENERAL RADIO CO                     | 1-2-3-4-6-7-8-9-10-16-17-18-19-40-41 |
| GERTSCH PRODUCTS INC                 | 1-2-6-13                             |
| GRAY INSTRUMENT CD                   | 9-12-13-14-18-41                     |
| GREINER CO EMIL                      | 9-14-18                              |
| GULTON INDUSTRIES INC METUCHEN       | 4                                    |
| HALLICRAFTERS CO CHICAGO             | 4-7-19-40                            |
| HATHAWAY INSTRUMENTS DIV LIONEL      | 18-19-40-41                          |
| HEATH CO SUB OF DAYSTROM INC         | 4-6-7-9-11-18-19-41                  |
| B HARBOR                             | 19-41                                |
| HEATH CO DIV OF DAYSTROM ST JOS      | 4-6-10-19-41                         |
| HELLIGE INC                          | 5                                    |
| HEWLETT PACKARD CO                   | 1-3-6-15-16                          |
| MEYER INDUSTRIES INCORPORATED        | 18                                   |
| LAB OF MARQUETTE CORP                | 10-16                                |
| HOLLAND ELECTRONICS                  | 14                                   |
| HOWELL INSTRUMENTS INC               | 4                                    |
| INDIKON CO                           | 4                                    |
| INDUSTRIAL CONTROL CO                | 4                                    |
| INDUSTRIAL DEVELOPMENT LABS INC      | 4-9                                  |
| INDUSTRIAL TEST EQUIPMENT CO         | 13                                   |
| INDUSTRIAL TRANSFORMER CORP          | 7-11                                 |
| INSTRON ENGG CORP                    | 12                                   |
| JACKSON ELECTRICAL INSTRUMENT CO     | 4                                    |
| JARVIS ELECTRONICS CORP              | 6-7-9                                |
| JONES ELECTRONIC CO INC M C          | 10-11                                |
| KAY ELECTRIC CO                      | 1-41                                 |
| KEITHLEY INSTRUMENTS INC             | 8                                    |
| KURTSTON ELECTRONICS                 | 41                                   |
| LABLINE INC                          | 14-15                                |
| LANGVIN DIV OF SONOTEC INCORP        | 1                                    |
| LEEDS & NORTHRUP CO                  | 4-5-6-7-8-9-14-18-19-41              |
| LEHIGH VALLEY ELECT ENGG & MFG CO    | 15                                   |
| LIQUIDMETER CORP                     | 4                                    |
| LUMATRON ELECTRONICS INC             | 1                                    |
| MACLEOD & HANOPOL                    | 7                                    |
| MAGNETIC METALS CO                   | 4                                    |
| MANSON LABORATORIES INC              | 1                                    |
| MARCONI INSTRUMENTS                  | 1-2-6-7-10                           |
| MARMA ELECTRONICS CO                 | 41                                   |
| MEASUREMENTS DIV MC GRAW-EDISON CO   | 1-3-4-6-7-10                         |
| MERIDIAN METALCRAFT INC              | 10-11-16                             |
| METAL SPECIALTY PRODUCTS CORP        | 17                                   |
| MICRO METRICS INC                    | 1-9-13-18-41                         |
| MID-EASTERN ELECTRONICS INC          | 8-9-41                               |
| MILLEN MFG CO JAMES                  | 6-11                                 |
| MILLIVAC INSTRUMENTS INC             | 9                                    |
| MINCO PRODUCTS INC                   | 14                                   |
| MINNEAPOLIS-HONEYWELL RUBICON OIV    | 8-9-13-14-18-41                      |
| MODEL ENGG & MFG INC                 | 6                                    |
| MONROE ELECTRONICS INC               | 41                                   |
| MUIRHEAD & CO LTD                    | 1-4-7-9-18-19-40-41                  |
| MUIRHEAD INSTRUMENTS INC             | 1-4-6-7-8-9-12-13-18-19-40-41        |
| MUTRON INC                           | 19-40-41                             |
| NEPTUNE ELECTRONICS CO               | 19-41                                |
| NETWORK INDUSTRIES INC               | 4                                    |
| NEW LONDON INST CO INC               | 1                                    |
| NORTH ATLANTIC INDUSTRIES INC        | 1                                    |
| NORTH ATLANTIC INDUSTRY INC          | 12-13-40                             |
| NORTHEAST ELECT CORP                 | 6                                    |
| OHMITE MFG CO                        | 41                                   |
| ORTHO PRECISION RESISTORS INC        | 1-4-6-9-17-18-41                     |
| PACO ELECTRONICS CO INC              | 19-40-41                             |
| POLYTRONICS CO                       | 9-10-14-18-41                        |
| PRD ELECTRONICS INC                  | 3-15                                 |
| PRODUCTION ELECTRONICS INC           | 41                                   |
| PROJECTS UNLIMITED INC               | 7                                    |
| PULSE ENGG INC                       | 7                                    |
| QUANTATRON INC                       | 14                                   |
| RADAR MEASUREMENTS CORP              | 3-11-15                              |
| RDF CORP                             | 14                                   |
| REMANCO INC                          | 10                                   |
| RESISTOR NETWORKS INC                | 9-13-18-41                           |
| ROHDE & SCHWARZ                      | 1-2-4-6-7-8-9-10-17-19-40-41         |
| ROSEMOUNT ENGG CO                    | 9                                    |
| SHALLCROSS MFG CO                    | 1-9-18-41                            |
| SIMMONDS ACCESSORIES INC             | 4                                    |
| SIMMONDS PRECISION PRODS TARRYTOWN   | 4-19                                 |
| SIMMONDS PRECISION PRODS GLENDALE    | 5-8-19                               |
| SINGER METRICS DIV SINGER MFG CO     | 7-9-14-18                            |
| SINGER METRICS SENSITIVE RES DIV     | 9-18                                 |
| SKIATRON ELECTRONICS TV CORP         | 9-41                                 |
| SPECIAL INSTRUMENTS LABORATORY INC   | 8                                    |
| SPERRY MICROWAVE ELECT INC           | 3-11-15                              |



PRODUCTS & MANUFACTURERS

Test Equipment—Bridges & Decade Boxes • Counting Devices • Generators

|                                   |                  |
|-----------------------------------|------------------|
| SPRAGUE ELECTRIC CO N ADAMS       | 4-19             |
| S'DODART AIRCRAFT RADIO CO        | 1                |
| SUN ELECTRIC CORP                 | 10               |
| S*STEMS INC                       | 4                |
| TAFFET ELECTRONICS INC            | 17               |
| TECHNICAL LABS                    | 1-2-6-18         |
| TECHNIQUE ASSOCIATES              | 14               |
| TEL-LABS INC                      | 9-18-41          |
| TERADYNE INC                      | 9                |
| THERMO ELECTRIC CO                | 14-18            |
| THERMONETICS INC                  | 14-15            |
| THETA INSTRUMENT CORP             | 13               |
| TCROTRON CORP                     | 40               |
| ULTRONIX INC                      | 1-9-14-41        |
| UNIVERSAL MFG CO INC              | 40               |
| UNIVERSAL TOROID COIL WINDING INC | 40               |
| VOLTRON PRODUCTS                  | 19               |
| WELNSCHTEL ENGG                   | 1-3-10-15-17     |
| WELCH SCIENTIFIC CO W M           | 19-40-41         |
| WEST COAST RESEARCH CORP          | 14               |
| WESTMORE INC                      | 17               |
| WILTRON CO                        | 11               |
| YOKOGAWA ELECTRIC WKS INC         | 4-6-7-9-18-19-41 |

**COUNTING DEVICES 3400**

|                                |    |
|--------------------------------|----|
| Counters, directional          | 1  |
| Counters, electromagnet        | 2  |
| Counters, electronic           | 3  |
| Counters, electronic digital   | 4  |
| Counters, events-per-unit time | 5  |
| Counters, frequency            | 6  |
| Counters, geiger               | 7  |
| Counters, impulse              | 8  |
| Counters, mechanical           | 9  |
| Counters, photoelectric        | 10 |
| Counters, preset               | 11 |
| Counters, proportional         | 12 |
| Counters, radiation            | 13 |
| Counters, revolution           | 14 |
| Counters, scintillation        | 15 |
| Counters, time-measuring       | 16 |

|  |  |
|--|--|
| ABACUS INC                             | 1-3-4-6-16                             |
| ABRAMS INSTRUMENT CORP                 | 2                                      |
| ACCURATE INSTRUMENT CO                 | 3                                      |
| ACCUTRONICS INC                        | 3-5-8-16                               |
| ADTROL ELECTRONICS INC                 | 3-4-6-16                               |
| AEROSPACE RESEARCH INC                 | 3-4-5-6-16                             |
| AMERAC INC                             | 6-9-14                                 |
| AMERICAN ASTRO-SYSTEMS                 | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16 |
| AMERICAN MISSILE PROD CO INC           | 1-3-4-5-6-11-                          |
| AMSTRO CORPORATION                     | 16                                     |
| AMTRON INC MILOTHIAN                   | 3-10                                   |
| ANADEX INSTRUMENT S INC                | 4-5-6-11                               |
| ANATRAN DIV OF ENOEVCO CORP            | 9-14                                   |
| ANTON ELECTRONICS LABS                 | 3-7-11-12                              |
| APPLIED DEVELOPMENT CORP               | 3-4-8-16                               |
| APPLIED DEVELOPMENT CORP MONTEREY PK   | 4                                      |
| AR6T ELECTRONICS INC                   | 4-10                                   |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD   | 3-4-10                                 |
| ATLANTIC INSTRUMENTS & ELECTRONICS INC | 3-6-                                   |
|  | 11                                     |
| ATOMIC ACCESSORIES INC                 | 7-12-13-15-16                          |
| ATOMIC LABS INC                        | 13                                     |
| ATOMUM CORP                            | 3-4-5-6-13-15                          |
| AUSTIN ELECTRONICS DIV AUSTIN CO       | 3-16                                   |
| AUTOMATIC TIMING & CONTROLS INC        | 8-14                                   |
| AUTOMATION MANAGEMENT INC              | 3-4-5-6                                |
| AUTO TROL CORP                         | 4                                      |
| AUTOTRON INC                           | 10                                     |
| AVIONICS INC                           | 3                                      |
| AVTRON MFG INC                         | 3-6-16                                 |
| BALLARD CO IRVING                      | 16                                     |
| BARKER & WILLIAMSON INC                | 9                                      |
| BECKMAN INST INC BERKELEY DIV          | 1-3-4-5-6-11-12-14-16                  |
|  | 1-3-10-14                              |
| BENSON LEHNER CORP                     | 6                                      |
| BIDDLE CO JAMES G                      | 8-9-11                                 |
| BOESCH MFG CO                          | 1-2-8-9-14                             |
| BOWMAR INSTRUMENT CORP                 | 3-10                                   |
| BOY-MAR ELECTRICAL SERVICE CO          | 16                                     |
| BROWN ENG CO INC                       | 10                                     |
| BURGESS CELLULOSE CO GRADE O MAT DIV   | 16                                     |
| CALCULAGRAPH CORP INC                  | 5                                      |
| CALIF TECHNICAL INDUST DIV TEXTRON INC | 2-5-8-16                               |
| CALIF ELECTRO SCIENTIFIC CORP          | 7-16                                   |
| CENTPOL ENG CO                         | 3-4-5-6                                |
| CHADWICK-HELMUTH CO                    | 2-4-8-16                               |
| CHRONO LOG CORP                        | 16                                     |
| CINCINNATI TIME RECORDER CO            | 3-8                                    |
| CLARK ELECTRONIC LABS                  | 4                                      |
| CLEVELAND METAL SPECIALTIES CO         | 14                                     |
| COLEMAN ELECTRONIC SYSTEMS             | 3                                      |
| COLORADO INSTRUMENT INC                | 3                                      |
| COMPTON CORP                           | 4-5-16                                 |
| COMPUTER EQUIPMENT CORP                | 4                                      |
| COMPUTER LOGIC CORP                    | 1-3-4-5-6-8-11-12-                     |
| COMPUTER MEASUREMENTS CO               | 14-16                                  |
| CONSOLIDATED CONTROLS CORP             | 2                                      |
| CONTROL DEVICES                        | 8                                      |

|  |                            |
|--|----------------------------|
| CONTROL LOGIC INC                            | 1-3-4                      |
| COSMIC RADIATION LABS                        | 4-11-13-16                 |
| DACO INSTRUMENT CO                           | 9                          |
| DATA INSTRUMENTS                             | 1-4-8-10                   |
| DATA TECH                                    | 1-3-4-11-14                |
| DATA TECHNOLOGY CORP PALO ALTO               | 4-5-6                      |
| DATASCAN INC                                 | 4-10-11-14                 |
| DATRAX DIV W W HENRY CO                      | 3                          |
| DEITZ CO S J                                 | 10                         |
| DENSON ELECTRONICS CORP                      | 3                          |
| DEVELOPMENTAL ELECT CORP                     | 4                          |
| DI-AN CONTROLS INC                           | 4                          |
| DIETZ CO S J                                 | 10                         |
| DIGITAL DESIGN CORP                          | 1-3-4-8-11-16              |
| DIGITAL ELECTRONICS INC                      | 3-4-5                      |
| DIGITAL SYSTEMS INC                          | 1-11                       |
| DIGITRAN CO DIV ENDEVCO                      | 9-14                       |
| DITMORE FRF;MUTH CORP                        | 9-11-14                    |
| DMETER MFG CO                                | 10                         |
| DURANT MFG CO PROVIDENCE                     | 1-2-3-10-11-14             |
| DURANT MFG CO MILWAUKEE                      | 1-2-6-8-9-10-11-14         |
| DURANT MFG CO WATERTOWN                      | 0                          |
| DYMEC DIV OF HEWLETT PACKARD CO              | 4-5-6-16                   |
| DYTRONICS CO                                 | 4                          |
| EAGLE SIGNAL CO DIV GAMEWELL CO              | 2-8-11-14                  |
| EASTERN SPECIALTY CO                         | 10                         |
| ELDORADO ELECT CO                            | 3-4-16                     |
| ELECTRIC TACHOMETER CORP                     | 2-5-9                      |
| ELECTRO DEVICES INC NEWTON                   | 10                         |
| ELECTRO PHYSICS CO                           | 10                         |
| ELECTRONIC CONTROL CORP                      | 10                         |
| ELECTRONIC CONTROLS INC                      | 3-8-10-14-16               |
| ELECTRONIC COUNTERS INC                      | 1-3-4-5-6-8-10-11-14-16    |
| ELECTRONIC DESIGN & DEVELOP CO               | 4-8-9-10-16                |
| ELECTRONIC ENGG CO OF CALIF                  | 16                         |
| ELECTRONIC PRODUCTS CO DIV VICTOREEN         | 7-13                       |
| ELECTRONIC PRODUCTS CORP BALTIMORE           | 16                         |
| ELGIN MICRONICS DIV ELGIN/NAT WATCH CO       | 2-3-                       |
|  | 4-8-16                     |
| ELGIN NATIONAL WATCH CO                      | 2-5-6-16                   |
| ENGINEERED ELECTRONICS CO                    | 4-11                       |
| ENGLER INSTRUMENT CO                         | 14-16                      |
| EPSCO INC CAMBRIDGE                          | 3-4-5-16                   |
| ERIE ELECTRONICS DIV                         | 6-11-16                    |
| ERIE PACIFIC                                 | 1-3-4-5-6-11-14-16         |
| EXACT ENGG MFG INC                           | 9-16                       |
| FISHER AKIN CO                               | 3-8                        |
| FRANKLIN SYSTEMS INC                         | 5-6-11-12-13-15-16         |
| FRED TRANSFORMER CO                          | 3-10-11                    |
| FRONTIER ELECT CO                            | 3-4                        |
| GARDNER LAB INC                              | 10                         |
| GENERAL ATRONICS CORP ATRONIC PROD DIV       | 3                          |
| GENERAL CONTROLS CO AIRCRAFT/ELEC CONTROLS   | 8-9-10-11                  |
| GENERAL CONTROLS CO SKOKIE                   | 3                          |
| GENERAL ELECTRIC CO ATOM POWER EQUIP         | 13-15-16                   |
| GENERAL ELECTRIC CO SPECIALTY CONTROL DEPT   | 10                         |
| GENERAL RADIO CO                             | 3-4-6-16                   |
| GIANNINI CONTROLS CORP CRAMER DIV            | 16                         |
| GORMAN MACHINE CORP                          | 3                          |
| GUARDIAN ELECTRIC MFG CO                     | 1-2-8                      |
| HAMILTON WATCH CO INDUSTRIAL PRODS DIV       | 16                         |
| HAMNER ELECTRONICS CO INC                    | 11-12-13-15-16             |
| HART MFG CO                                  | 8                          |
| HARVEY WELLS ELECTRONICS INC                 | 1-3-6-11-15-16             |
| HAYDON CO A W WATERBURY                      | 2-5-16                     |
| HAYDON INSTRUMENT CO                         | 1-2-5-6-8-9-11-14-16       |
| HEATH CO SUB OF DAYSTROM INC                 | 7-13                       |
| HEWLETT PACKARD CO                           | 3-4-5-6-11-16              |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 3-4-6-13                   |
| HOWARD CRYSTAL HOLDERS INC                   | 10                         |
| HURLETRON INC WHEATON ENG DIV                | 8-16                       |
| H W ELECTRONICS INC                          | 4-5-6-15-16                |
| HYDRORPIPE INC SUB BROOKS INST CO            | 5-6-8-11                   |
| ICONIX INC                                   | 4-5-6-11-16                |
| INDUSTRIAL ELECTRONICS INC                   | 10                         |
| INERTIA SWITCH INC                           | 9                          |
| INFRARED INDUSTRIES INC WESTERN DIV          | 10                         |
| INSTRUMENT CORP OF FLA                       | 3-4-16                     |
| INSTRUMENTS INC                              | 13                         |
| INTERCONTINENTAL INSTRUMENTS INC             | 3-4-6                      |
| ISOTOPIES INC                                | 7-12-13-15                 |
| JACK INDUSTRIES BILL                         | 2                          |
| JACOBS INSTRUMENT CO                         | 3-4-5                      |
| JARVIS ELECTRONICS CORP                      | 3-10-14                    |
| KEARFOTT DIV GPI LITTLE FALLS                | 1                          |
| KOLLSMAN INST CORP STD KOLLSMAN IND INC      | 9-                         |
|  | 14                         |
| KOLLSMAN INSTRUMENT CORP                     | 9-14                       |
| SUB STANDARD KOLLSMAN IND SYOSSET            | 4-5-11-13-15               |
| LANDSVERK ELECTROMETER CO                    | 3-6                        |
| LAVOTE LABS INC                              | 3-4                        |
| LEACH CORP SPECIAL PRODUCTS DIV              | 8                          |
| LEHIGH VALLEY ELECT ENGG & MFG CO            | 7                          |
| LEIGHTON LABS H W                            | 9-12                       |
| LIBRASCOPE DIV GENERAL PRECISION INC         | 16                         |
| LIEBEL-FLORSHEIM CO                          | 16                         |
| LIONEL CORP LIONEL ELECTRONIC LABS DIV       | 3                          |
| MACHINERY ELECTRIFICATION INC                | 6                          |
| MANSON LABORATORIES INC                      | 3                          |
| MAST DEVELOPMENT CO INC                      | 2-4-5-8-9-11               |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 3-4-5-6-11-12-16           |
| MEASUREMENT ENGG LTD                         | 10-15                      |
| MERIAM INSTRUMENT CO ELECTRONIC DIV          | 0                          |
| M F ELECTRONICS CORP                         | 3                          |
| MICRO METRICS INC                            | 3-4-5-6                    |
| MICROSPACE INC                               | 4                          |
| MODULAR INST CORP DIV ASTROSONICS INC        | 3-4-                       |
|  | 5-6-8-10-11-12-13-14-15-16 |
| MORAN INSTRUMENT CORP                        | 7-15                       |
| NANILOA CORP                                 | 1-3-4-5-11                 |

|  |                              |
|--|------------------------------|
| NATL RADIAC INC                              | 7-13-15                      |
| NAVIGATION COMPUTER CORP                     | 4-11                         |
| NORTHEASTERN ENG INC                         | 3-4-5-6-7-11-13-16           |
| NORTH ELECTRIC CO                            | 4                            |
| NUCLEAR-CHICAGO CORP                         | 7-11-12-13-15-16             |
| NUCLEAR CORP OF AMER DENVILLE                | 7-13-15                      |
| NUCLEAR DEVELOPMENT LAB INC                  | 7-13                         |
| NUCLEAR MEASUREMENTS CORP                    | 7-12-13-15                   |
| NUCLEONIC CORP OF AMERICA                    | 7-13-15                      |
| NYTRONICS INC LEXINGTON                      | 10-16                        |
| O DELL BROS                                  | 1-3-8                        |
| OLYMPIC INSTRUMENTS INC                      | 9                            |
| OMCO   | 7                            |
| PACKARD INSTRUMENT CO                        | 3-4-5-6-7-8-10-11-12-        |
|  | 13-15-16                     |
| PARABAM INC                                  | 4-8-9-16                     |
| PASTORIZA ELECT INC                          | 3-4                          |
| PENWOOD NUMECHRON CO                         | 3-4-8-11-16                  |
| PERFECT COMPONENTS INC                       | 9                            |
| PERFORMANCE MEASUREMENTS CO                  | 4                            |
| PHILIPS ELECTRONIC INSTRUMENTS               | 7-12-15                      |
| PHOTOBELL CO                                 | 3-10                         |
| PHOTOCON RESEARCH PRODUCTS                   | 2-9-11                       |
| PILOT CHEMICALS INC                          | 15                           |
| PLUG IN INSTRUMENTS INC                      | 3-4-5-6-16                   |
| POTTER AERONAUTICAL CORP                     | 5-6                          |
| POTTER PACIFIC CORP DIV OF                   | 3-4-5-6-11-12                |
| POTTER AERONAUTICAL CORP                     | 11                           |
| PRECISION SPECIALTIES INC                    | 1-2-8-9-10-11-14             |
| PRESIN CO INC                                | 1-3-4-5-6-11-16              |
| RACAL ELECTRONICS LTD                        | 3-4-5-8-16                   |
| RADIOPHONE CO                                | 7-11-12-13-15                |
| RADIATION COUNTER LABS INC                   | 4-5-6-16                     |
| RANSOM RESEARCH                              | 4                            |
| RESE ENGG INC                                | 12-13                        |
| REUTER STOKES ELECT COMPONENTS               | 5-8-9-14-16                  |
| ROBERTSON INSTRUMENT CO                      | 1-3-4-5-6-11-16              |
| ROBOTOMICS ENTERPRISES INC                   | 6                            |
| ROHOE & SCHWARZ                              | 3                            |
| ROSEMOUNT ENG CO                             | 2-9-14-16                    |
| ROWAN CONTROLLER CO RED BANK                 | 2-16                         |
| ROYSON ENGG CO                               | 4-16                         |
| SCHMELING ELECTRONICS DIV RARITAN INOS CORP  | 1-3-4-                       |
|  | 5-6-11                       |
| SCHLUMBERGER RIDGEFIELD INSTRUMENTS          | 13                           |
| SEKONIC INC                                  | 13-15                        |
| SEMI ELEMENTS INC                            | 1-3-10                       |
| SENSORY INC                                  | 4-11                         |
| SERVO CORP OF AMERICA                        | 16                           |
| SESSIONS CLOCK CO INDUSTRIAL TIMING DIV      | 2-3-16                       |
| SIGMA INSTRUMENTS INC                        | 3                            |
| SORENSEN INDUSTRIAL ELECTRONIC CO            | 14                           |
| SPACE INSTRUMENTATION CORP                   | 6-16                         |
| SPERRY MICROWAVE ELECT INC                   | 3-4-10-11-16                 |
| STANOARD INSTRUMENT CORP                     | 9                            |
| STEPPER MOTOR DIV LAND ATR INC               | 10                           |
| STRANDBERG ENGG LABS INC                     | 1-3-4-5-6-8-9-10-11-13-14-16 |
| STREETER AMET                                | 13                           |
| SUMMERS & MILLS INC                          | 16                           |
| SUNSHINE SCIENTIFIC INSTRUMENT               | 9-16                         |
| SYSTEMATICS OF MO INC                        | 6                            |
| SYSTEMS INC                                  | 3-4-5-6-11-16                |
| SYSTRON DONNER CORP                          | 1-2-5-8-9-16                 |
| TALLER & COOPER INC                          | 7-12-13-15                   |
| TECHNICAL ASSOCIATES BURBANK                 | 4-5-16                       |
| TEKTRONIX INC BEAVERTON                      | 6                            |
| TELECHROME MFG CORP                          | 8-9-10                       |
| TELECOMPUTING CORP ELECTR SYS & DATA INST OV | 9                            |
| THETA INSTRUMENT CORP                        | 10                           |
| TRI-TRONICS CO                               | 3-8-10-13-16                 |
| TROTT ELECTRONICS INC                        | 3-7-8-13                     |
| TROXLER ELECTRONICS LAB INC                  | 5                            |
| UNIVERSAL MATCH CO UNDYNAMICS DIV            | 5                            |
| UNIV MATCH CORP ARMA DIV AVNMC & ELECT DEPT  | 3-4-10-11                    |
|  | 4-6                          |
| UNIVERSAL MFG CO INC                         | 1-2-3-4-                     |
| VECTOR MFG CO SO HAMPTON                     | 5-6-8-9-10-11-14             |
| VEEDER ROOT INC ELECT CONTROLS DIV           | 1-2-3-4-                     |
|  | 5-6-8-9-10-11-14             |
| VENNER ELECTRONICS LTD                       | 3-4-5-6-8-11-14-16           |
| VICTOREEN INSTRUMENT CO CLEVELAND            | 7-12-13-                     |
|  | 15                           |
| VOLK RADIOCHEMICAL CO                        | 7                            |
| WAELINE INC                                  | 16                           |
| WADELL DYNAMICS INC                          | 3-4-6                        |
| WASHINGTON TECHNOLOGICAL ASSOC INC           | 4-5                          |
| WATERMAN PRODUCTS CO                         | 1-10                         |
| WAYNE GEORGE CORP                            | 3-4-5-6-8-11                 |
| WELTRONIC CO                                 | 10                           |
| WINOSOR ELECTRONICS INC                      | 10                           |
| WINTRONICS INC                               | 7-12-13-15                   |
| N WOOD COUNTER LAB INC                       | 1-3-10                       |
| WORNER ELECTRONIC DEVICES                    |                              |

**GENERATORS 3500**

|                               |    |
|-------------------------------|----|
| Generators, A-F signal        | 1  |
| Generators, color TV signal   | 2  |
| Generators, F-M signal        | 3  |
| Generators, harmonic          | 4  |
| Generators, microwave signal  | 5  |
| Generators, noise             | 6  |
| Generators, phase modulation  | 7  |
| Generators, pulse             | 8  |
| Generators, radar calibration | 9  |
| Generators, R-F signal        | 10 |

For Company Addresses, See Alphabetical Listing of Electronic Mfrs.

## Test Equipment—Generators

|                                   |    |
|-----------------------------------|----|
| Generators, SHF .....             | 11 |
| Generators, single-sideband ..... | 12 |
| Generators, square wave .....     | 13 |
| Generators, sweep .....           | 14 |
| Generators, sync .....            | 15 |
| Generators, stretcher .....       | 16 |
| Generators, timing marker .....   | 17 |
| Generators, TV signal .....       | 18 |
| Generators, UHF .....             | 19 |
| Generators, VHF .....             | 20 |
| Generators, waveform .....        | 21 |
| Multipliers, frequency .....      | 22 |
| Oscillators .....                 | 23 |

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|--|--|
| ABACUS INC                                   | 8  |
| ABBEY ELECTRONICS CORP                       | 1-13   |
| ACCUTRONICS INC                              | 13-17  |
| ADLER ELECTRONICS INC                        | 3  |
| ADVANCED MEASUREMENT INST INC                | 1-3-8-10-12-13-14-19-20                                  |
| AERDSpace RESEARCH INC                       | 22   |
| AETNA ELECTRONICS CORP                       | 21   |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC    | 6-19-21  |
| AIRCORP INC                                  | 22   |
| AIRCRAFT RADIO CORP                          | 10-19-20   |
| AJAX ELECTROTHERMIC CORP                     | 22   |
| ALFRED ELECTRONICS                           | 5-7-8-13   |
| ALLEN ELECTRONIC CORP                        | 14   |
| ALLISON LABS INC                             | 6  |
| ALTO SCIENTIFIC CO                           | 8  |
| AMERAC INC                                   | 22   |
| AMERICAN AIRFRAME CORP                       | 1-3-13-14  |
| AMERICAN ASTRO-SYSTEMS                       | 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22 |
| AMERICAN ELECT LABS INC                      | 4-5  |
| AMERICAN MISSILE PROD CO INC                 | 17-21  |
| AMULEX ELECTRONICS INC                       | 8-13-21  |
| ANDERTON ELECTRONIC LAB                      | 23   |
| ANDREA RADIO CORP                            | 2-3-14-18-19-20  |
| APPLIED DEVELOPMENT CORP MONTEREY PK         | 8-17   |
| APPLIED MICROWAVE LAB INC                    | 4-5-19-22  |
| APPLIED RESEARCH INC                         | 22   |
| APPLIED SYSTEMS CORP                         | 8  |
| ARF PRODUCTS INC RATON                       | 7  |
| ARKAY INTERNATIONAL INC                      | 10   |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD         | 23   |
| ASTRODATA INC                                | 17   |
| ATELIERS DE MONTAGES ELECT                   | 10   |
| BABCOCK ELECT CORP                           | 3-10-19  |
| BACMAN INST INC BERKELEY DIV                 | 4-8-17   |
| BEHLMAN INVAR ELECTRONICS CORP               | 23   |
| BENRUS WATCH CO INC                          | 13   |
| B & K INSTRUMENTS INC OF BRUEL & KJAER       | 1  |
| B & K MFG CO                                 | 2-15-18  |
| BOONTON RADIO CORP                           | 3-10-14-18-20  |
| BORG-WARNER CONTROLS                         | 3-5-10-11-19-20  |
| BOSCO ELECT INC                              | 23   |
| BROWN ENG CO INC                             | 10   |
| BRUNO NEW YORK INDUST CORP                   | 5-10-19  |
| BUDD ELECTRONICS A DIV OF THE BUDD CO        | 19-20  |
| BURMAC ELECTRONICS CO INC                    | 8  |
| BURR BROWN RESEARCH CORP                     | 1-13   |
| CALBEST ELECTRONICS CO                       | 3  |
| CALIF TECHNICAL INDUST DIV TEXTRON INC       | 10   |
| CAROL ELECT DIV WEECO                        | 1-8-10   |
| CHALCO ENGINEERING CORP                      | 1  |
| CLOUGH BRENGL E CO                           | 1-10-14  |
| COMMUNICATION MEASUREMENTS LABS              | 1-13-21  |
| CAMPAGNIE GENERALE DE METROLOGIE             | 1-3-8-14-18-20   |
| COMPUTER LOGIC CORP                          | 8-17-21  |
| COMPUTER TEST CORP                           | 8  |
| COOPERTRONIX                                 | 8-14   |
| CORDIN CO THE                                | 0  |
| CRANE ELECTRONICS CO                         | 8  |
| CYBETRONICS INC                              | 8  |
| DATA CONTROL SYSTEMS INC                     | 3  |
| DATA TECHNOLOGY CORP PALO ALTO               | 17   |
| DATAPULSE INC                                | 8  |
| DAVEN CO                                     | 1  |
| DAWE INSTRUMENTS LTD                         | 1-6-8  |
| DECITRON ELECTRONICS CORP                    | 5-6-9-10-12  |
| DELTA F INC                                  | 10   |
| DIGITAL ELECTRONICS INC                      | 8-13   |
| DIGITAL SYSTEMS INC                          | 8  |
| DIGITECH INC WILTON                          | 8  |
| DON BOSCO ELECT SUB OF HOWELL ELECT MOTORSC6 | 6-8  |
| DUKANE CORP                                  | 23   |
| DUMONT LABS INC ALLEN B                      | 8-18   |
| DYMEC DIV OF HEWLETT PACKARD CO              | 5-10   |
| DYTRONICS CO                                 | 1-13   |
| E H RESEARCH LAB INC                         | 8-13   |
| ELECT MECHANICAL RES INC                     | 15   |
| ELECTRAMATIC INC                             | 1-4-6  |
| ELECTRIC SPECIALTY CO                        | 0  |
| ELECTRONIC COUNTERS INC                      | 8-17   |
| ELECTRONIC INSTRUMENT CO INC                 | 1-2-3-10-13-14-18  |
| ELECTRONIC INTL CO                           | 1  |
| ELECTRONIC MEASUREMENTS CORP N Y             | 1-10   |
| ELECTRONICS INTL CO INC OKLA                 | 10   |
| ELECTRONICS OF CLEARFIELD INC                | 1-8-14   |
| ELGECO INC                                   | 6  |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 8-21   |
| ELIN DIV INTL ELECT RESCH CORP               | 1-13   |

|  |                                     |
|--|-------------------------------------|
| EMI COSSOR ELECTRONICS                       | 23                                  |
| EMPIRE DEVICES PRODUCTS CORP                 | 5                                   |
| ENGINEERING ASSOCIATES                       | 1-3-5-6-8-10-11-13-19-20-22         |
| ERA DYNAMICS                                 | 23                                  |
| ESPEY MFG & ELECTRONICS CORP                 | 9                                   |
| EXACT ELECTRONICS INC                        | 8-13-21                             |
| FERRIS INSTRUMENT CORP                       | 0-3-10-12-19-20                     |
| FISCHER ELECTRONICS INC                      | 1-23                                |
| FISHER AKIN CO                               | 8-13                                |
| FOTO VIDEO LABS                              | 2-9-15-18                           |
| FRANKLIN ELECTRONICS INC                     | 8                                   |
| FREDERICK ELECT CORP                         | 8-21                                |
| FREQUENCY ENGG LABS                          | 5-7-9-10-19-20-22                   |
| FRONTIER ELECT CO                            | 8-17                                |
| FURZEHILL LABS LTD                           | 1-13                                |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 1-4-6                               |
| GENERAL APPLIED SCIENCE LAB                  | 8-13                                |
| GENERAL COMMUNICATION CO                     | 5-9                                 |
| GENERAL DEVICES INC                          | 23                                  |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 8                                   |
| GENERAL MICROWAVE CORP                       | 5-6-9-10-22                         |
| GENERAL RADIO CO                             | 1-6-8-10-13-14-19-20-22             |
| GENERAL TECHNOLOGY CORP                      | 22                                  |
| GERTSCH PRODUCTS INC                         | 22                                  |
| GURLEY W & L E                               | 8                                   |
| GYREX CORP                                   | 1                                   |
| HALLICRAFTERS CO CHICAGO                     | 10                                  |
| THE A W HAYDON CO CULVER CITY                | 8                                   |
| HEATH CO SUB OF DAYSTROM INC                 | 1-2-4-10-13-14-18-20-23             |
| HEATH CO DIV OF DAYSTROM INC                 | 1-2-3-10-13                         |
| HERMES-SONIC CORP                            | 23                                  |
| HEWLETT PACKARD CO                           | 1-4-5-6-8-10-11-13-14-19-20-21      |
| HICKOK ELECTRICAL INSTRUMENT CO              | 1-2-3-4-7-8-10-13-14-17-18-19-20-21 |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV | 8-12                                |
| HOLT INSTRUMENT LABS                         | 1                                   |
| HOUSTON INSTRUMENT CORP                      | 14                                  |
| HURLETRON INC WHEATON ENG DIV                | 8-17                                |
| H W ELECTRONICS INC                          | 8                                   |
| HYPERION INC                                 | 17                                  |
| ICONIX INC                                   | 8-21                                |
| INDUSTRIAL CONTROL CO                        | 14                                  |
| INSTRUMENT CORP OF AMER                      | 8-13                                |
| INTERCONTINENTAL INSTRUMENTS INC             | 8-13                                |
| INTERELECTRONICS CORP                        | 1-4-6-13-21-22                      |
| INTERNATIONAL DATA SYSTEMS INC               | 12                                  |
| ITEK ELECTRO-PRODUCTS                        | 17-22                               |
| I TEL INC                                    | 4-14-22                             |
| JACKSON ELECTRICAL INSTRUMENT CO             | 1-3-13-14-18-20                     |
| JACOBS INSTRUMENT CO                         | 10-14-21                            |
| JERROLD ELECTRONICS CORP                     | 10-14-21                            |
| JETRONIC INDUSTRIES                          | 1-2-3-5-8-10-13-19                  |
| KARG LABS INC                                | 3                                   |
| KAY ELECTRIC CO                              | 1-3-6-7-8-9-10-14-18-19-20          |
| KELL STROM TOOL CO INC ELECT DIV             | 8                                   |
| KROHN-HITE CORP                              | 1-13                                |
| KURTSTON ELECTRONICS                         | 1-10-13-22                          |
| LABORATORY FOR ELECTRONICS INC               | 5-8-9-10-11-14-19-20-22             |
| LAMPKIN LABS INC                             | 10                                  |
| LA ROSE & ASSOC INC W T                      | 20                                  |
| LAVOIE LABS INC                              | 8-13                                |
| LEAR STEIGLER INC ELECT INST DIV             | 15                                  |
| LINK DIV GENERAL PRECISION INC               | 8                                   |
| LIVINGSTON ELECT CORP                        | 1                                   |
| LUMATRON ELECTRONICS INC                     | 1                                   |
| MADIGAN CORP                                 | 3-10-12                             |
| MANSON LABORATORIES INC                      | 5-7-8-10-12-13-17-19-20             |
| MANUFACTURERS ENGG & EQUIP CORP              | 14                                  |
| MARCONI INSTRUMENTS                          | 1-3-4-6-8-10-13-14                  |
| MARYLAND TELECOMMUNICATIONS INC              | 15                                  |
| MAXSON INSTRUMENTS                           | 5                                   |
| DIV MAXSON ELECTRONICS CORP                  | 5                                   |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 1-5-7-8-9-10-11-13-17-19-20-21-22   |
| MEASUREMENT ENGG LTD                         | 1-6-9-13                            |
| MEASUREMENTS DIV MC GRAW-EDISON CO           | 1-2-3-8-10-12-13-18-19-20           |
| MELABS                                       | 3-5-10-14-22                        |
| MENLO PARK ENGG                              | 14-19-20                            |
| METAL SPECIALTY PRODUCTS CORP                | 1-10-17-21                          |
| M F ELECTRONICS CORP                         | 1                                   |
| MICRONETICS INC                              | 5-9                                 |
| MICRO NOW INSTRUMENT CO INC                  | 4-22                                |
| MICRO STATE ELECTRONICS CORP                 | 4                                   |
| MIRATEL INC NEW BRIGHTON                     | 0                                   |
| MISSOURI RESEARCH LABORATORIES INC           | 8                                   |
| MODEL ENGG & MFG INC                         | 1-3-5-7-8-9-10-12-19-20-21-22       |
| MONTRONICS INC                               | 4-22                                |
| MOTOROLA COMMUNICATIONS & ELECT INC          | 10                                  |
| MURHEAD & CO LTD                             | 1-10                                |
| MURHEAD INSTRUMENTS INC                      | 1                                   |
| MUTRON INC                                   | 1-10                                |
| NAVIGATION COMPUTER CORP                     | 8                                   |
| NEICO MICROWAVE CO                           | 5                                   |
| NEW LONDON INST CO INC                       | 3-6-10-20                           |
| NORRMAN LABORATORIES ERNST                   | 1-10-17-22                          |
| NORTHEAST ELECT CORP                         | 1                                   |
| NORTHEASTERN ENG INC                         | 3-10-14-19-20                       |
| NORTHERN RADIO CO                            | 3-10-13-22                          |
| NUCLEAR-ELECTRONICS CORP                     | 3-5-10-19-20                        |
| ONEIDA ELECTRONICS INC                       | 11                                  |
| ORBITRAN CO INC                              | 8-9-17                              |
| PACIFIC TRANSDUCER CORP                      | 14                                  |
| PACO ELECTRONICS CO INC                      | 2-3-4-10-13-14-18                   |
| PACO PRECISION                               | 23                                  |
| PARABAM INC                                  | 1-8-13-21                           |
| PARADYNAMICS INC                             | 8-13-14                             |

## PRODUCTS & MANUFACTURERS

|   |                             |
|---|-----------------------------|
| PASTORIZA ELECT INC                         | 8-13-14                     |
| PERKIN ELMER CORP VERNISTAT DIV             | 0                           |
| PHILCO CORP SIERRA ELECTRONIC DIV           | 3-10                        |
| PHILAMON ABS INC                            | 8-22                        |
| PHOTO-TRONIC PRODUCTS CORP                  | 18                          |
| PLANETRONICS INC                            | 5                           |
| PLECTRON CORP                               | 1-3                         |
| POLARAD ELECTRONICS CORP                    | 3-4-5-6-8-14                |
| PRD ELECTRONICS INC                         | 5                           |
| PRECISE ELECTRONICS & DEVELOPMENT CORP      | 1-10                        |
| PRECISION APPARATUS CO                      | 23                          |
| PRESCOTT TV CO                              | 15                          |
| PROBESCOPE CO INC                           | 14                          |
| PROBESCOPE CO INC SYOSSET                   | 14                          |
| PULSE ENG INC                               | 8                           |
| RADAR ENGINEERS                             | 8-19                        |
| RADAR MEASUREMENTS CORP                     | 5                           |
| RADIAPHONE CO                               | 1                           |
| RADIATION AT STANFORD                       | 8                           |
| RADIATION INC PRODUCTION DIV                | 5-8-10                      |
| RADIATION INSTRUMENT CO                     | 8                           |
| RADIO CITY PROD CO                          | 23                          |
| RCA ELECTRN TUBE DIV INDIANAPLS             | 1-2-3-10-13-14-18-19-20     |
| RCA ELECTRN TUBE DIV MARION                 | 1-2-3-10-13-14-18-19-20     |
| RCA DEFENSE ELECT PRODS CAMDEN              | 10-15                       |
| RCA ELECTRN TUBE DIV HARRISON               | 1-2-3-10-13-14-18-19-20     |
| RCA ELECTRN TUBE DIV WOODBRIDGE             | 1-2-3-10-13-14-18-19-20     |
| RCA ELECT TUBE DIV CINN                     | 1-2-3-10-13-14-18-19-20     |
| RCA ELECTRN TUBE DIV LANCASTER              | 1-2-3-10-13-14-18-19-20     |
| RANK CINTEL LTD                             | 23                          |
| REACH CORP                                  | 1                           |
| REEVES INSTRUMENT CORP                      | 6                           |
| REMANCO INC                                 | 5-6-8-9-10-21               |
| REPUBLIC ELECT INDUST CORP                  | 1                           |
| RESEARCH INDUSTRIAL LAB OF ELECTRONICS      | 8                           |
| RESE ENGG INC                               | 8                           |
| RFS ENGINEERING CO                          | 8                           |
| RIKER INDUSTRIES INC                        | 2-8-13-14-15-18             |
| RIVERBANK LABS ENGG DEPT                    | 1                           |
| R M S ASSOCIATES INC                        | 9                           |
| RMS ENG INC                                 | 22                          |
| ROBERTSON INSTRUMENT CO                     | 1-3-6-10-11-14-18-19-20     |
| ROHDE & SCHWARZ                             | 1-3-6-10-11-14-18-19-20     |
| RON ELECTRONICS CORP                        | 12                          |
| R S ELECTRONICS CORP                        | 8                           |
| RUTHERFORD ELECTRONICS CO                   | 3                           |
| SCOTT INC H H                               | 3-6                         |
| SERVICE INSTRUMENTS CORP                    | 4                           |
| SERVICE INSTRUMENT CORP                     | 6                           |
| SERVO CORP OF AMERICA                       | 7-8-13                      |
| SIERRA ELECTRONIC DIV PHILCO CORP           | 3                           |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 2-8-14                      |
| SIMPSON ELECTRIC CO MERCER                  | 1-4-18-21                   |
| SINGER METRICS DIV SINGER MFG CO            | 1-10-12-14                  |
| THE SOLARTRON ELECTRONIC GROUP LTD          | 1-3-8-21                    |
| SOLID STATE ELECTRONICS CO                  | 1-3-4-8-10-15-21            |
| SORENSEN INDUSTRIAL ELECTRONIC CO           | 10                          |
| SOUTHWESTERN INDUSTRIAL ELECT CO            | 23                          |
| SPECIALTY ELECTRONICS DEVELOPMENT CORP      | 23                          |
| SPECTRAN ELECTRONICS CORP                   | 1                           |
| SPENCER-KENNEDY LABS INC                    | 8                           |
| SPERRY MICROWAVE ELECT INC                  | 5-6                         |
| SPIVEY INC JAMES S                          | 23                          |
| STODDART AIRCRAFT RADIO CO                  | 8                           |
| STRAND LABS INC                             | 5-9                         |
| SULLIVAN LTD H W                            | 23                          |
| SUMMERS & MILLS INC                         | 10                          |
| SYSTEMS INC                                 | 1-3-12-17-21                |
| SYSTRON DONNER CORP                         | 1                           |
| TAFFET ELECTRONICS INC                      | 1-10-17-21                  |
| TEKTRONIX INC BEAVERTON                     | 8-13-17-21                  |
| TELECHROME MFG CORP                         | 2-5-6-8-12-13-15-18-21      |
| TELETRON INDUSTRIES CORP                    | 10                          |
| TELEMET CO                                  | 2-15-17-18-21               |
| TELEMETRICS INC                             | 8                           |
| TELEVISION UTILITIES CORP DIV NORD          | 18                          |
| TEL-INSTRUMENT ELECTRONICS CORP             | 3-14                        |
| TELONIC ENGINEERING CORP                    | 3-4-5-8-9-10-14-20-22-18-19 |
| TELONIC INDUSTRIES INC                      | 3-8-10-14-18-19-20          |
| TEXAS INSTRUMENTS INC APPARATUS DIV         | 8                           |
| TOPPING ELECTRONICS LTD F V                 | 4-10-22                     |
| TRAK ELECTRONICS COMPANY INC                | 14                          |
| TRIPLETT ELECTRICAL INST BLUFFTON           | 2-3-10-18-19                |
| U S SCIENCE CORP                            | 12                          |
| VALOR ELECTRONICS CO                        | 8                           |
| VELONEX DIV PULSE ENGR                      | 8-21                        |
| VERCO INC                                   | 1-8                         |
| VICTOREEN INSTRUMENT CO CLEVELAND           | 8                           |
| VITRO ELECTRONICS DIV OF VITRO CORP OF AM   | 15                          |
| VITRO LABORATORIES                          | 8-17-22                     |
| VUE TRONICS INC DV OF PRESCOTT CO           | 15                          |
| WALTHAM ELECTRONICS CORP                    | 1-3-4-5-6-7-10-13-14-19-20  |
| WAVEFORMS INC                               | 1-12-13                     |
| WAVELINE INC                                | 6                           |
| WEINSCHEL ENGG                              | 5-13                        |
| WESTERN INSTRUMENT CO                       | 21                          |
| WILTRON CO                                  | 7-8-13                      |
| WINTRONICS INC                              | 7                           |



# PRODUCTS & MANUFACTURERS

# Test Equipment—Meters

## METERS 2900

|                                 |    |
|---------------------------------|----|
| Electrometers .....             | 1  |
| Meters, capacitance .....       | 2  |
| Meters, conductance .....       | 3  |
| Meters, current .....           | 4  |
| Meters, flux .....              | 5  |
| Meters, Frequency .....         | 6  |
| Meters, impedance .....         | 7  |
| Meters, microampere .....       | 8  |
| Meter multipliers .....         | 9  |
| Meters, ohm .....               | 10 |
| Meters, phase .....             | 11 |
| Meters, power .....             | 12 |
| Meters, power factor .....      | 13 |
| Meters, snap around .....       | 14 |
| Meters, tension .....           | 15 |
| Meters, vacuum tube volt .....  | 16 |
| Meters, volt .....              | 17 |
| Meters, watt .....              | 18 |
| Meters, watt-hour .....         | 19 |
| Multitester .....               | 20 |
| Voltmeters, digital .....       | 21 |
| Voltmeters, electrostatic ..... | 22 |

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| ABEY ELECTRONICS CORP                  | 10-20  |
| AD-YU ELECTRONICS LAB INC              | 6  |
| AIRCRAFT RADIO CORP                    | 1  |
| AIRPAX ELECTRONICS PACIFIC DIV         | 20   |
| ALCO ELECTRONIC PRODUCTS INC           | 4-8-17-20  |
| ALEXANDRIA DIV AMF                     | 6-17   |
| ALWAC COMPUTER DIV EL-TRONICS INC      | 6  |
| AMERIC INC                             | 6  |
| AMERICAN AIRFRAME CORP                 | 6-10-20  |
| AMERICAN ASTRO-SYSTEMS                 | 1-2-3-4-14-5-6-7-8-9-10-11-12-13-15-16-17-18-19-20-21-22 |
| AMERICAN MACH & FOUNDRY CO NEW YORK    | 17   |
| AMF INSTR DIV AMER MACH & FDRY         | 6-17-18  |
| AMERICAN SPACE EXPLORATION INC         | 21   |
| AMERICAN STANDARD CONTROL DV ROCHESTER | 4-   |
| AMMON INSTRUMENTS INC                  | 10-17  |
| AMSTRO CORPORATION                     | 4-8-17   |
| ANADIX INSTRUMENT S INC                | 10   |
| APP-IED PHYSICS CORP                   | 6  |
| ARISTO CRAFT DISTINCTIVE MINIATURES    | 1  |
| ARKAY INTERNATIONAL INC                | 4-20   |
| ASSEMBLY PRODUCTS INC                  | 12-16-20   |
| ASSOCIATED RESEARCH INC                | 12-16-17-18-20   |
| ASTRO SYSTEMS INC                      | 10-20  |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC    | 11   |
| AUTO DATA                              | 17   |
| AUTO TEST INC CHICAGO                  | 21   |
| AVIONICS INC                           | 14-17  |
| AVNET CORP LOS ANG                     | 8-17   |
| AVTRON MFG INC                         | 17   |
| BACH-SIMPSON LTD                       | 6  |
| BALLANTINE LABS INC                    | 4-6-8-9-10-16-17-20                                      |
| BARER-COLMAN CO                        | 2-9-16-21  |
| BARKER & WILLIAMSON INC                | 17   |
| BARNES DEVELOPMENT CO                  | 6  |
| BARNETT INST CO                        | 2  |
| BARNETT INSTRUMENT CO                  | 10-16-17-20  |
| BARRY ELECTRONICS CORP NEW YORK        | 16   |
| BASSETT INC REX                        | 8  |
| BECKMAN INST INC BERKELEY DIV          | 4-6-10-11-16-21  |
| BELL INC F W                           | 21   |
| BELLEVILLE HEXEM CORP                  | 4-8-10-16-17   |
| BERGEN LABS INC                        | 10-16  |
| BIDDLE CO JAMES G                      | 6-10-11  |
| BIRD ELECTRONICS CORP                  | 12-18  |
| B & K INSTRUMENTS INC OF BRUEL & KJAER | 1  |
| B & K MFG CO                           | 7-10-16-17-20  |
| BOONTON ELECTRONICS CORP               | 16   |
| BORG-WARNER CONTROLS                   | 10-12-16   |
| BRIDGE ELECTRONICS CO INC              | 6-16   |
| BRUND NEW YORK INDUST CORP             | 10-14-16-17  |
| BUCK ENGG CO                           | 4-17   |
| BUDELMAN ELECTRONICS CORP              | 6  |
| BURR BROWN RESEARCH CORP               | 17   |
| CAMBRIDGE INSTRUMENT CO INC            | 5  |
| CANADIAN RESEARCH INSTITUTE            | 4-6-10-12-17-18-22                                       |
| CAROL ELECT DIV WEECO                  | 20   |
| CARTER CO J C                          | 2  |
| CENTURY ELECT INST INC TULSA           | 5  |
| CHATILLON SONS JOHN                    | 15   |
| CIMRON CORP                            | 4-8-21   |
| CLOUGH BRENLE F CO                     | 16   |
| COMU ELECTRONICS INC KIN TFL DIV       | 8-17-21  |
| COILS ELECTRONICS CO                   | 0  |
| COLUMBIA ELECT MFG CO                  | 4-14-17  |
| COMMUNICATION MEASUREMENTS LABS        | 10   |
| CAMPAGNIE GENERALE DE METROLOGIE       | 4-8-16-17-20   |
| CONSOLIDATED CONTROLS CORP             | 6  |
| CONSOLIDATED ELECT CORP                | 17   |
| CUBIC CORP                             | 10-21  |
| CURTIS INSTRUMENTS INC                 | 4-18-19  |
| CURTISS-WRIGHT CORP ELECTRONICS DIV    | 17   |
| CUSTOM SCIENTIFIC INSTRUMENTS INC      | 22   |
| DANA LAB INC                           | 21   |

|  |                                       |
|--|---------------------------------------|
| DATA INSTRUMENTS                             | 17-2                                  |
| DAVEN CO                                     | 6-15                                  |
| DAWE INSTRUMENTS LTD                         | 6-16                                  |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 2-3-4-5-6-8-9-10-11-13-14-17-18-20    |
| DIAMOND ANTENNA & MICROWAVE CORP             | 11                                    |
| DIGITAL ELECTRONICS INC                      | 21                                    |
| DITMORE FREEMUTH CORP                        | 4-17                                  |
| DYMEC DIV OF HEWLETT PACKARD CO              | 21                                    |
| DYNAMICS INST CO                             | 1-16-20                               |
| DYTRONICS CO                                 | 6-11                                  |
| EALING CORP                                  | 8                                     |
| EASTERN SPECIALTY CO                         | 11                                    |
| E H RESEARCH LAB INC                         | 1-8                                   |
| ELCOR INC                                    | 4                                     |
| ELECTRIC DESIGN & MFG CO                     | 4-8-17                                |
| ELECTRICAL INSTRUMENT CORP                   | 4-6-8-9-17                            |
| ELECTRO IMPULSE LAB INC                      | 6-12                                  |
| ELECTRO INSTRUMENT INC                       | 2-7-10-17-20-21                       |
| ELECTRO-MECHANICAL INSTRUMENT CO             | 4-8-17                                |
| ELECTRO SCIENTIFIC IND INC                   | 2                                     |
| ELECTRONIC APPLICATIONS INC                  | 22                                    |
| ELECTRONIC COUNTERS INC                      | 6                                     |
| ELECTRONIC DEVELOPMENT LABS                  | 4-17                                  |
| ELECTRONIC INSTRUMENT CO INC                 | 16-20                                 |
| ELECTRONIC MEASUREMENTS CORP N Y             | 16-20                                 |
| ELECTRONICS OF CLEARFIELD INC                | 16                                    |
| ELECTRONICS SYSTEMS INC                      | 11                                    |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 6                                     |
| ENGELHARD INDUSTRIES                         | 17                                    |
| INDUST EQUIPT DIV                            | 17                                    |
| ENGINEERING ASSOCIATES                       | 6-16                                  |
| EPIC INC                                     | 2-4-5-12-16-17-18                     |
| EPSCO INC CAMBRIDGE                          | 10-21                                 |
| ERDCO ENGG CORP                              | 2                                     |
| ERIE PACIFIC                                 | 6                                     |
| ESPEY MFG & ELECTRONICS CORP                 | 6                                     |
| ESTERLINE ANGUS INSTRUMENT COMPANY INC       | 6-                                    |
| FERRANTI ELECT INC                           | 13-17-18                              |
| FLOW CORP                                    | 19-22                                 |
| FLUKE MFG CO INC JOHN                        | 16                                    |
| FRANKLIN INSTRUMENT INC                      | 16-17-18                              |
| FREQUENCY ENGG LABS                          | 20-21                                 |
| FURZEHILL LABS LTD                           | 6                                     |
| F X R INC WOODSIDE                           | 16                                    |
| GENERAL COMMUNICATION CO                     | 6                                     |
| GENERAL METERS INC                           | 10-17-18-19                           |
| GENERAL MICROWAVE CORP                       | 6-7-12                                |
| GENERAL RADIO CO                             | 7-16                                  |
| GERTSCH PRODUCTS INC                         | 6-11-16                               |
| G W MFG CO                                   | 4                                     |
| GOMBOS INC CO JOHN                           | 6                                     |
| GREIBACH INSTRUMENT SCORP                    | 4-8-10-17-20                          |
| GYRA ELECTRONICS CORP                        | 1                                     |
| HALEX INC                                    | 1-22                                  |
| HALLICRAFTERS CO CHICAGO                     | 10-16                                 |
| HALMAR ELECTRONICS INC                       | 9                                     |
| HEATH CO SUB OF DAYSTROM INC                 | 2-4-10-16-17-18                       |
| B HARBOR                                     | 18                                    |
| HEATH CO DIV OF DAYSTROM INC ST JOS          | 16-30                                 |
| HELIPOT DIV BECKMAN INST FULLERTON           | 6-8-17                                |
| HEWLETT PACKARD CO                           | 4-6-8-9-10-16-17-21                   |
| HEYER INDUSTRIES INCORPORATED                | 8-10-17                               |
| LAB OF MARQUETTE CORP                        | 8-10-17                               |
| HICKOK ELECTRICAL INSTRUMENT CO              | 2-3-7-8-10-11-12-13-14-16-17-18-20-22 |
| HOUSTON INSTRUMENT CORP BELLAIRE             | 17                                    |
| HOUSTON INSTRUMENT CORP                      | 16                                    |
| HOWELL INSTRUMENTS INC                       | 21                                    |
| HOYT ELECTRICAL INSTRUMENT WORKS             | 8-17                                  |
| HYCON MFG CO                                 | 21                                    |
| HYDROPOISE INC SUB BROOKS INST CO            | 6                                     |
| IDEAL PRECISION METER CO                     | 4-8-17                                |
| INDUSTRIAL CONTROL CO                        | 8                                     |
| INDUSTRIAL DEVICES INC                       | 17                                    |
| INDUSTRIAL INSTRUMENTS INC                   | 10                                    |
| INDUSTRIAL TEST EQUIPMENT CO                 | 11-13                                 |
| INDUSTRIAL WINDING MACHINERY CORP            | 15                                    |
| INSTRUMENT ELECTRONICS CORP                  | 16                                    |
| INSTRUMENT MASTERS INC                       | 4-8-9-10-17-20                        |
| INSTRUMENTS INC                              | 2                                     |
| INTERCONTINENTAL INSTRUMENTS INC             | 21                                    |
| INTERNATIONAL INSTRUMENTS INC                | 4-8-17-20                             |
| INTL INSTRUMENT INC                          | 4-8-17-20                             |
| IRWIN LABS INC                               | 5                                     |
| ITI ELECTRONICS INC                          | 20                                    |
| JACKSON ELECTRICAL INSTRUMENT CO             | 16                                    |
| JETRONIC INDUSTRIES                          | 6-10-16-20-21                         |
| JONES ELECTRONIC CO INC M C                  | 18                                    |
| KAY ELECTRIC CO                              | 16                                    |
| KEITHLEY INSTRUMENTS INC                     | 10-16-17-22                           |
| KELL STROM TOOL CO INC ELECT DIV             | 6                                     |
| LAMPKIN LAB INC FDC DIV                      | 0-6                                   |
| LAMPKIN LABS INC                             | 6                                     |
| LANDSVERK ELECTROMETER CO                    | 1-17                                  |
| LAVOIE LABS INC                              | 6                                     |
| LEEDS & NDRTHRUP CO                          | 5-8-10-17                             |
| LEYGHTON-PAIGE CORP                          | 4-12-17                               |
| LINK DIV GENERAL PRECISION INC               | 21                                    |
| MACLEOD & HANOPOL                            | 2-10                                  |
| MARCONI INSTRUMENTS                          | 6-16                                  |
| MARINE ELECTRIC CORP                         | 3                                     |
| MARION INSTRUMENT DIV                        | 4-8-17                                |
| MASTERCRAFT INSTRUMENT CO                    | 4-8-17                                |
| MAXSON ELECTRONICS CORP N Y                  | 11                                    |
| MAXSON INSTRUMENTS                           | 11                                    |
| DIV MAXSON ELECTRONICS CORP                  | 11                                    |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 6-11-21                               |
| MCMARTIN INDUSTRIES INC                      | 6                                     |
| MEASUREMENT ENGG LTD                         | 12-18                                 |
| MEASUREMENTS DIV MC GRAW-EDISON CO           | 6-10-16-                              |
| MEDISTOR INST CO                             | 1-16                                  |

|   |   |
|---|---|
| MELABS                                      | 6                                       |
| MERIDIAN METALCRAFT INC                     | 6                                       |
| MFSUR Matic ELECTRONICS CORP                | 16-17                                   |
| METAL SPECIALTY PRODUCTS CORP               | 6                                       |
| METER MAKERS INC                            | 20                                      |
| METERS INC                                  | 4-8-10-17-20                            |
| METETELIC CORP                              | 1-4-8-17                                |
| METRONIX INC                                | 16                                      |
| MICRO INSTRUMENT CO                         | 2-17                                    |
| MICROWAVE ASSOCIATES INC                    | 6                                       |
| MID-EASTERN ELECTRONICS INC                 | 1                                       |
| MILLEN MFG CO JAMES                         | 6                                       |
| MILLER CO M C                               | 0-4-8-17-20-22                          |
| MILLIVAC INSTRUMENTS INC                    | 8-10-16-17-20                           |
| MINI-TOOL TECHNICAL INDUST INC              | 10-17                                   |
| MINNEAPOLIS-HONEYWELL PRECISION METER DIV   | 8-17                                    |
| MINNEAPOLIS-HONEYWELL BROWN INST DIV        | 1                                       |
| MODEL ENGG & MFG INC                        | 7-10-12-17-18-20                        |
| MONROE ELECTRONICS INC                      | 1                                       |
| MOSELEY CO F L                              | 17                                      |
| MOTOROLA COMMUNICATIONS & ELECT INC         | 6-17                                    |
| MUIRHEAD INSTRUMENTS INC                    | 11-16                                   |
| MURA CORP THE                               | 4-10-17-20                              |
| MUTRON INC                                  | 17                                      |
| NEW LONDON INST CO INC                      | 6                                       |
| NON LINEAR SYSTEMS INC                      | 20-21                                   |
| NORTH ATLANTIC INDUSTRIES INC               | 11                                      |
| NORTH ATLANTIC INDUST INC                   | 11-16-18-21                             |
| NORTHEAST ELECT CORP                        | 16                                      |
| NORTHERN RADIO MFG CO LTD                   | 6                                       |
| NUCLEAR-CHICAGO CORP                        | 1                                       |
| NUCLEAR-ELECTRONICS CORP                    | 16                                      |
| NUCLIDE ANALYSIS ASSOC                      | 1-4-16-17                               |
| NUTRON DIV WESTMORE INC                     | 20                                      |
| OHIO SEMICONDUCTORS                         | 5                                       |
| DIV TECUMSEN PRODS CO                       | 6-9                                     |
| ONIC DEVICES INC                            | 6                                       |
| ORION ELECTRONICS CORP                      | 11-17                                   |
| PACE ELECTRICAL INSTRUMENTS CO              | 4-8-9-17                                |
| PACO ELECTRONICS CO INC                     | 1-2-4-8-10-16-17-20                     |
| PARADYNAMICS INC                            | 12                                      |
| PARKER ELECTRICAL INSTRUMENT CORP           | 4-6-8-9-17                              |
| PHAOSTRON INSTRUMENT & ELECTRONIC CO        | 4-6-8-10-16-17                          |
| PHILCO CORP SIERRA ELECTRONIC DIV           | 16                                      |
| PLANETRONICS INC                            | 16-20                                   |
| POLYTRONICS CO                              | 10                                      |
| POTTER AERONAUTICAL CORP                    | 6                                       |
| PRD ELECTRONICS INC                         | 6                                       |
| PRECISE ELECTRONICS & DEVELOPMENT CORP      | 16                                      |
| PRECISION SPECIALTIES INC                   | 15                                      |
| PRINCETON APPLIED RESEARCH CORP             | 21                                      |
| QUAN TECH LAB INC                           | 8                                       |
| Q V S INC                                   | 8-17                                    |
| RADAR MEASUREMENTS CORP                     | 6-7-18                                  |
| RADIAPHONE CO                               | 16                                      |
| RCA ELECTRN TUBE DIV INDIANAPLS             | 10-16-17-20                             |
| RCA ELECTRN TUBE DIV MARION                 | 10-16-17-20                             |
| RCA ELECTRN TURF DIV HARRISON               | 10-16-17-20                             |
| RCA ELECTRN TUBE DIV WOODBRIDGE             | 10-16-17-20                             |
| RCA FLECT TUBE DIV CTNN                     | 10-16-17-20                             |
| RCA ELECTRN TUBE DIV LANCASTER              | 10-16-17-20                             |
| RADIO FREQUENCY LABS INC                    | 5                                       |
| RANGERTONE INC                              | 6                                       |
| RAWSON ELECTRICAL INSTRUMENT CO             | 4-5-8-12-17-18-20-22                    |
| REDCOR CORP                                 | 18                                      |
| RESEARCH INDUSTRIAL LAB OF ELECTRONICS      | 10-                                     |
| RIL ELECTRONICS CORP                        | 1-10-16                                 |
| ROBERTSON INSTRUMENT CO                     | 10-16-17-20-21                          |
| ROBINAIR MANUF CORP                         | 20                                      |
| ROHDF & SCHWARZ                             | 2-6-7-10-20                             |
| ROWAN CONTROLLER CO RFD BANK                | 4-6-8-10-14-16-17-20                    |
| SANGAMO ELECTRIC CO                         | 4-13-17-18-19                           |
| SAVOY ELECTRONICS INC FT LAUDERDALE         | 6                                       |
| SCOPE CO INC                                | 16-20                                   |
| SFCO ELECTRONICS INC                        | 16                                      |
| SEKONIC INC                                 | 4-17                                    |
| SEMITRONICS CORP                            | 4-8-17                                  |
| SERVICE INSTRUMENTS CORP                    | 16                                      |
| SERVICE INSTRUMENT CORP                     | 10-16                                   |
| SHURITE METERS                              | 4-17                                    |
| SIERRA ELECTRONIC DIV PHILCO CORP           | 12-16-18                                |
| SIMMONDS PRECISION PRODS GLENDALE           | 2                                       |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 2-3-4-5-6-7-8-9-10-11-12-16-17-18-19-20 |
| SIMPSON ELECTRIC CO FLAMBEAU                | 4-6-8-9-10-11-12-14-16-17-18-20         |
| SIMPSON ELECTRIC CO MERCER                  | 2-4-6-10-16-17-20                       |
| SINGER METRICS DIV SINGER MFG CO            | 4-5-6-8-9-12-13-17-18-22                |
| SINGER METRICS SENSITIVE RES DIV            | 4-5-6-8-9-12-13-17-18-22                |
| SIVERS LAB                                  | 6                                       |
| SMITH-FLORENCE INC                          | 8-10-16-17-20-21                        |
| THE SOLARTRON ELECTRONIC GRDUP LTD          | 14-21                                   |
| SOLID STATE ELECTRONICS CO                  | 6                                       |
| SPECTRO MAGNETIC INDUST                     | 5                                       |
| STERLING MFG CO                             | 4-8-17                                  |
| STEVENS-FVANS INC                           | 10-17-21                                |
| SUMMERS & MILLS INC                         | 1-2-3                                   |
| SUN ELECTRIC CORP                           | 2-3-4-6-8-10-17                         |
| SUNSHINE SCIENTIFIC INSTRUMENT              | 8-10-14-16-17-18-20                     |
| SWEENEY MFG CO B K                          | 15-17-22                                |
| SYSTRON DONNER CORP                         | 21                                      |
| TAFFET ELECTRONICS INC                      | 6                                       |
| TEKTRONIX INC BEAVERTON                     | 2                                       |
| TELECHROME MFG CORP                         | 6                                       |
| TELOSTAT CORP                               | 10                                      |



Test Equipment—Meters • Meters, RF • Meters, Audio • Meters, Special Purpose

|                                      |                         |
|--------------------------------------|-------------------------|
| TESTING MACHINES INC                 | 15                      |
| THERMOLYNE CORP                      | 4-8-17                  |
| THFTA INSTRUMENT CORP                | 11-17                   |
| TDROUE CONTRDLS INC                  | 15                      |
| TRICONIX INC                         | 12                      |
| TRIO LABS INC                        | 16                      |
| TRIPLETT ELECTRICAL INSTRUMENT CORP  | 4-8-17                  |
| TRIPLETT ELECTRICAL INST BLUFFTON    | 4-8-9-10-14-16-17-18-20 |
| VACUUM ELECTRONICS CORP              | 1                       |
| VARO MFG CO                          | 6                       |
| VENNER ELECTRONICS LTD               | 21                      |
| VERCO INC                            | 4-6-10-17               |
| VOLTRON PRODUCTS                     | 4-6-11-12-16-17-18      |
| WACLINE INC                          | 4-6-8-17                |
| WASHINGTON TECHNOLOGICAL ASSOC INC   | 1                       |
| WAVEFORMS INC                        | 16                      |
| WAVELINE INC                         | 6                       |
| WEIDNHOF CORP                        | 4-17                    |
| WFLCH SCIENTIFIC CO W M              | 4-10-11-17-18           |
| WESTERN APPARATUS                    | 17                      |
| WESTERN ELECTRODYNAMICS              | 0                       |
| WESTMORE INC                         | 10-17-20                |
| WILK INSTRUMENTS DIV QUALITY ELEC CO | 17                      |
| WILTRON CO                           | 11                      |
| WINTRONICS INC                       | 11                      |
| YOKOGAWA ELECTRIC WKS INC            | 11-13-17-18             |
| ZACHARIAS ELECTRONICS CORP           | 10                      |
| ZINN INSTRUMENTS                     | 21                      |

**METERS—RF 3000**

|                             |    |
|-----------------------------|----|
| Ammeters, RF                | 1  |
| Meters, attenuation         | 2  |
| Meters, distortion          | 3  |
| Meters, field strength      | 4  |
| Meters, FM Deviation        | 5  |
| Meters, grid dip            | 6  |
| Meters, output              | 7  |
| Meters, phase               | 8  |
| Meters, RF frequency        | 9  |
| Meters, R-F power           | 10 |
| Meters, standing wave ratio | 11 |
| Meters, volt                | 12 |
| Meters, wave                | 13 |

|  |                               |
|--|-------------------------------|
| ADVANCED MEASUREMENT INST INC                | 5-6                           |
| AD-YU ELECTRONICS LAB INC                    | 8                             |
| AEROSPACE RESEARCH INC                       | 11                            |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC    | 10                            |
| ALCO ELECTRONIC PRODUCTS INC                 | 6                             |
| AMERAC INC                                   | 13                            |
| AMERICAN ASTRO-SYSTEMS                       | 1-2-3-4-5-6-7-8-9-10-11-12-13 |
| AMERICAN MACH & FOUNDRY CO NEW YORK          | 9                             |
| ARF PRODUCTS INC RATON                       | 5                             |
| ASSEMBLY PRODUCTS INC                        | 1-7-10-12                     |
| BACH-SIMPSON LTD                             | 1-12                          |
| BARKER & WILLIAMSON INC                      | 3-6-9-11-13                   |
| BECKMAN INST INC BERKELEY DIV                | 9                             |
| BENCO TELEVISION ASSOC LTD                   | 4-10-12                       |
| BIRO ELECTRONIC CORP                         | 10                            |
| BOONTON ELECTRONICS CORP                     | 3-6-10                        |
| BORG-WARNER CONTROLS                         | 10-11-12                      |
| BRUNO NEW YORK INDUST CORP                   | 10                            |
| BUDELMAN ELECTRONICS CORP                    | 5-9                           |
| CAORE INDUSTRIES CORP                        | 4-10                          |
| CHEMALLOW ELECTRONICS CORP                   | 10                            |
| DAVEN CO                                     | 2-7                           |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 1-7-9-12                      |
| DECITRON ELECTRONICS CORP                    | 10                            |
| DIAMOND ANTENNA & MICROWAVE CORP             | 8-9-13                        |
| DOUGLAS MICROWAVE CO                         | 11                            |
| OYTRONICS CO                                 | 8                             |
| ELECTRO IMPULSE LAB INC                      | 9-10                          |
| ELECTRONIC DEVELOPMENT LABS                  | 1                             |
| ELECTRONIC INSTRUMENT CO INC                 | 12                            |
| ELECTRONICS OF CLEARFIELD INC                | 9-10                          |
| ELECTRONICS SYSTEMS INC                      | 8                             |
| EMPIRE DEVICES PRODUCTS CORP                 | 4                             |
| ENGELHARD INDUSTRIES                         | 12                            |
| INDUST EQUIPT DIV                            | 1                             |
| ENGELHARD INDUSTRIES INC                     | 1                             |
| ENGINEERING ASSOCIATES                       | 4-6-9-11                      |
| FERRIS INSTRUMENT CORP                       | 4                             |
| FREQUENCY ENGG LABS                          | 9-13                          |
| F X R INC WOODSIDE                           | 13                            |
| GENERAL COMMUNICATION CO                     | 9-10                          |
| GENERAL METERS INC                           | 1-12                          |
| GENERAL MICROWAVE CORP                       | 2-4-9-10-11-13                |
| GENERAL RADIO CO                             | 5-13                          |
| GRTSCH PRODUCTS INC                          | 5                             |
| GRIFBACH INSTRUMENT SCORP                    | 1-12                          |
| HAMMARLUND MFG CO MARS HILL                  | 9                             |
| HEATH CO SUB OF DAYSTROM INC                 | 4-6-7-10-11-12                |
| HEATH CO DIV OF DAYSTROM INC                 | ST JOS 6                      |
| HEWLETT PACKARD CO                           | 10-11-12-13                   |
| HEYER INDUSTRIES INCORPORATED                | 12                            |
| LAB OF MARQUETTE CORP                        | 12                            |
| HICKOK ELECTRICAL INSTRUMENT CO              | 1-12                          |
| IDEAL PRECISION METER CO                     | 1-12                          |
| INSTRUMENT MASTERS INC                       | 1-12                          |

|   |                |
|---|----------------|
| INTERNATIONAL INSTRUMENTS INC               | 12             |
| JENNINGS RADIO MFG CORP SAN JOSE            | 12             |
| JONES ELECTRONIC CO INC M C                 | 10-11          |
| KAY ELECTRIC CO                             | 12             |
| LAMPKIN LABS INC                            | 5-9            |
| LAVOIE LABS INC                             | 5              |
| MARCONI INSTRUMENTS                         | 5-9-10         |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV  | 5-8            |
| MCMARTIN INDUSTRIES INC                     | 5-9            |
| MEASUREMENTS DIV MC GRAY-EDISON CO          | 4-5-6-9-12     |
| MELABS                                      | 12             |
| METAL SPECIALTY PRODUCTS CORP               | 6-9            |
| MICRO INSTRUMENT CO                         | 12             |
| MILLEN MFG CO JAMES                         | 6-9-11         |
| MILLIVAC INSTRUMENTS INC                    | 12             |
| MOBIL ELECTRONICS MFG CO                    | 9              |
| MODEL ENGG & MFG INC                        | 7-10-12        |
| MOTOROLA COMMUNICATIONS & ELECT INC         | 12             |
| NEW LONDON INST CO INC                      | 5              |
| NORTHEAST ELECT CORP                        | 10             |
| ORION ELECTRONICS CORP                      | 7-12           |
| PACO ELECTRONICS CO INC                     | 6-12           |
| PHILCO CORP SIERRA ELECTRONIC DIV           | 10             |
| PHILMORE MFG CO INC                         | 4              |
| PLAS TRON CORP                              | 4-10           |
| PRD ELECTRONICS INC                         | 11             |
| PROBESCOPE CO INC SYOSSET                   | 3-4-5-9-13     |
| PROJECTS UNLIMITED INC                      | 11             |
| RADAR MEASUREMENTS CORP                     | 10-11-13       |
| RADATRON INC                                | 4-10-11        |
| RAILWAY COMMUNICATIONS INC                  | 13             |
| RAWSON ELECTRICAL INSTRUMENT CO             | 12             |
| REMANCO INC                                 | 9-10           |
| SECO ELECTRONICS INC                        | 10-11          |
| SERCO ELECT RESEARCH CORP                   | 11             |
| SERVIF INSTRUMENT CORP                      | 12             |
| SIERRA ELECTRONIC DIV PHILCO CORP           | 10             |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 1-9-12         |
| SIMPSON ELECTRIC CO FLAMBEAU                | 12             |
| SINGER METRICS DIV SINGER MFG CO            | 1-12           |
| SINGER METRICS SENSITIVE RES DIV            | 1-12           |
| SMITH ELECTRONIC INC                        | 4              |
| SPERRY MICROWAVE ELECT INC                  | 2-4-9-10-11-13 |
| STOODART AIRCRAFT RADIO CO                  | 4              |
| SUN ELECTRIC CORP                           | 1-4-7-9        |
| SUNSHINE SCIENTIFIC INSTRUMENT              | 1-12           |
| SYSTRON OONNER CORP                         | 13             |
| TAFFET ELECTRONICS INC                      | 6-9            |
| TELEMET CO                                  | 8              |
| TRICONIX INC                                | 4              |
| TRIPLETT ELECTRICAL INSTRUMENT CORP         | 1              |
| TRIPLETT ELECTRICAL INST BLUFFTON           | 1              |
| VITRO ELECTRONICS DIV DF VITRO CORP OF AM   | 4-8            |
| WACLINE INC                                 | 1-12           |
| WAVELINE INC                                | 2-9-11-13      |
| WEINSCHEL ENGG                              | 2-4-10-13      |
| WILK INSTRUMENTS DIV QUALITY ELEC CO        | 12             |
| WILTRON CO                                  | 8-11           |
| YOKOGAWA ELECTRIC WKS INC                   | 1-12           |

**METERS, AUDIO 3100**

|                         |   |
|-------------------------|---|
| Meters, A-F             | 1 |
| Meters, decibel         | 2 |
| Meters, distortion      | 3 |
| Meters, intermodulation | 4 |
| Meters, recording       | 5 |
| Meters, wow & flutter   | 6 |

|  |             |
|--|-------------|
| AIRPAX ELECTRONICS PACIFIC DIV               | 6           |
| AMERICAN ASTRO-SYSTEMS                       | 1-2-3-4-5-6 |
| AMMON INSTRUMENTS INC                        | 2           |
| AMPLIFIER CORP OF AMER                       | 6           |
| ASSEMBLY PRODUCTS INC                        | 2-5         |
| AUDIO INSTRUMENT CO                          | 4           |
| AUDIO PRECISION AIDS INC                     | 1           |
| BALLANTINE LABS INC                          | 2           |
| BARKER & WILLIAMSON INC                      | 3           |
| BORG-WARNER CONTROLS                         | 1-2         |
| CLOUGH BRENGLE CO                            | 2           |
| DAVEN CO                                     | 2-3         |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 1-2         |
| DYNAMU MAGNETRONICS CORP DIV MATCO ELECT IN3 | 2           |
| ELECTRO-MECHANICAL INSTRUMENT CO             | 2           |
| ELECTRONIC INSTRUMENT CO INC                 | 1           |
| GENERAL RADIO CO                             | 3           |
| HEATH CO SUB OF DAYSTROM INC                 | 3-4         |
| HEWLETT PACKARD CO                           | 3           |
| HICKOK ELECTRICAL INSTRUMENT CO              | 1           |
| HOYT ELECTRICAL INSTRUMENT WORKS             | 1           |
| IDEAL PRECISION METER CO                     | 2-5         |
| INDUSTRIAL ACOUSTIC CO                       | 1-2         |
| INTERNATIONAL INSTRUMENTS INC                | 2           |
| INTL INSTRUMENT INC                          | 2           |
| ITI ELECTRONICS INC                          | 1           |
| KAY ELECTRIC CO                              | 6           |
| LANGVIN DIV OF SONDETEC INCORP               | 1-2-5       |
| MARION INSTRUMENT DIV                        | 2           |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 3           |
| METERS INC                                   | 2           |

**PRODUCTS & MANUFACTURERS**

|   |           |
|---|-----------|
| MILLIVAC INSTRUMENTS INC                    | 1         |
| MURA CORP THE                               | 1         |
| NORTH ATLANTIC INDUST INC                   | 3-4       |
| NORTHEAST ELECT CORP                        | 1         |
| NORTHERN RADID MFG CO LTD                   | 2         |
| ORION ELECTRONICS CORP                      | 1         |
| PACE ELECTRICAL INSTRUMENTS CO              | 2         |
| PROBESCOPE CO INC SYOSSET                   | 1-2-3-4-6 |
| QUALITONE CO                                | 1         |
| QUAN TECH LAB INC                           | 3-6       |
| RCA ELECTRN TUBE DIV INDIANAPLS             | 1         |
| RCA ELECTRN TUBE DIV MARION                 | 1         |
| RCA ELECTRN TUBE DIV HARRISON               | 1         |
| RCA ELECTRN TUBE DIV WOODBRIDGE             | 1         |
| RCA ELECT TUBE DIV CINN                     | 1         |
| RCA ELECTRN TUBE DIV LANCASTER              | 1         |
| ROBINS INDUSTRIES CORP                      | 2         |
| SCOTT INC H H                               | 2         |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 1-2       |
| SIMPSON ELECTRIC CO FLAMBEAU                | 1-2       |
| SUN ELECTRIC CORP                           | 2         |
| THETA INSTRUMENT CORP                       | 10        |
| TRIPLETT ELECTRICAL INSTRUMENT CORP         | 2         |
| TRIPLETT ELECTRICAL INST BLUFFTON           | 2         |
| WACLINE INC                                 | 1-2       |
| WAVEFORMS INC                               | 1         |

**METERS, SPECIAL PURPOSE 4000**

|                               |    |
|-------------------------------|----|
| Boxes, echo                   | 1  |
| Calorimeters                  | 2  |
| Gaussmeters                   | 3  |
| Magnetometers                 | 4  |
| Meters, acceleration          | 5  |
| Meters, cable testing         | 6  |
| Meters, counting rate         | 7  |
| Meters, deflection            | 8  |
| Meters, deviation             | 9  |
| Meters, elapsed time          | 10 |
| Meters, electronic micrometer | 11 |
| Meters, events-per-unit time  | 12 |
| Meters, flutter               | 13 |
| Meters, goniometer            | 14 |
| Meters, humidity              | 15 |
| Meters, infrared              | 16 |
| Meters, photoelectric         | 17 |
| Meters, pyrometer             | 18 |
| Meters, rate                  | 19 |
| Meters, ratio                 | 20 |
| Meters, tachometer            | 21 |
| Meters, thermocouple          | 22 |
| Meters, time                  | 23 |
| Meters, ultra-violet          | 24 |
| Meters, vibrating read        | 25 |
| Meters, vibration             | 26 |
| Meters, X-ray intensity       | 27 |
| Meter shunts                  | 28 |
| Micromanometers               | 29 |
| Multipliers, meter            | 30 |
| Tensiometers, wire            | 31 |

|  |             |
|--|-------------|
| ABBEY ELECTRONICS CORP                     | 22          |
| ADVANCED INSTRUMENTS                       | 0           |
| AD-YU ELECTRONICS LAB INC                  | 6           |
| AIRPAX ELECT INC SEMINOLE DIV              | 21          |
| AIRPAX ELECTRONICS PACIFIC DIV             | 21          |
| ALNOR INST CO DIV OF ILL TESTING LABS INC  | 15-18-22    |
| ALPHA SCIENTIFIC LABS INC                  | 3           |
| ALWAC COMPUTER DIV EL-TRONICS INC          | 6           |
| AMERAC INC                                 | 1           |
| AMERICAN GYRO DIV TAMAR ELECT INC          | 22          |
| AMF INSTR DIV AMER MACH & FDRY             | 21          |
| AMSTRO CORPORATION                         | 10-18-21-23 |
| ANNIS CO R B                               | 4-10-20-23  |
| APPLIED CONTROL CORP                       | 3           |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD       | 18-26       |
| ASSOCIATED RESEARCH INC                    | 6           |
| ATELIERS DE MONTAGES ELECT                 | 7           |
| ATOMIC ACCESSORIES INC                     | 7-10-19     |
| AUTOMATION DYNAMICS CORP                   | 1-6         |
| AUTO TEST INC CHICAGO                      | 21-28       |
| AVTRON MFG INC                             | 12          |
| BACH-SIMPSON LTD                           | 10-21-28-30 |
| BALLANTINE LABS INC                        | 30          |
| BARBER-COLMAN CO                           | 18-22       |
| BARNES DEVELOPMENT CO                      | 9           |
| BARNETT INST CO                            | 28          |
| BEARING INSPECTION INC                     | 26          |
| BECKMAN INST INC BERKELEY DIV              | 10-12-20    |
| BELL INC F W                               | 3           |
| BERGEN LABS INC                            | 10          |
| BIDDLE CO JAMES G                          | 6-10-21-25  |
| BRISTOL MOTORS DIV VOCALINE CO AMERICA INC | 23          |
| BYREX CORP                                 | 8           |

# PRODUCTS & MANUFACTURERS

# Test Equipment—Meters, Special Purpose • Oscilloscopes

|  |                        |
|--|------------------------|
| CALIFORNIA COMPUTER PROD INC                 | 12                     |
| CAMBRIDGE INSTRUMENT CO INC                  | 15                     |
| CANAOTIAN RESEARCH INSTITUTE                 | 6-17-18-21-22-28-29-30 |
| CHEMALLOW ELECTRONICS CORP                   | 2                      |
| CHRONO LOG CORP                              | 10-23                  |
| CIMRON CORP                                  | 20                     |
| COLEMAN INSTRUMENTS INC                      | 17                     |
| CONRAD CARSON ELECTRONICS INC                | 15                     |
| CONSOLIDATED ELECT CORP                      | 26                     |
| CORDIN CO THE                                | 0                      |
| CRAFT LABS                                   | 6-18                   |
| CRAMER OIV GIANNINI CONTROLS CORP            | 10-23                  |
| CURIC CORP                                   | 2-7-20                 |
| CURTIS INSTRUMENTS INC                       | 10-17-23               |
| CUSTOM SCIENTIFIC INSTRUMENTS INC            | 31                     |
| DALMO VICTOR CO DIV TEXTRON INC              | 4                      |
| DAYSTROM INC TRAWICOIL DIV                   | 21                     |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 10-21-22-28-29-30      |
| DEJUR-AMSCO CORP ELECTRONICS DIV             | 10-12-17               |
| DEMENT LABS                                  | 16-24                  |
| DIAMOND ANTENNA & MICROWAVE CORP             | 11                     |
| DICE CO J W                                  | 31                     |
| DILLON & CO INC W C                          | 7-12-21                |
| ELECTRIC TACHOMETER CORP                     | 2                      |
| ELECTRO IMPULSE LAB INC                      | 9-10-23                |
| ELECTRO INSTRUMENT INC                       | 31                     |
| ELECTROMATIC EQUIP CO                        | 14                     |
| ELECTRO MEC INSTRUMENT CORP                  | 16-17-24               |
| ELECTRO PHYSICS CO                           | 21                     |
| ELECTRO PRODUCTS LABS INC                    | 13                     |
| ELECTRONIC APPLICATIONS INC                  | 7                      |
| ELECTRONIC COUNTERS INC                      | 18-22-28               |
| ELECTRONIC DEVELOPMENT LABS                  | 10-                    |
| ELGIN MICRONICS DIV ELGIN NAT WATCH CO       | 23                     |
| ENDEVCO CORP                                 | 5-26                   |
| ENGINEERING ASSOCIATES                       | 1                      |
| ENGLER INSTRUMENT CO                         | 7-10-23                |
| E O ELECTRONICS INC                          | 26                     |
| EPIC INC                                     | 6-10-18-21-26          |
| EPSCO INC CAMBRIDGE                          | 12                     |
| ERWOOD INC                                   | 26                     |
| ESTERLINE ANGUS INSTRUMENT COMPANY INC       | 21                     |
| FARRAND OPTICAL CO INC                       | 16-17-24               |
| FLOW CORP                                    | 22-29                  |
| FORK STANDARDS INC                           | 21                     |
| GAMMA SCIENTIFIC INC                         | 17                     |
| GARDNER LAB INC                              | 16-17                  |
| GB COMPONENTS INC                            | 28                     |
| GEARTRONICS CORPORATION                      | 21                     |
| GENERAL COMMUNICATION CO                     | 1                      |
| GENERAL KINETICS INC                         | 21-29                  |
| GENERAL METERS INC                           | 1-2                    |
| GENERAL MICROWAVE CORP                       | 5-9                    |
| GENERAL RADIO CO                             | 5-26                   |
| GEOTECHNICAL CORP                            | 20                     |
| GERTSCH PRODUCTS INC                         | 10-23                  |
| GIANNINI CONTROLS CORP CRAMER DIV            | 2-15-17-31             |
| G M MFG CO                                   | 28                     |
| GRAY INSTRUMENT CO                           | 2                      |
| GREINER CO EMIL                              | 14-17                  |
| HACKER INSTRUMENTS INC                       | 3-4                    |
| HALEX INC                                    | 7-10-12-23             |
| HAYDON CO A W WATERBURY                      | 21                     |
| HEATH CO OIV OF DAYSTROM INC                 | 2-12-20-21-28-30       |
| HEWLETT PACKARD CO                           | 21-28                  |
| MEYER INDUSTRIES INCORPORATED                | 3-11                   |
| LAB OF MARQUETTE CORP                        | 17-26                  |
| HICKOK ELECTRICAL INSTRUMENT CO              | 15-29                  |
| HICO CORP                                    | 15-29                  |
| HILL & CO E VERNON                           | 10-23                  |
| HOBBS CORP JOHN W DIV STEWART-WARNER CORP    | 18-21-22               |
| HOWELL INSTRUMENTS INC                       | 28                     |
| HOYT ELECTRICAL INSTRUMENT WORKS             | 5-20                   |
| HUMPHREY INC                                 | 23                     |
| HUPPERT CO K H                               | 19                     |
| HURLETRON INC WHEATON ENG DIV                | 15                     |
| HYDROPOISE INC SUB BROOKS INST CO            | 22-28                  |
| HYGRODYNAMICS INC                            | 31                     |
| IDEAL PRECISION METER CO                     | 5-12-26                |
| ILLUMITRONIC ENGG CO                         | 20                     |
| IMPACT-O-GRAPH CORP                          | 31                     |
| INDUSTRIAL TEST EQUIPMENT CO                 | 6                      |
| INDUSTRIAL WINDING MACHINERY CORP            | 22                     |
| INSTRUMENT LABS CORPORATION                  | 26                     |
| INTERNATIONAL INSTRUMENTS INC                | 7                      |
| INTERNATIONAL RESEARCH & DEVELOPMENT CORP    | 14-20-21-30            |
| ISOTOPIES INC                                | 17                     |
| JARVIS ELECTRONICS CORP                      | 5-17                   |
| KENTRON HAWAII LTD                           | 9                      |
| KEUFFEL & ESSER CO                           | 26                     |
| KNOPP INC                                    | 15-21                  |
| KORFUND CO INC                               | 9                      |
| LABLINE INC                                  | 18-22                  |
| LAMPKIN LABS INC                             | 9-26                   |
| LEOS & NORTHROP CO                           | 2                      |
| LEHIGH VALLEY ELECT ENGG & MFG CO            | 10                     |
| LEKTRA LABS INC                              | 22                     |
| LELAND AIRBORNE PRODUCTS                     | 11-20                  |
| THE LEWIS ENGINEERING CO                     | 3-4                    |
| LINK DIV GENERAL PRECISION INC               | 19-20                  |
| MAGNAFLUX CORP                               | 10                     |
| MAGNETIC INSTRUMENT CO INC                   | 18                     |
| MARION INSTRUMENT DIV                        | 9-12                   |
| MASTERCRAFT INSTRUMENT CO                    | 7                      |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV   | 9                      |
| MEASUREMENT ENGG LTD                         | 16-17-18-24            |
| MEASUREMENTS DIV MC GRAW-EDISON CO           | 11                     |
| MEASUREMENT SYSTEMS INC                      |                        |
| MEDISTOR INST CO                             |                        |

|   |                |
|---|----------------|
| MELABS                                      | 2              |
| METERS INC                                  | 18-21-22-28    |
| METRON INSTRUMENT CO DENVER                 | 21             |
| METRON INSTRUMENT CO                        | 21             |
| MILLER ELECTRO RESEARCH LABS                | 20             |
| MINI-TOOL TECHNICAL INDUST INC              | 2              |
| MINNEAPOLIS-HONEYWELL PRECISION METER OIV   | 10             |
| MONROE ELECTRONICS INC                      | 29             |
| MONTRONICS INC                              | 15             |
| MUIRHEAD INSTRUMENTS INC                    | 6-11-22-31     |
| NEWTON INSTRUMENT CO INC                    | 10             |
| NON LINEAR SYSTEMS INC                      | 9-20           |
| NORTH ATLANTIC INDUST INC                   | 20             |
| NUCLEAR-CHICAGO CORP                        | 7-19-25        |
| NUCLEAR MEASUREMENTS CORP                   | 19             |
| NUCLEONIC CORP OF AMERICA                   | 7-10-19        |
| OHIO SEMICONDUCTORS                         | 4              |
| DIV TECUMSEN PRODS CO                       | 28-30          |
| PACE ELECTRICAL INSTRUMENTS CO              | 17             |
| PACIFIC PHOTOMETRIC INSTRUMENTS             | 10             |
| PARABAM INC                                 | 15             |
| PARKS LAB HENRY FRANCIS                     | 3              |
| PASTORIZA ELECT INC                         | 23             |
| PENNWOOD NUMECHRON CO                       | 2              |
| PERKIN-ELMER CORP SO WILTON PL              | 2              |
| PHILCO CORP SIERRA ELECTRONIC DIV           | 27             |
| PHILIPS ELECTRONIC INSTRUMENTS              | 2              |
| PHOENIX PRECISION INSTRUMENT CO             | 15             |
| PHYS CHEMICAL RES CORP                      | 27             |
| PICKER X-RAY CORP WAITE MFG DIV INC         | 21             |
| POWER INSTRUMENTS INC                       | 1              |
| PRD ELECTRONICS INC                         | 28             |
| PRECISION RESISTOR CO                       | 11             |
| PRECISION SPECIALTIES INC                   | 17-24          |
| PROCESS & INSTRUMENTS                       | 22             |
| PYROMETER INSTRUMENT CO                     | 29             |
| QUAN TECH LAB INC                           | 18             |
| Q V S INC                                   | 27             |
| RADAR MEASUREMENTS CORP                     | 11             |
| RCA ELECTRN TUBE DIV INDIANAPLS             | 11             |
| RCA ELECTRN TUBE DIV MARION                 | 11             |
| RCA ELECTRN TUBE DIV HARRISON               | 11             |
| RCA ELECTRN TUBE DIV WOODBRIDGE             | 11             |
| RCA ELECT TUBE DIV CINN                     | 11             |
| RCA ELECTRN TUBE DIV LANCASTER              | 11             |
| RADIO FREQUENCY LABS INC                    | 9              |
| RADIO SPECIALTY MFG CO                      | 3-22           |
| RAWSON ELECTRICAL INSTRUMENT CO             | 8              |
| RAZDOW LABORATORIES INC                     | 20             |
| ROBERTSON INSTRUMENT CO                     | 6              |
| ROHDE & SCHWARZ                             | 6-10-28-30     |
| ROWAN CONTROLLER CO RED BANK                | 21-28          |
| SANGANO ELECTRIC CO                         | 11             |
| SCHOENE ELECTRONICS LABORATORY              | 4              |
| SCHONSTEDT ENG CO                           | 26             |
| SCOTT INC H                                 | 7-19-20        |
| SEABOARD ELECTRONIC CORP                    | 18-22          |
| SERVICE ASSOCIATED INC                      | 2-6            |
| SIERRA ELECTRONIC DIV PHILCO CORP           | 10-23-28-30    |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 3-6-8-20-      |
| SINGER METRICS DIV SINGER MFG CO            | 6-20-22-       |
| SINGER METRICS SENSITIVE RES DIV            | 28-30          |
| SMITH-FLORENCE INC                          | 22-28-30       |
| SOHOT DIV OF THERMOLAB CORP                 | 6              |
| SOLID STATE CONTROLS INC                    | 22             |
| SPACE INSTRUMENTATION CORP                  | 3              |
| SPECTRAL DYNAMICS CORP OF SAN DIEGO         | 8-21           |
| SPERRY MICROWAVE ELECT INC                  | 26             |
| STANDARD INSTRUMENT CORP                    | 1              |
| STEVENS-EVANS INC                           | 10             |
| STRANDBERG ENGG LABS INC                    | 20             |
| SUN ELECTRIC CORP                           | 21             |
| SUNSHINE SCIENTIFIC INSTRUMENT              | 10-21-22       |
| SYSTRON DONNER CORP                         | 3-6-10-21-     |
| TE CO THE                                   | 23-25-28-29    |
| TECHNICAL PRODUCTS CO INSTRUMENT DIV        | 5-8-12-26      |
| TELOSTAT CORP                               | 16-24          |
| TESTING MACHINES INC                        | 26             |
| THERMO ELECTRIC CO                          | 15             |
| THERMOLYNE CORP                             | 8-26           |
| THETA INSTRUMENT CORP                       | 18-22          |
| TRACERLAB INC WALTHAM                       | 18             |
| TRELCON ENGINEERING CO                      | 9-14           |
| TRIPLETT ELECTRICAL INST BLUFFTON           | 7-27           |
| TROXLER ELECTRONICS LAB INC                 | 0              |
| U S TAXIMETER CORP                          | 28             |
| UNHOLTZ DICKIE CORP                         | 7-9            |
| UNITED AERO PRODUCTS CORP                   | 21             |
| DIV AERO CHATILLON CORP                     | 26             |
| UNIWAVE INC                                 | 5-11-26        |
| VERCO INC                                   | 21             |
| VIBRATION ENGINEERING PLANT                 | 9              |
| VICTOREEN INSTRUMENT CO, CLEVELAND          | 26             |
| VOLTRON PRODUCTS                            | 7              |
| WAELINE INC                                 | 9-21-22        |
| WAVELABS INC                                | 10-21-22-28-31 |
| WELCH SCIENTIFIC CO W M                     | 26             |
| WEST INSTRUMENT CORP                        | 17             |
| WESTERN APPARATUS                           | 23             |
| WESTMORE INC                                | 16             |
| WILK INSTRUMENTS DIV QUALITY ELEC CO        | 21             |
| WINSTROM                                    | 22-28          |
| YOKOGAWA ELECTRIC WKS INC                   | 31             |
| ZERNICKOW CO                                | 21-28-29-30    |
| ZINN INSTRUMENTS                            | 21             |
| ZOOMAR INC                                  | 20             |

|  |                     |
|--|---------------------|
| OSCILLOSCOPES 3600                           |                     |
| Cameras, oscilloscope recording . . . . .    | 1                   |
| Oscillographs, cathode-ray . . . . .         | 2                   |
| Oscillographs, direct writing . . . . .      | 3                   |
| Oscillographs, multi-channel . . . . .       | 4                   |
| Oscillographs, projection . . . . .          | 5                   |
| Oscillographs, recording . . . . .           | 6                   |
| Oscillographs, transient study . . . . .     | 7                   |
| Oscilloscopes, cathode-ray . . . . .         | 8                   |
| Oscilloscopes, direct writing . . . . .      | 9                   |
| Oscilloscopes, multi-channel . . . . .       | 10                  |
| Oscilloscopes, projection . . . . .          | 11                  |
| Oscilloscopes, recording . . . . .           | 12                  |
| Oscilloscopes, transient study . . . . .     | 13                  |
| Synchrosopes . . . . .                       | 14                  |
| Tracers, electron tube curve . . . . .       | 15                  |
| ALLEGANY INSTRUMENT CO                       | 1-2-10              |
| AMERICAN AIRFRAME CORP                       | 2                   |
| AMERICAN ASTRO-SYSTEMS                       | 1-2-3-4-5-6-7-8-9-  |
|  | 10-11-12-13-14-15   |
| AMERICAN OPTICAL CO INSTRUMENT DIV           | 4                   |
| ANALAB INSTRUMENT CORP                       | 1-2-7-8-9-10-12-13- |
|  | 14                  |
| BACH-SIMPSON LTD                             | 8                   |
| BARRY ELECTRONICS CORP NEW YORK              | 1                   |
| BEATTIE-COLEMAN INC                          | 1                   |
| BECKMAN INST INC BERKELEY DIV                | 6                   |
| BENRUS WATCH CO INC                          | 8                   |
| BUILDING BLOCKS ELECTRONIC CO                | 8                   |
| CALIFORNIA INSTRUMENTS CORP                  | 8                   |
| CANADIAN APPLIED RESCH DV A V ROE CANADA LT4 | 1                   |
| CAROL ELECT DIV WEEO                         | 8                   |
| CAROL ELECT OIV WEEO INC                     | 8                   |
| CENTRAL ELECTRONICS INC                      | 2                   |
| CENTRAL RESEARCH LABS                        | 2                   |
| CENTRAL SCIENTIFIC CO CHICAGO                | 8                   |
| CENTURY ELECT INST INC TULSA                 | 3-4-6-7             |
| CENTURY ELECTRONICS & INSTS INC              |                     |
| SUB CENTURY GEOPHYSICAL CORP                 | 3-4-6               |
| CHADWICK-HELMUTH CO                          | 1                   |
| CHICAGO AERIAL INDUSTRIES                    | 1                   |
| CAMPAGNE GENERALE DE METROLOGIE              | 8                   |
| DALLONS LABS                                 | 3-4-8               |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 14                  |
| DAYTON ELECT PROD CO INC                     | 8-9-10-12-14        |
| DUMONT LABS INC ALLEN B                      | 1-2-8-13            |
| DYTRONICS CO                                 | 2                   |
| EDGERTON GERMESHAUSEN & GRIER BOSTON         | 2-7-                |
|  | 13                  |
| ELECTRODYNAMIC INSTRUMENT CORP               | 4-6                 |
| ELECTRO INSTRUMENT INC                       | 8-10                |
| ELECTRO-MEDICAL LAB INC                      | 1-3                 |
| ELECTRONIC INSTRUMENT CO INC                 | 8                   |
| ELECTRONIC MEASUREMENTS CORP N Y             | 2                   |
| ELECTRONIC TUBE & INST DIV                   |                     |
| GENERAL ATRONICS CORP                        | 1-2-8-9-10-12-13    |
| ELECTRONICS OF CLEARFIELD INC                | 8                   |
| ENSCO INC                                    | 2-10                |
| EPIC INC                                     | 2-4                 |
| FURZEHILL LABS LTD                           | 8                   |
| GENERAL ATRONICS CORP ELECT TUBE & INST      | 1-                  |
|  | 2-9-10-12-13        |
| GEOTECHNICAL CORP                            | 1-2-3-4-5-6-7       |
| GORDON ENTERPRISES                           | 1                   |
| HAMILTON WATCH CO INDUSTRIAL PRODS DIV       | 2-3-                |
|  | 4-5-6-7             |
| HATHAWAY INSTRUMENTS DIV LIONEL              | 1-6                 |
| HEATH CO SUB OF DAYSTROM INC B HARBOR        | 8                   |
| HEATH CO DIV OF DAYSTROM INC ST JOS          | 8                   |
| HEWLETT PACKARD CO                           | 1-2-8-10-13-14      |
| MEYER INDUSTRIES INCORPORATED                | 8                   |
| LAB OF MARQUETTE CORP                        | 10                  |
| HICKOK ELECTRICAL INSTRUMENT CO              | 8-                  |
| HUGHES AIRCRAFT CO VACUUM TUBE PROD DIV      | 12-13               |
| IT & T INDUSTRIAL PRODUCTS DIV               | 2-3-4-5-6-7-        |
|  | 8-9-10-11-12-13     |
| JACKSON ELECTRICAL INSTRUMENT CO             | 8                   |
| JETRONIC INDUSTRIES                          | 8                   |
| LAS LAB INC                                  | 1                   |
| LAVOIE LABS INC                              | 8-14                |
| LUMATRON ELECTRONICS INC                     | 8                   |
| METAL SPECIALTY PRODUCTS CORP                | 2-8                 |
| MICROMETRIC MFG CO                           | 2                   |
| MIDWESTERN INSTRUMENTS                       | 3-4-6               |
| MILLEN MFG CO JAMES                          | 14                  |
| MINNEAPOLIS-HONEYWELL HEI-ANO DIV            | 3-4-6               |
| MODEL ENGG & MFG INC                         | 8-10-14             |
| NATIONAL UNION ELECT CORP ELECT DIV          | 8                   |
| PACKARD BELL ELECTRONICS CORP LOS ANG        | 10                  |
| PACO ELECTRONICS CO INC                      | 2-8                 |
| PHILBRICK RESEARCHES INC GEORGE A            | 1-8-10              |
| PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV    | 8                   |
| PLANETRONICS INC                             | 8                   |
| POLYTRONIC RESEARCH INC                      | 8                   |
| PRECISE ELECTRONICS & DEVELOPMENT CORP       | 8                   |
| PROBESCOPE CO INC                            | 2-8                 |
| PROBESCOPE CO INC SYOSSET                    | 10                  |
| PRODUCERS SALES CORP & PHOTO-SONICS INC      | 1                   |
| RADIAPHONE CO                                | 8                   |
| RCA ELECTRN TUBE DIV INDIANAPLS              | 8                   |
| RCA ELECTRN TUBE DIV MARION                  | 8                   |
| RCA ELECTRN TUBE DIV HARRISON                | 8                   |

For Company Addresses, See Alphabetical Listing of Electronic Mfrs.



|                                 |               |   |         |
|---------------------------------|---------------|---|---------|
| RCA ELECTRN TUBE DIV WOODBRIDGE | 8             | SCOPE CO INC                                | 8-10    |
| RCA ELECT TUBE DIV CINN         | 8             | SERVICE INSTRUMENT CORP                     | 8       |
| RCA ELECTRN TUBE DIV LANCASTER  | 8             | SIERRA ELECTRONIC DIV PHILCO CORP           | 10      |
| RAILWAY COMMUNICATIONS INC      | 10            | SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 8       |
| REPUBLIC ELECT INDUSTRY CORP    | 8             | SIMPSON ELECTRIC CO MERCER                  | 8       |
| R M S ASSOCIATES INC            | 11            | SINGER METRICS DIV SINGER MFG CO            | 1       |
| ROBERTSON INSTRUMENT CO         | 8             | SKIATRON ELECTRONICS TV CORP                | 8-13-15 |
| ROHDE & SCHWARZ                 | 2             | THE SOLARTRON ELECTRONIC GROUP LTD          | 8-10-13 |
| ROTEK INSTRUMENT CORP           | 21            | SPECTRAN ELECTRONICS CORP                   | 7-13    |
| SCHWARZER CORP                  | 3-4-6-9-10-12 | SPIVEY INC JAMES S                          | 8       |

|                                     |              |
|-------------------------------------|--------------|
| TAFLET ELECTRONICS INC              | 2-8          |
| TECHNI RITE ELECTRONICS INC         | 3-4-6-7      |
| TEKTRONIX INC BEAVERTON             | 1-8-10-13-15 |
| TELECHROME MFG CORP                 | 1            |
| TELEMET CO                          | 1            |
| TEXAS INSTRUMENTS INC APPARATUS DIV | 3-4-6        |
| TRIPLETT ELECTRICAL INST BLUFFTON   | 8            |
| WATERMAN PRODUCTS CO                | 2-4-8-10-14  |
| WESTERN ELECTRODYNAMICS             | 6            |
| WHITEHALL ELECTRONICS CORP          | 8            |
| WILTRON CO                          | 8            |

SPECIAL PURPOSE TEST EQUIPMENT 3700

|                                |    |                                 |    |                                |    |
|--------------------------------|----|---------------------------------|----|--------------------------------|----|
| Accelerometers.....            | 1  | Analyzers, spectrum.....        | 52 | Comparators, reluctance....    | 23 |
| Analyzers, antenna pattern..   | 59 | Analyzers, stress.....          | 90 | Comparators, surface.....      | 24 |
| Analyzers, audio-amplifier..   | 60 | Analyzers, surface.....         | 91 | Comparators, voltage.....      | 25 |
| Analyzers, cable.....          | 61 | Analyzers, telemetric data..    | 92 | Converters, frequency.....     | 26 |
| Analyzers, capacitor.....      | 62 | Analyzers, thyatron.....        | 93 | Dividers, voltage.....         | 27 |
| Analyzers, circuit.....        | 63 | Analyzers, transducer.....      | 94 | Electronic switch.....         | 58 |
| Analyzers, coincidence.....    | 64 | Analyzers, transistor.....      | 95 | Galvanometers.....             | 28 |
| Analyzers, color.....          | 65 | Analyzers, ultrasonic.....      | 96 | Lights, neon test.....         | 55 |
| Analyzers, crystal.....        | 66 | Analyzers, vibration.....       | 97 | Locators, cable & line         |    |
| Analyzers, differential.....   | 67 | Analyzers, video.....           | 98 | faults.....                    | 29 |
| Analyzers, digital.....        | 68 | Analyzers, waveform.....        | 53 | Locators, open-short.....      | 30 |
| Analyzers, dimensional.....    | 69 | Attenuators, A-F.....           | 2  | Locators, pipe & cable....     | 31 |
| Analyzers, distortion.....     | 70 | Attenuators, R-F.....           | 3  | Photometers.....               | 56 |
| Analyzers, electrochemical.... | 71 | Barretters.....                 | 4  | Pressure measuring equip..     | 32 |
| Analyzers, engine.....         | 72 | Bolometers.....                 | 5  | Probes.....                    | 33 |
| Analyzers, frequency.....      | 73 | Boxes, echo.....                | 6  | Recorders, frequency           |    |
| Analyzers, gas.....            | 74 | Calibrators, DC.....            | 7  | response.....                  | 34 |
| Analyzers, harmonic.....       | 75 | Calibrators, sweep.....         | 8  | R-F interference equipment..   | 35 |
| Analyzers, infra-red.....      | 76 | Chronographs.....               | 9  | Slotted lines.....             | 36 |
| Analyzers, interference.....   | 77 | Chronoscopes.....               | 10 | Spectrometers.....             | 37 |
| Analyzers, intermodulation.... | 78 | Collimators, infra-red.....     | 11 | Spectrophotometers.....        | 38 |
| Analyzers, internal            |    | Colorimeters.....               | 57 | Spectroscopic source units..   | 39 |
| combustion.....                | 79 | Comparators, automatic          |    | Test equipment, corona....     | 40 |
| Analyzers, magnetic.....       | 80 | resistance.....                 | 12 | Test equipment, dielectric..   | 41 |
| Analyzers, microwave.....      | 81 | Comparators, capacitance... 13  |    | Thermocouples.....             | 42 |
| Analyzers, multi-channel....   | 82 | Comparators, circuit            |    | Thermopiles.....               | 43 |
| Analyzers, noise.....          | 83 | linearity.....                  | 14 | Tracers, electron tube         |    |
| Analyzers, phase & voltage..   | 84 | Comparators, densitometer.. 15  |    | Tracers, signal.....           | 44 |
| Analyzers, pulse.....          | 85 | Comparators, dielectric..... 16 |    | Tracers, transistor curve..    | 45 |
| Analyzers, radar.....          | 86 | Comparators, impedance.... 17   |    | Transducers.....               | 46 |
| Analyzers, relay.....          | 87 | Comparators, inductance.... 18  |    | Tracers, pressure.....         | 48 |
| Analyzers, servo.....          | 88 | Comparators, iron core.... 10   |    | Transducers, telemetering..    | 49 |
| Analyzers, sonic &             |    | Comparators, micro              |    | Transducers, temperature... 50 |    |
| sub-sonic.....                 | 89 | photometer.....                 | 20 | VSWR measuring equipment... 51 |    |
|                                |    | Comparators, phase.....         | 21 |                                |    |
|                                |    | Comparators, Q.....             | 22 |                                |    |

|  |                    |
|--|--------------------|
| CENTURY COIL CORP                            | 26-27              |
| CENTURY ELECT INST INC TULSA                 | 1-28               |
| CENTURY ELECTRONICS & INSTS INC              |                    |
| SUB CENTURY GEDPHYSICAL CORP                 | 47-48              |
| CENTURY ELECT CO MINEOLA                     | 0                  |
| C F S ELECTRONIC PRODUCTS INC                | 2                  |
| CHACE CO W M                                 | 42                 |
| CHALCO ENGINEERING CORP                      | 25-26              |
| CINEMA CORP                                  | 7-12-25-28         |
| CINEMA ENGINEERING DIV AEROVOX CORP          | 2                  |
| CLEVELAND INSTRUMENT CO                      | 24                 |
| CLIPPARD INSTRUMENT LAB CINN                 | 12-13              |
| COMU ELECTRONICS INC KIN TEL DIV             | 7-28               |
| CDHU ELECTRONICS INC MASSA DIV               | 1-28               |
| CDELMAN INSTRUMENTS INC                      | 38-71              |
| COLVIN LABS INC                              | 48                 |
| COMPONENTS FOR RESEARCH INC                  | 27                 |
| COMPUDYNE CORP                               | 33                 |
| COMPUTER INSTRUMENTS CORP                    | 27-48              |
| COMPUTER TEST CORP                           | 0-7-25             |
| CON-ELCO                                     | 47                 |
| CONAX CORP                                   | 42-50              |
| CONNECTICUT INSTRUMENT CORP                  | 38                 |
| CONOFLOW CORP                                | 48                 |
| CONSOLIDATED AIRBORNE SYSTEMS INC            | 12-25-27           |
|  | 32                 |
| CONSOLIDATED CONTROLS CORP                   | 32                 |
| CONSOLIDATED ELECT CORP                      | 1-28-32-34-37-47   |
|  | 48-49-50           |
| CONTINENTAL SENSING INC                      | 42                 |
| CONTROLLER CORP                              | 42                 |
| CORBETT SCIENCE LABS F W                     | 12-17-18           |
| CROGGENICS INC                               | 42-43-50           |
| CURTISS WRIGHT CORP                          | 46                 |
| CURTISS-WRIGHT CORP ELECTRONICS DIV          | 42-48              |
| CUSTOM SCIENTIFIC INSTRUMENTS INC            | 33-41              |
| CUTLER HAMMER INC                            | 55                 |
| DALLONS LABS                                 | 5-7-32-42-48-49-50 |
| DALLONS SEMICONDUCTORS DIV DALLONS LABS INC  |                    |
| DATA CONTROL SYSTEMS INC                     | 49                 |
| DATA INSTRUMENTS                             | 47                 |
| DATA SENSORS INC                             | 32-48-49           |
| DATA TECHNOLOGY INC                          | 35                 |
| DATAMETRICS INC                              | 32                 |
| DATASCAN INC                                 | 13-25              |
| DAVEN CO                                     | 1-2-27             |
| DAVIDSON OPTRONICS INC                       | 11-37              |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV |                    |
|  | 7-28-42-47-50      |
| DBM RESEARCH CDRP                            | 35                 |
| DECITRON ELECTRONICS CORP                    | 35                 |
| DECKER CORP                                  | 19-47              |
| DECO ELECTRONICS INC                         | 51                 |
| DELSEN CORP                                  | 16                 |
| DELTA DESIGN INC C/O NON LINEAR SYSTEMS INC  |                    |
|  | 32                 |
| DEMENT LABS                                  | 39                 |
| DEMORAY BONAROI CORP                         | 36                 |
| DIAMOND ANTENNA & MICROWAVE CORP             | 3-6-33-36          |
| DIGITAL DESIGN CORP                          | 12-21-25           |
| DIGITECH INC NORWALK                         | 0                  |
| DI-TRAM CORPORATION                          | 13-25-29           |
| DMETER MFG CO                                | 27                 |
| DON LAN ELECTRONICS CORP SUB QUANTATRON INC  |                    |
|  | 47-50              |
| DOUGLAS MICROWAVE CO                         | 3-6-27-36-51       |
| DREXEL DYNAMICS CORP                         | 12                 |
| DUKANE CORP                                  | 52                 |
| DUMONT LABS INC ALLEN B                      | 39-85-92           |
| OYMEC DIV OF HEWLETT PACKARD CO              | 3                  |
| DYNAMIC MEASUREMENTS CO                      | 1-46-47-48-49      |
| DYNAPLEX CORP                                | 7-26               |
| DYNATRON LAB                                 | 26                 |
| DYNATRONIC INST CORP ELECTR DIV              |                    |
| LAB LINE INSTRUMENTS INC                     | 33                 |
| DYTRONICS CO                                 | 17-31              |
| EALING CORP                                  | 37                 |
| EBAUCHES A DEP SEMICONDUCTEURS               | 46                 |
| EDCLIFF INSTRUMENTS                          | 1-33-47-48-49      |
| EOO CANADA LTO                               | 47                 |
| EDD CORP COLLEGE PT                          | 47                 |
| EISLER TRANSFORMER CO INC                    | 41                 |
| ELCOR INC                                    | 25                 |
| ELECT MECHANICAL RES INC                     | 8                  |
| ELECTRA SCIENTIFIC CORP                      | 1                  |
| ELECTRAMATIC INC                             | 30                 |
| ELECTRO DEVICES INC NEWTON                   | 18                 |
| ELECTRO IMPULSE LAB INC                      | 3-5-27-43-51       |
| ELECTRO INSTRUMENT INC                       | 13-17-18-25        |
| ELECTROMAGNETIC TECHCORP                     | 35                 |
| ELECTRO PHYSICS CO                           | 20                 |
| ELECTROSPACE CORP                            | 29-41              |
| ELECTRONANITICS CORPDRATION                  | 3                  |
| ELECTRONIC COUNTERS INC                      | 9                  |
| ELECTRONIC DEVELOPMENT CORP                  | 7-25               |
| ELECTRONIC DEVELOPMENT LABS                  | 42                 |
| ELECTRONIC INSTRUMENT CO INC                 | 12-13-18-33        |
| ELECTRONIC PROCESS CORP SAN CARLOS           | 47                 |
| ELECTRONIC RESEARCH ASSOCIATES INC           | 26                 |
| ELECTRONIC SPECIALTY CO                      |                    |
| TECHNICRAFT DIVISION                         | 36                 |

|   |                                |
|---|--------------------------------|
| ABBEY ELECTRONICS CORP                      | 7                              |
| ACCURATE INSTRUMENT CO                      | 27                             |
| ACUTRONICS INC                              | 8                              |
| ACOUSTICA ASSOCIATES INC                    | 1-47                           |
| ACOUSTICA ASSOCIATES                        | 47-96                          |
| AEDCM CORP                                  | 25                             |
| ADVANCED ELECTRONICS INC                    | 33-42                          |
| ADVANCED INSTRUMENTS                        | 0                              |
| ADVANCED KINETICS INC                       | 38                             |
| ADVANCED MEASUREMENT INST INC               | 8                              |
| AD-VU ELECTRONICS LAB INC                   | 2-3-21-26-33                   |
| AEROFLEX LABORATORIES INC                   | 32-47-48                       |
| AEROJET GENERAL CORP ASTRONICS DIV          | 37-38                          |
| AEROLITE ELECTRONICS CORP                   | 33                             |
| AEROLUX LIGHT CORP                          | 54-55                          |
| AERO RESEARCH INSTRUMENT CO                 | 42-50                          |
| AEROSPACE RESEARCH INC                      | 21-26-49-51                    |
| AETNA ELECTRONICS CORP                      | 0                              |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC   | 3                              |
| AIR O TRONICS ENG CO                        | 33                             |
| AIRPAX ELECT INC SEMINOLE DIV               | 26                             |
| AIRTEC INC                                  | 3-5-6-36                       |
| ALERT PRODUCTS INC                          | 29                             |
| ALFORD MFG CO                               | 3-17-33-36-51                  |
| ALLEGANY INSTRUMENT CO                      | 32-47-48                       |
| ALNOR INST CO OV OF ILL TESTING LABS INC    | 28                             |
| ALPHA SCIENTIFIC LABS INC                   | 37                             |
| AMERIC INC                                  | 26                             |
| AMERICAN AEROSPACE CONTROLS INC             | 32                             |
| AMERICAN ASTRO-SYSTEMS                      | 1-2-3-4-5-6-7-8-9-             |
|   | 10-11-12-13-14-15-16-17-18-19- |
|   | 20-21-22-23-24-25-26-27-28-29- |
|   | 30-31-32-33-34-35-36-37-38-39- |
|   | 40-41-42-43-44-45-46-47-48-49- |
|   | 50-51                          |
| AMERICAN BRAKE SHOE CO RAYMOND ATCHLEY DIV  | 32                             |
| AMERICAN ELECTRIC CABLE CO                  | 42                             |
| AMERICAN ELECTRONICS CO MINN                | 46                             |
| AMERICAN INSTRUMENT CO                      | 38                             |
| AMERICAN RESEARCH & MFG CORP                | 32                             |
| AMERICAN STANDARD CORP NORWOOD PRODS        | 32                             |
| AMERICAN THERMO ELECTRIC CO                 | 42                             |
| AMTHOR TESTING INST CO                      | 32                             |
| ANADIX INSTRUMENT S INC                     | 25-26                          |
| ANCHOR SPEC MFG CO                          | 1-6-13                         |
| ANDREA RADIO CORP                           | 1                              |
| ANGLER INDUSTRIES                           | 29-30-33                       |
| ANGSTROMN PRECISION INC                     | 7-12                           |
| APPLIED RESEARCH INC                        | 3                              |
| APPLIED RESEARCH LABS                       | 15-33-37-39                    |
| AR & DA ENGG CO                             | 47                             |
| ARENBERG ULTRASONIC LABORATORY INC          | 3                              |
| ARRA RESEARCH ASSOCIATES                    | 3                              |
| ASCOP DIV ELECTRO MECHANICAL RESCH INC      | 52-                            |
|   | 73-83-92                       |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD LONDON | 53                             |

|  |                            |
|--|----------------------------|
| ASSOCIATED ELECTRICAL INDUSTRIES LTD   | 6-37-                      |
| LEICESTER                              | 51                         |
| ASSOCIATED RESEARCH INC                | 29-40                      |
| ASTRA TECHNICAL INSTRUMENT CORP        | 33-50                      |
| ASTROLAB INC                           | 3                          |
| ASTRO SYSTEMS INC                      | 27                         |
| ATLANTIC RESEARCH CORP                 | 48                         |
| AUSTIN ELECTRONICS DIV AUSTIN CO       | 12-25                      |
| AUTHORIZED MFRS SERVICE CO             | 25                         |
| AUTO DATA                              | 12-25                      |
| AUTOMATIC ELECTRIC CO                  | 30                         |
| AUTOMATION DYNAMICS CORP               | 6                          |
| AUTOMATION MANAGEMENT INC              | 1                          |
| AVTRON MFG INC                         | 9-25-26                    |
| BACH-SIMPSON LTD                       | 27                         |
| BALLANTINE LABS INC                    | 7                          |
| BARBER-COLMAN CO                       | 35                         |
| BARKER & WILLIAMSON INC                | 2-3                        |
| BARNES DEVELOPMENT CO                  | 12-13-17-18                |
| BARNES ENGINEERING CO                  | 37                         |
| BARNETT INST CO                        | 28-33                      |
| BAUSCH & LOMB INCORP                   | 24-37-38                   |
| BECKMAN INST INC                       | 38-52-71-74-76             |
| BECKMAN INST INC BERKELEY DIV          | 47                         |
| BELZ INDUSTRIES DIV EL TRONICS INC     | 3-36                       |
| BENCO TELEVISION ASSOC LTD             | 3                          |
| BENSON LEHNER G B LTO                  | 12                         |
| BERGEN LABS INC                        | 25                         |
| BEVA LABORATORY                        | 52-64                      |
| B & F INSTRUMENTS INC                  | 1-7-47                     |
| B & H INSTRUMENT CO INC                | 72-73                      |
| BIDDLE CO JAMES G                      | 28-38-40-41-43             |
| BINARY ELECTRONICS INC                 | 12-13-17-25                |
| B & K INSTRUMENTS INC OF BRUEL & KJAER | 34                         |
| BLISS ELECTRONIC CORP                  | 12-25                      |
| BOGART MFG CDRP                        | 3                          |
| BOONTON RADIO CORP                     | 47                         |
| BORG-WARNER CONTROLS                   | 1-36                       |
| BRISTOL CO LOS ANG                     | 32-42-48-50                |
| BROWN ENG CO INC                       | 47                         |
| BRUNO NEW YORK INDOUST CORP            | 5                          |
| BUDD STANLEY CO                        | 36-51                      |
| BYTREX CORP                            | 1-47-48                    |
| CALIF TECHNICAL INDUST DIV TEXTRON INC | 10-                        |
|  | 12-14-17-18-25-26-34-41-51 |
| CALIFORNIA COMPUTER PRODS INC ANAHEIM  | 25                         |
| CALIFORNIA INSTRUMENTS CORP            | 25                         |
| CAMBRIDGE INSTRUMENT CO INC            | 28                         |
| CAMBRIDGE SYSTEMS INC                  | 33                         |
| CAMPBELL X RAY CORP                    | 29                         |
| CANADIAN RESEARCH INSTITUE             | 7-15-16-29-40-             |
|  | 41-42                      |
| CARAO CORP                             | 27                         |
| CARTER PRINCETON ELECTR DIV            | 12-14-25                   |
| CEDAR ENG DIV CONTROL DATA CORP        | 1                          |
| CENTRAL DYNAMICS LTD                   | 25                         |
| CENTROL ENG CO                         | 41                         |



# PRODUCTS & MANUFACTURERS

# Test Equipment—Special Purpose

|  |                            |  |                        |   |                     |
|--|----------------------------|--|------------------------|---|---------------------|
| ELECTRONICS OF CLEARFIELD INC                  | 33-42                      | KOLLSMAN INSTRUMENT CORP                   |                        | PRECISION SENSORS INC                         | 48                  |
| ELON INSTRUMENTS INC                           |                            | SUR STANDARD KOLLSMAN IND                  | 1-11-32-47-48          | PRINCETON APPLIED RESEARCH CORP               | 7                   |
| ELK ELECTRONICS LABS INC                       | 53-73-75-78                | KORFUNO CO INC                             | 1-32-47                | PRINCETON OIV ELECTRO MECHANICAL RESCH INC    | 48                  |
| EMI COSSOR ELECTRONICS                         | 59-92                      | KULITE BYTREX CORP                         | 1-47-48                | PROBESCOPE CO INC                             | 8-34-35             |
| EMPIRE DEVICES PRODUCTS CORP                   | 3-35                       | LARLINE INC                                | 15                     | PROBESCOPE CO INC SYOSSET                     | 34-35               |
| ENDEVOX CORP                                   | 1-32-47-48-49              | LANGEVIN DIV OF SONOTEC INCORP             | 2                      | PROCESS & INSTRUMENTS                         | 37-38               |
| ENGELHARD INDUSTRIES INC                       | 42-50                      | LAVOIE LABS INC                            | 0-52                   | PROJECTS UNLIMITED INC                        | 2-3-51              |
| ENGELMANN MICROWAVE CO                         | 3                          | LEACH CORP SPECIAL PRODUCTS OIV            | 12-25-26               | PYE TELECOMMUNICATIONS LTD                    | 53-61-63-98         |
| ENTRON INC                                     | 25-43                      | LEROW ASSOCIATES                           | 47-48                  | PYROMETER INSTRUMENT CO                       | 42                  |
| EPPEL LAB INC                                  | 7-26                       | LEEDS & NORTHRUP CO                        | 7-27-28-29-30-42-47-48 | QUANTATRON INC                                | 47-50               |
| EPSCO INC CAMBRIDGE                            | 7-26                       | LEHIGH VALLEY ELECT ENGG & MFG CO          | 19-33                  | QUAN TECH LAB INC                             | 35-52               |
| ERA DYNAMICS                                   | 26                         | THE LEWIS ENGINEERING CO                   | 42-50                  | RAOAR ENGINEERS                               | 29                  |
| ERCONA CORP                                    | 52-69-71-91                | LORAL ELECTRONICS CORP                     | 73-81-85-86-88         | RAOAR MEASUREMENTS CORP                       | 6-36-51             |
| EROCO ENGG CORP                                | 3                          | MAOIGAN CORP                               | 3                      | RADIO CITY PROO CO                            | 62-63               |
| ERIE ELECTRONICS OIV                           | 47-48-49-50                | MAGNAVOX COMPANY THE FT WAYNE              | 62                     | RCA DEFENSE ELECT PROOS CAMOEN                | 14-29-63-68-80-86   |
| ESPEY MFG & ELECTRONICS CORP                   | 26-27                      | MAGNETIC ANALYSIS CORP                     | 19                     |   |                     |
| EXACT ELECTRONICS INC                          | 7-25                       | MAGNETIC CIRCUIT ELEMENTS INC              | 25                     | RADIO ENGG CO                                 | 54                  |
| FARRANO OPTICAL CO INC                         | 11-38                      | MAGNETIC RESEARCH CORP                     | 25                     | RADIO FREQUENCY LABS INC                      | 7-26                |
| FERRIS INC J W                                 | 1-12                       | MARCONI INSTRUMENTS                        | 2-3-22                 | RAYTHEON CO INDUSTRIAL COMPONENTS OIV         | 1                   |
| FERRIS INSTRUMENT CORP                         | 3-35-36                    | MAROUTH PROO                               | 24                     | R C L ELECTRONICS INC                         | 2-3                 |
| FERRITRON ELECTRONICS CO INC                   | 83-95                      | MARION INSTRUMENT OIV                      | 7                      | ROF CORP                                      | 14                  |
| FIOLITONE MICROWAVE INC                        | 33                         | MASON-NEILAND OIV WORTHINGTON CORP         | 48                     | REDCOR CORP                                   | 14                  |
| FILMOHM CORP                                   | 3-5                        | MAXSON ELECTRONICS CORP N Y                | 1                      | REEDER & CO CHARLES M                         | 42-43               |
| FLUIDOYNE ENGG CORP                            | 32-33                      | MAXSON INSTRUMENTS                         | 1                      | REEVES INSTRUMENT CORP                        | 1                   |
| FLUKE MFG CO INC JOHN                          | 7-27                       | OIV MAXSON ELECTRONICS CORP                | 1                      | RESEARCH INC                                  | 1-47                |
| F & M SCIENTIFIC CORP                          | 74                         | MAXSON ELECTRONICS CORP ELECTRONIC OES OIV | 21-26                  | RESEARCH INDUSTRIAL LAB OF ELECTRONICS        | 25                  |
| FOSTORIA CORP DEPT O2                          | 50                         | MEASUREMENTS OIV MC GRAW-EDISON CO         | 2-3-4-5-33             | RESEARCH MFG CORP                             | 33-47               |
| FREED TRANSFORMER CO                           | 13-17-18                   |  | 33                     | RESISTOR NETWORKS INC                         | 7-25-27             |
| FREQUENCY ENGG LABS                            | 27                         | MEASUREMENT SYSTEMS INC                    | 11-38-39               | RFS ENGINEERING CO                            | 7-25                |
| FRONTIER ELECT CO                              | 9-10-26                    | MECA ELECTRONICS INC OOVER                 | 3                      | RHEEM ELECTRONICS CORP                        | 47                  |
| FURANE PLASTICS INC HEMPSTEAD                  | 41                         | MECHANICS FOR ELECTRONICS INC              | 47                     | RIL ELECTRONICS CORP                          | 32                  |
| F X R INC WOODSIOE                             | 5-33                       | MEGISTOR INST CO                           | 7                      | RIVERBANK LABS ENGG DEPT                      | 26                  |
| GC ELECTRONICS CO OIV TEXTRON ELECTRONICS      | 30                         | MELABS                                     | 3-35                   | ROBINAIR MANUF CORP                           | 42                  |
|  | 25                         | MELTRON CORP                               | 32-48                  | ROHOE & SCHWARZ                               | 3-29-41             |
| GENERAL AUTOMATICS INC                         | 3-6                        | MERCURY CONTACTS INC                       | 33                     | ROSEMOUNT ENGG CO                             | 33-47-48-50         |
| GENERAL COMMUNICATION CO                       | 68-71-73-82-85-92-95       | MERIDIAN METALCRAFT INC                    | 3-6                    | ROTEX INSTRUMENT CORP                         | 25-27               |
| GENERAL DEVICES INC                            | 32-47-48                   | MERRIMAC RESEARCH & DEVELOPMENT INC        | 2-3                    | RUE PRODUCTS                                  | 30                  |
| GENERAL KINETICS INC                           | 3-5-6-33-36                | MESUR MATIC ELECTRONICS CORP               | 17-27                  | RUTHERFORD RESEARCH PROOS CO                  | 40-41               |
| GENERAL MICROWAVE CORP                         | 1-2-3-13-17-18-26-34-36-41 | METAL SPECIALTY PRODUCTS CORP              | 2-3                    | SANBORN CO                                    | 47-48-88            |
| GENERAL RADIO CO                               | 1                          | METAVAC INC                                | 28                     | SANGAMO ELECTRIC CO                           | 26                  |
| GENISCO INC                                    | 3-17-21-25-26-27           | METERS INC                                 | 0                      | SARATOGA INDUSTRIES                           | 73                  |
| GERTSCH PRODUCTS INC                           | 47-48-49-50                | MICROROOT INC MAGNETICS OIV                | 47                     | SAXONBURG CERAMICS INC                        | 42                  |
| GIANNINI CONTROLS CORP TRANSDUCER OIV          | 32-33-47-48-49-50          | MICRO MEASUREMENTS CORP                    | 47                     | SCHAEVITZ ENGG                                | 47-48               |
|  | 49-50                      | MICROMETRICAL MFG CO                       | 14-27                  | SCIENTIFIC ELECTRONIC LABS INC                | 55                  |
| GIANNINI CONTROLS CORP NJ OIV                  | 0-15-38                    | MICRO METRICS INC                          | 1-32-47-48-49-50       | SEABOARD ELECTRONIC CORP                      | 25                  |
|  | 47                         | MICRO SYSTEMS INC                          | 81                     | SECO ELECTRONICS INC                          | 51                  |
| GILFORD INSTRUMENT LABS INC                    | 42                         | MID-EASTERN ELECTRONICS INC                | 7                      | SEMTRAN INSTRUMENTS INC                       | 1-32-47-48-49       |
| GLASSCO INSTRUMENTS CO                         | 32                         | MIDWESTERN INSTRUMENTS                     | 28                     | SERVO ASSOCIATED INC                          | 42                  |
| GRAY INSTRUMENT CO                             | 47-48                      | MILLEN MFG CO JAMES                        | 51                     | SERVO CONSULTANTS LTO                         | 88                  |
| GREEN INSTRUMENTS INC H J                      | 47-48                      | MILLITEST CORP                             | 12-14                  | SERVO CORP OF AMERICA                         | 5-11-50             |
| GUIDANCE CONTROLS CORP                         | 49-50                      | MINCO PRODUCTS INC                         | 50                     | SERVOMECHANISMS INC EL SEGUNDO                | 32-47-48-49-50      |
| GULTON INDUSTRIES INC METUCHEN                 | 49-50                      | MINNEAPOLIS-HONEYWELL HEILAND DIV          | 28                     |   |                     |
|  | 7                          | MINNEAPOLIS-HONEYWELL BOSTON OIV           | 47                     | SHALLCROSS MFG CO                             | 3                   |
| HALMAR ELECTRONICS INC                         | 9                          | MINNEAPOLIS-HONEYWELL FALL RIVER OIV       | 32-48-49-50            | SHORT BROS & HARLANDO LTO                     | 84-88-94            |
| HAMILTON WATCH CO INDUSTRIAL PROOS OIV         | 42-47                      | MINNEAPOLIS-HONEYWELL OROANCE OIV          | 1-5-34                 | SIERRA ELECTRONIC OIV PHILCO CORP             | 29-51               |
|  | 50                         | MINNEAPOLIS-HONEYWELL BROWN INST OIV       | 42-49                  | SIGMA INSTRUMENTS INC                         | 21                  |
| HARREL INC                                     | 32                         | MINNEAPOLIS-HONEYWELL RUBICON OIV          | 28                     | SIMPSON ELECTRIC CO OIV AMER GAGE & MACH CO   | 7-28-33             |
| HASTINGS-RAYOIST INC                           | 12-13-17-25                | MISSOURI RESEARCH LABORATORIES INC         | 8-86                   | SIMPSON ELECTRIC CO MERCER                    | 45                  |
| THE A W HAYDON CO CULVER CITY                  | 47-48-49-50                | MKS INSTRUMENTS INC                        | 0                      | SINGER METRICS OIV SINGER MFG CO              | 7-8-12-25-          |
| HAZELTINE ELECTRONICS OIV/HAZELTINE CORP       | 7-32-47-48-49-50           | MODERN DESIGN OIV H C SCHLOER INC          | 7-32-48                | SINGER METRICS PANORAMIC DIV                  | 52                  |
|  | 47-48-49-50                | MONROE ELECTRONICS INC                     | 2-3-26-29-34           | SINGER METRICS SENSITIVE RES OIV              | 7-25-27-28-29-32-42 |
| HEATH CO SUB OF DAYSTROM INC B HARBOR 70-75-78 | 15-57                      | MUIRHEAD & CO LTO                          | 73-75-88               | SIVERS LAB                                    | 7-25-27-29-30-33    |
| HEATH CO OIV OF DAYSTROM INC ST JOS            | 2-3-4-5-6-26-27-33-36      | MUIRHEAD INSTRUMENTS LTO                   | 2-3-27-28-29-31-40     | SMITH-FLORENCE INC                            | 42-47-48            |
|  | 32                         | MUIRHEAD INSTRUMENTS INC                   | 29-30-31-40-41         | THE SOLARTRON ELECTRONIC GROUP LTO            | 48-49               |
| HELLIGE INC                                    | 32                         | MUTRON INC                                 | 2-3                    | SOLID STATE ELECTRONICS CO                    | 68-71               |
| HEWLETT PACKARD CO                             | 32                         | NATIONAL ELECTRONICS LAB                   | 46                     | SOUTHERN INSTRUMENTS COMPUTER OIV             | 62-63-97            |
| HEYER INDUSTRIES INCORPORATED                  | 32                         | NATIONAL INSTRUMENT LABS INC               | 15-20-37-              | SOUTHWESTERN INDUSTRIAL ELECT CO              | 47                  |
| LAB OF MARQUETTE CORP                          | 39                         | NATIONAL SPECTROGRAPHIC LABS INC           | 38-39                  | SPACE INSTRUMENTATION CORP                    | 8                   |
| HICO CORP                                      | 32                         | NATL ULTRASONIC CORP                       | 47                     | SPECIFIC PROO                                 | 1-26-32-47-48       |
| HIOYNE INSTRUMENT & ENGRG CO                   | 32                         | NEVAOA AIR PRODUCTS CO                     | 24                     | SPEC TOOL CO                                  | 52-76               |
| HILL & CO E VERNON                             | 34                         | NEW LONDON INST CO INC                     | 3                      | SPECTRA ELECT CORP                            | 37-                 |
| HOGAN FAXIMILE CORP                            | 1                          | NICHOLS PRODUCTS CO                        | 33-36-39-51            | SPECTROLAB OIV TEXTRON ELECTRONICS INC        | 38                  |
| HOLLAND ELECTRONICS                            | 7                          | NON LINEAR SYSTEMS INC                     | 7-12-25                | SPERRY MICROWAVE ELECT INC                    | 3-4-5-6-33-35-      |
| HOLT INSTRUMENT LABS                           | 26-34                      | NORTHEASTERN ENGG INC                      | 36                     | SPERRY PHOENIX CO OIV                         | 1                   |
| HOUSTON INSTRUMENT CORP BELLAIRE               | 34                         | NUCLEONIC CORP OF AMERICA                  | 39-42                  | STANOARD ELECTRIC PRODUCTS                    | 29                  |
| HOUSTON INSTRUMENT CORP                        | 28                         | NUCLOIE ANALYSIS ASSOC                     | 11                     | STATHAM INSTRUMENTS INC OF PUERTO RICE        |                     |
| HOWELL INSTRUMENTS INC                         | 1-49                       | OPTIC ELECTRONIC CORP                      | 12-13-25               | HATO REY INO SUBOIV                           | 1-47                |
| HUMPHREY INC                                   | 21                         | OPTIMIZED DEVICES INC                      | 1                      | STATHAM INSTRUMENTS INC                       | 1-48                |
| H W ELECTRONICS INC                            | 25                         | OTIS ELEVATOR CO DEFENSE & INDUSTRIAL OIV  | 1-7                    | STEPHENS TRU-SONIC INC                        | 47-48               |
| HYCON MFG CO                                   | 26                         | OZONE METAL PRODUCTS CORP                  | 32-47-48-50            | STOODART AIRCRAFT RADIO CO                    | 3-35                |
| HYDROPOISE INC SUB BROOKS INST CO              | 32                         | PACE ENGINEERING CO                        | 32-42-47-48-49         | STRANO LABS INC                               | 37                  |
| MYTECH OIV OF BISSETT BERMAN CORP              | 32-48                      | PACIFIC AUTOMATION PRODUCTS                | 7                      | STUCKER & YALE INC                            | 7-17-18-28-         |
| IOEAL AEROSMITH INC OIV ROYAL INDUSTRIES       | 41                         | PACO PRECISION                             | 61-62-63-95            | SUNSHINE SCIENTIFIC INSTRUMENT                | 30-40-41            |
| IOEAL INDUSTRIES INC SYCAMORE                  | 17-25                      | PARR MFG CORP                              | 29                     | SYSTRON DONNER CORP                           | 1-47-49             |
| INDOAMER ELECTRONICS                           | 37                         | PASTORIZA ELECT INC                        | 7-12-14-17-25          | TAFFET ELECTRONICS INC                        | 2-3                 |
| INDUSTRIAL ACOUSTIC CO                         | 13-17-18-21-26             | PATTERSON MOOS RESEARCH OIV LEESONA CORP   | 71-76                  | TE CO THE                                     | 11                  |
| INDUSTRIAL TEST EQUIPMENT CO                   | 21-27                      | PERKIN ELMER CORP                          | 37-38                  | TECHNICAL DYNAMICS OIV JAMIESON INO INC       | 1-                  |
| INFRARED INDUSTRIES INC WALTHAM                | 38-50                      | PERKIN-ELMER CORP SO WILTON PL             | 29-30                  |   | 47                  |
| INSTRUMENT CORP OF FLA                         | 29-30-31                   | PESCHEL ELECTRONICS INC                    | 33                     | TECHICRAFT OIV                                | 36                  |
| INSTRUMENT DEVELOPMENT LABS INC                | 38                         | PHASSTRON INSTRUMENT & ELECTRONIC CO       | 24                     | TEKTRONIX INC BEAVERTON                       | 33-44-46            |
| INSTRUMENT LABS CORPORATION                    | 52                         | PHILCO CORP LANSDALE OIV                   | 29-43                  | TELECOMPUTING CORP ELECTR SYS & OATA INST OIV | 47                  |
| INSTRUMENTATION ASSOCIATES                     | 35                         | PHILCO CORP STERRA ELECTRONIC OIV          | 47-51                  | TELECTROSONIC CORP                            | 92                  |
| INTERCONTINENTAL INSTRUMENTS INC               | 47                         | PHILIPS ELECTRONIC INSTRUMENTS             | 32                     | TEL-INSTRUMENT ELECTRONICS CORP               | 26                  |
| INTERFERENCE MEASUREMENT LAB INC               | 21                         | PHOTOCON RESEARCH PRODUCTS                 | 28-34                  | TELONIC INDUSTRIES INC                        | 3-51                |
| INTERNATIONAL ELECT MAGNETICS INC              | 25-26                      | PHOTON INSTRUMENT CO                       | 32-33-42-47            | TEN BOSCH INC M                               | 1                   |
| INTERNATIONAL RESEARCH & DEVELOPMENT CORP      | 9-10-37-38-39              | PHYSICAL SCIENCES CORP                     | 40-41                  | TERAOYNE INC                                  | 12                  |
|  | 36                         | PIASECKI AIRCRAFT CORP MAYFIELD ELECT OIV  | 21                     | TESTING MACHINES INC                          | 28                  |
| INTERSTATE ELECTRONICS CORP                    | 27                         | PICKARO & BURNS INC SUB GORHAM CORP        | 26                     | THERMONETICS INC                              | 50                  |
| I-T-E CIRCUIT BREAKER CO                       | 27                         | PIONEER MAGNETICS INC                      | 86                     | THETA INSTRUMENT CORP                         | 14-21-25-47         |
| ITT FEDERAL LABS FT WAYNE                      | 27                         | PITOMETER LOG CORP                         | 35                     | THWING ALBERT INSTRUMENT CO                   | 42                  |
| JARRELL ASH CO                                 | 9-10-37-38-39              | POLARAD ELECTRONICS CORP                   | 27                     | TRACERLAB INC WALTHAM                         | 33-64-67            |
| JARVIS ELECTRONICS CORP                        | 27-29-30-47                | POLYTRONICS CO                             | 15                     | TRANSOATA INC                                 | 29                  |
| JERROLO ELECTRONICS CORP                       | 3-14-25-51                 | POOLE INSTRUMENTS INC                      | 47                     | TRANSLINE ELECT COMMUNICATIONS CO             | 72                  |
| JONES ELECTRONIC CO INC M C                    | 51                         | POTTER PACIFIC CORP                        | 3-4-5-36-51            | TRICONIX INC                                  | 35-37               |
| JULIE RESEARCH LABS                            | 27                         | POTTER AERONAUTICAL CORP                   | 47                     | TRIMOUNT INSTRUMENT OIV GENERAL CONTROLS CO   | 33                  |
| -V-V-M OIVISION FIOELITONE MICROWAVE INC       | 3                          | PRO ELECTRONICS INC                        | 61-62-63-75-78-95-98   | TRIO LABS INC                                 | 25                  |
| KAY ELECTRIC CO                                | 2-3                        | PRECISION APPARATUS CO                     | 61-62-63-75-78-95-98   | TRIPLETT ELECTRICAL INST BLUFFTON             | 28                  |
| KAYE & CO INC JOSEPH                           | 42                         | PRECISION CORPORATION                      | 0                      | TWINCO INC                                    | 7                   |
| KEPCO INC                                      | 25                         |  |                        | U S RECORDING CO                              | 2                   |
| KEUFFEL & ESSER CO                             | 1-11                       |  |                        |   |                     |
| KEYSTONE ELECTRONICS CORP N Y                  | 33                         |  |                        |   |                     |
| KIODE & CO WALTER                              | 26                         |  |                        |   |                     |
| KISTLER INSTRUMENT CORP                        | 1-32-47-48-49              |  |                        |   |                     |
| KNOPP INC                                      | 21-25                      |  |                        |   |                     |
| KOLLSMAN INST CORP STO KOLLSMAN INO INC        | 11-32-47-48                |  |                        |   |                     |

|   |                     |
|---|---------------------|
| U S SCIENCE CORP                          | 1-33                |
| ULMER CO THE DIV MICROTRON INDUSTRIES INC | 42                  |
| UNHOLTZ DICKIE CORP                       | 7                   |
| UNION SWITCH & SIGNAL DIV                 | 9                   |
| UNITED AERO PRODUCTS CORP                 |                     |
| DIV AERO CHATILLON CORP                   | 1-32-47-48          |
| UNITED ELECTRIC CONTROLS CO               | 32                  |
| UNITED MINERAL & CHEMICAL CORP            | 53-62               |
| UNITED SENSOR & CONTROL CORP              | 33-42               |
| UNIVERSAL MFG CO INC                      | 18                  |
| VACUUM ELECTRONICS CORP                   | 37                  |
| VERCO INC                                 | 12-25-26            |
| VIBRATION ENGINEERING PLANT               | 47                  |
| VINSON ENGG & SALES CORP                  | 37-47-48            |
| VINSON MFG INC                            | 37-47-48            |
| VITRO LABORATORIES                        | 26                  |
| VOLTRON PRODUCTS                          | 7-25-26-27-47-49-50 |
| WADDELL DYNAMICS INC                      | 32                  |
| WALLIN OPTICAL SYSTEMS INC                | 11                  |
| WALTHAM ELECTRONICS CORP                  | 3                   |
| WATERMAN PRODUCTS CO                      | 3                   |
| WAVELABS INC                              | 47                  |
| WAVELINE INC                              | 3-5-33-36-51        |
| WEINSCHEL ENGG                            | 3-4-5               |
| WELTRONIC CO                              | 26                  |
| WEST COAST RESEARCH CORP                  | 33-47-48-49-50      |
| WESTERN ELECTRODYNAMICS                   | 0                   |
| WESTERNS INC                              | 7-27                |
| WHITTAKER CONTROLS & GUIDANCE             | 1                   |
| WIANTCO ENG CO                            | 1-32-47-48-49       |
| WILK INSTRUMENTS DIV QUALITY ELEC CO      | 7                   |
| WILTRON CO                                | 21-36-51            |
| WINDSOR ELECTRONICS INC                   | 42                  |
| WINTRONICS INC                            | 21-33               |
| YORK RESEARCH CORP KIP ELECTRONICS DIV    | 5-                  |
| ZOOMAR INC                                | 40-41               |
|   | 11                  |

STANDARDS 3800

|                          |    |
|--------------------------|----|
| Calibrators, crystal     | 1  |
| Oscillators, reference   | 2  |
| Oscillators, tuning fork | 3  |
| Standards, capacitance   | 4  |
| Standards, frequency     | 5  |
| Standards, inductance    | 6  |
| Standards, phase         | 7  |
| Standards, Q             | 8  |
| Standards, resistance    | 9  |
| Standards, temperature   | 10 |
| Standards, time          | 11 |
| Standards, voltage       | 12 |

|   |                   |
|---|-------------------|
| ACCURATE INSTRUMENT CO                  | 5                 |
| ACCUTRONICS INC                         | 3-5               |
| ADVANCED MEASUREMENT INST INC           | 2                 |
| AD-YU ELECTRONICS LAB INC               | 7-11              |
| AEROSPACE RESEARCH INC                  | 3-5-11-12         |
| AEROVOX CORP                            | 4-6-9             |
| AIRTEC INC                              | 12                |
| AIRTRONICS INTL CORP                    | 12                |
| ALLEGANY INSTRUMENT CO                  | 11                |
| AMERICAN ASTRO-SYSTEMS                  | 1-2-3-4-5-6-7-8-9 |
| AMERICAN ELECTRIC CABLE CO              | 10-11-12          |
| AMERICAN TIME PROO INC                  | 5-11              |
| ANGSTROM PRECISION INC                  | 9                 |
| ARCO ELECT INC                          | 4                 |
| ASTRO SYSTEMS INC                       | 6-7-12            |
| ATELIERS DE MONTAGES ELECT              | 2-5               |
| BALCO RESEARCH LABS CAPACITOR DIV       | 12                |
| BALLANTINE LABS INC                     | 4                 |
| BASSETT INC REX                         | 5                 |
| BECKMAN INST INC BERKELEY DIV           | 3-9               |
| BIDDLE CO JAMES G                       | 12                |
| BILL JACK INDUSTRIES                    | 9-12              |
| BINARY ELECTRONICS INC                  | 6                 |
| BOONTON ELECTRONICS CORP                | 8                 |
| BOONTON RADIO CORP                      | 5-                |
| BORG EQUIP DIV AMPHENOL BORG ELECT CORP | 11                |
| BREW & CO RICHARD O                     | 11                |
| BROWN ENG CO INC                        | 1                 |
| BUELMAN ELECTRONICS CORP                | 5                 |
| BULOVA WATCH CO ELECT DIV               | 2-5-11-12         |
| CENTURY ELECT INST INC TULSA            | 12                |
| COMU ELECTRONICS INC KIN TEL DIV        | 12                |
| COLLINS CORP G L                        | 12                |
| CONN LTO C G                            | 5                 |
| CONSOLIDATED AIRBORNE SYSTEMS INC       | 9                 |
| CONSOLIDATED CONTROLS CORP              | 12                |
| CROUYGENICS INC                         | 10                |
| OALLONS LABS                            | 12                |
| OATA CONTROL SYSTEMS INC                | 2                 |
| DELTA F INC                             | 2-3-5-11-12       |
| DEMORNAY BONAROI CORP                   | 5                 |
| DEVELCO INC                             | 2-5               |
| DOORSETT ELECTRONICS                    | 2                 |
| ORAKE CO R L                            | 1                 |
| OYMEC DIV OF HEWLETT PACKARD CO         | 5                 |
| OYTRONICS CO                            | 2-7               |
| ELECTRON ARC DIV IONICS INC             | 5                 |
| ELECTRONIC CONTROLS SYSTEMS INC         | 12                |
| ELECTRONIC COUNTERS INC                 | 5                 |
| ELECTRONIC DEVELOPMENT CORP             | 12                |

|   |              |
|---|--------------|
| ENGELHARD INDUSTRIES                        |              |
| INDUST EQUIPT DIV                           | 7-10-12      |
| ENGINEERING ASSOCIATES                      | 5-12         |
| EPPLEY LAB INC                              | 12           |
| EPSCO INC CAMBRIDGE                         | 12           |
| FENWAL ELECTRONIC INC                       | 10           |
| FERRIS INSTRUMENT CORP                      | 1            |
| FORK STANDARDS INC                          | 3-5-11       |
| FRONTIER ELECT CO                           | 2-5-11       |
| GB COMPONENTS INC                           | 9            |
| GENERAL COMMUNICATION CO                    | 5            |
| GENERAL MICROWAVE CORP                      | 1            |
| GENERAL RADIO CO                            | 2-4-5-6-9-11 |
| GENERAL TECHNOLOGY CORP                     | 5-11         |
| GEOTECHNICAL CORP                           | 5-11         |
| GERTSCH PRODUCTS INC                        | 5-7          |
| GIBBS MFG RESEARCH CORP                     | 2-5-11       |
| GILFORD INSTRUMENT LABS INC                 | 0            |
| GRAY INSTRUMENT CO                          | 9            |
| GREEN INSTRUMENTS INC H J                   | 10           |
| GYREX CORP                                  | 5-5-11       |
| HAMILTON ELECTRONICS CORP                   | 5            |
| HAMILTON WATCH CO INDUSTRIAL PRODS DIV      | 3-5          |
| HAMMARLUND MFG CO MARS HILL                 | 5            |
| HATHAWAY INSTRUMENTS DIV LIONEL             | 5            |
| HEATH CO DIV OF DAYSTROM INC                | 1            |
| HENRY ENGINEERING CO                        | 12           |
| HEWLETT PACKARD CO                          | 1-2-5-11     |
| HOLT INSTRUMENT LABS                        | 12           |
| HYPERION INC                                | 11           |
| INDUSTRIAL TEST EQUIPMENT CO                | 3-5-7        |
| INFRARED INDUSTRIES INC WESTERN DIV         | 10           |
| INSTRU LAB INC                              | 12           |
| IONICS INC ELECTRON ARC DIV                 | 5            |
| ITEK ELECTRO - PRODUCTS                     | 5            |
| ITT FEDERAL LABS NUTLEY                     | 5            |
| JACK INDUSTRIES BILL                        | 12           |
| JACOBS INSTRUMENT CO                        | 5            |
| JARVIS ELECTRONICS CORP                     | 9            |
| KAY ELECTRIC CO                             | 2-5          |
| KAYE & CO INC JOSEPH                        | 10           |
| KEPCO INC                                   | 12           |
| LAVOIE LABS INC                             | 5            |
| LEEDS & NORTHRUP CO                         | 4-6-9-10-12  |
| LEHIGH VALLEY ELECT ENGG & MFG CO           | 1            |
| MACLEOD & HANOPOL                           | 4            |
| MAXSON INSTRUMENTS                          | 7            |
| DIV MAXSON ELECTRONICS CORP                 |              |
| MAXSON ELECTRONICS CORP ELECTRONIC DES DIV  | 7            |
| MEASUREMENT ENGG LTD                        | 1            |
| MEASUREMENTS DIV MC GRAW-EDISON CO          | 1-5          |
| MEDISTOR INST CO                            | 12           |
| MELPAR INC                                  | 5            |
| MICRO NOW INSTRUMENT CO INC                 | 1            |
| MID-EASTERN ELECTRONICS INC                 | 9-12         |
| MINNEAPOLIS-HONEYWELL RUBICON DIV           | 9            |
| MONTRONICS INC                              | 5            |
| MUIRHEAD & CO LTD                           | 3-4          |
| MUIRHEAD INSTRUMENTS INC                    | 2-3-4-5-9-12 |
| NATIONAL COMPANY INC                        | 5            |
| NEW LONDON INST CO INC                      | 1-5          |
| NORRMAN LABORATORIES ERNST                  | 5-11         |
| NORTH ATLANTIC INDUSTRY INC                 | 6-7-12       |
| NORTHEASTERN ENG INC                        | 1-2-5-11     |
| NORTH HILLS ELECTRONICS INC                 | 12           |
| PARKS LAB HENRY FRANCIS                     | 2-5          |
| PHAOSTRON INSTRUMENT & ELECTRONIC CO        | 12           |
| PHILAMON LABS INC                           | 2-3-5        |
| PIEZO CRYSTAL CO                            | 1-2          |
| POLYTRONICS CO                              | 9            |
| PRD ELECTRONICS INC                         | 5            |
| PRL ELECTRONICS INC                         | 12           |
| PROBESCOPE CO INC                           | 1            |
| PROBESCOPE CO INC SYOSSET                   | 10           |
| RADIATION ELECT CO DIV COMPOMETER CORP      | 1            |
| RADIO FREQUENCY LABS INC                    | 10           |
| ROF CORP                                    | 10           |
| REEVES HOFFMAN DIV                          | 1-2-5-11     |
| REMANCO INC                                 | 12           |
| RESISTOR NETWORKS INC                       | 9-12         |
| RIVERBANK LABS ENGG DEPT                    | 3-5-11       |
| RMS ENG INC                                 | 2-5          |
| ROBOTONICS ENTERPRISES INC                  | 11           |
| ROHDE & SCHWARZ                             | 1-4-5-11     |
| ROSEMOUNT ENG CO                            | 10           |
| ROTEK INSTRUMENT CORP                       | 21           |
| RUTHERFORD RESEARCH PROOS CO                | 6-8          |
| SANGAMO ELECTRIC CO                         | 4            |
| SAVOY ELECTRONICS INC FT LAUDERDALE         | 5            |
| SECURITY DEVICES LAB                        | 3            |
| SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO | 12           |
| SINGER METRICS DIV SINGER MFG CO            | 1-5-6-9-     |
| SINGER METRICS SENSITIVE RES DIV            | 9-10-12      |
| SOLID STATE ELECTRONICS CO                  | 2-3-5        |
| SPRAGUE ELECTRIC CO N ADAMS                 | 4            |
| STRANO LABS INC                             | 2-5          |
| SULZER LABORATORIES INC                     | 5            |
| SYSTEMS INC                                 | 1-2-5        |
| SYSTRON DONNER CORP                         | 5            |
| TEL-LABS INC                                | 9            |
| THETA INSTRUMENT CORP                       | 7            |
| TIME & FREQUENCY                            | 3-5-11-12    |
| TRANSDATA INC                               | 1            |
| TRAN SONICS                                 | 10           |
| TWINCO INC                                  | 12           |
| VALPEY CRYSTAL CORP                         | 2            |
| VOLTRON PRODUCTS                            | 12           |
| WALTHAM ELECTRONICS CORP                    | 1            |
| WESTERN INSTRUMENT CO                       | 7-12         |
| WESTREX CO DIV OF LITTON SYS INC            | 3-11         |
| WILK INSTRUMENTS DIV QUALITY ELEC CO        | 12           |
| WILTRON CO                                  | 7            |
| YOKOGAWA ELECTRIC WKS INC                   | 12           |

TESTERS 3900

|                                  |    |
|----------------------------------|----|
| Chambers, environmental test     | 25 |
| Chambers, temperature & humidity | 26 |
| Chambers, vibration              | 27 |
| Dehumidifiers                    | 28 |
| Dehydrator                       | 29 |
| Medical electronic equipment     | 32 |
| Temperature test cabinets        | 30 |
| Testers, cable                   | 1  |
| Testers, capacitor               | 2  |
| Testers, cathode ray tube        | 3  |
| Testers, circuit                 | 4  |
| Testers, coil                    | 5  |
| Testers, computer                | 6  |
| Testers, crystal                 | 7  |
| Testers, diode                   | 8  |
| Testers, distortion              | 9  |
| Testers, guided missile          | 10 |
| Testers, insulation              | 11 |
| Testers, magnetron               | 12 |
| Testers, microwave               | 13 |
| Testers, motor                   | 14 |
| Testers, radar                   | 15 |
| Testers, relay                   | 16 |
| Testers, synchro error           | 17 |
| Testers, thickness, ultrasonic   | 18 |
| Testers, transistor              | 19 |
| Testers, tube                    | 20 |
| Testers, tube automatic          | 21 |
| Testers, tube socket             | 22 |
| Testers, vibration               | 23 |
| Testers, transformers            | 24 |
| Vibration measuring equipment    | 31 |

|  |                                |
|--|--------------------------------|
| ACCURATE ELECTRONICS INC                   | 1-11                           |
| ACOUSTICA ASSOCIATES INC                   | 10                             |
| ACOUSTICA ASSOCIATES                       | 32                             |
| ADVANCE TECHNOLOGY LABS DIV AMER STANDARD  | 1                              |
| ADVANCED ELECTRONICS INC                   | 23                             |
| AD-YU ELECTRONICS LAB INC                  | 1                              |
| AEROTRONIC ASSOCIATES INC                  | 8-19                           |
| AEROVOX CORP                               | 2                              |
| AIR BORNE CONTROLS INC                     | 1-4                            |
| AIRBORNE INSTRS LAB DIV CUTLER HAMMER INC  | 4                              |
| AIRCRAFT & ELECT SPEC                      | 1                              |
| AIRPAX ELECTRONICS PACIFIC DIV             | 4                              |
| AIR-SHIELDS INC                            | 28-29                          |
| AIRTEC INC                                 | 13                             |
| AIRTRONICS INTL CORP                       | 4                              |
| ALECTRIC MFG CO                            | 20                             |
| ALERT PRODUCTS INC                         | 1                              |
| ALL AMERICAN TOOL & MFG CO                 | 23                             |
| ALLEN ELECTRIC & EQUIPMENT CO              | 0                              |
| ALLSTATE ELECTRONICS INC                   | 0                              |
| AMERICAN ASTRO-SYSTEMS                     | 1-2-3-4-5-6-7-8-9-             |
|  | 10-11-12-13-14-15-16-17-18-19- |
|  | 20-22-23                       |
| AMERICAN AVIONICS INC                      | 19                             |
| AMERICAN BOSCH CORP                        | 6                              |
| AMER CHAIN & CABLE WILSON MECH INST DIV    | 0                              |
| AMERICAN ELECTRIC CABLE CO                 | 1                              |
| AMERICAN ELECT LABS INC                    | 1-19                           |
| AMERICAN ELECT LABS MICROWAVE & PHASING    | 19                             |
| AMF INSTR DIV AMER MACH & FDRY             | 4                              |
| AMERICAN RESEARCH CORP                     | 25-26-30                       |
| AMERICAN RESEARCH & MFG CORP               | 23                             |
| AMULEX ELECTRONICS INC                     | 1-2-8-13-19-20                 |
| ANCHOR SPEC MFG CO                         | 1-2-4-11-14-17-18-20-23        |
| ANKO MFG CO                                | 19-20                          |
| APPARATUS DEVELOPMENT CO                   | 4-20                           |
| APPLIED CONTROL CORP                       | 8-19                           |
| APPLIED DEVELOPMENT CORP MONTEREY PK       | 6                              |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD       | 32                             |
| ASSOCIATED ELECTRICAL INDUSTRIES LTD       | 13                             |
| ASSOCIATED RESEARCH INC                    | 1-4-11                         |
| ATLANTIC INSTRUMENTS & ELECTRONICS INC     | 4-10                           |
| ATLANTIS ELECTRONICS CORP STRATFORD OR     | 8-19                           |
| ATLANTIS ELECTRONIC CORP BROADWAY          | 2-8-19                         |
| AUDIO ACCESSORIES                          | 1                              |
| AUDIO ELECTRONICS                          | 4                              |
| AUERBACH CORP                              | 1                              |
| AUSTIN ELECTRONICS DIV AUSTIN CO           | 15                             |
| AUTHORIZED MFRS SERVICE CO                 | 4                              |
| AUTOMATIC ELECTRIC CO                      | 16                             |
| AUTOMATION DYNAMICS CORP                   | 1                              |
| AUTO TEST INC NEILLSVILLE                  | 0                              |
| BACHE & CO SEMON                           | 32                             |
| BARKER & WILLIAMSON INC                    | 1                              |
| BARNES DEVELOPMENT CO                      | 1-2-8-11-16-19-22              |
| BARNETT INST CO                            | 2-3-4-20                       |
| BEARING INSPECTION INC                     | 23                             |
| BECKMAN INST INC BERKELEY DIV              | 6-13                           |
| BELOCK INSTRUMENT CORP                     | 1                              |
| BELZ INDUSTRIES DIV EL TRONICS INC         | 13                             |
| BIDDLE CO JAMES G                          | 1-4-11-14                      |
| BILL JACK INDUSTRIES                       | 8                              |
| B & K MFG CO                               | 3-5-7-19-21                    |
| BLACK LIGHT EASTERN CORP                   | 32                             |
| BLISS ELECTRONIC CORP                      | 1-2-4-11-16                    |
| BOOTH CO ARTHUR E                          | 16                             |
| BROOKS RESEARCH                            | 13                             |
| BRUNO NEW YORK INOUST CORP                 | 1                              |
| BUOD ELECTRONICS A DIV OF THE BUOD CO      | 6-13-                          |
|  | 15-17                          |
| BUOD STANLEY CO                            | 32                             |
| BURDICK CORP                               | 13                             |
| BURMAC ELECTRONICS CO                      | 12                             |
| CALBEST ELECTRONICS CO                     | 1                              |
| CALIDYNE CO INC SUB LING-ALTEC ELECTRONICS | 23                             |



PRODUCTS & MANUFACTURERS

|  |                             |  |                      |   |                      |
|--|-----------------------------|--|----------------------|---|----------------------|
| CALIF TECHNICAL INDUST DIV TEXTRON INC       | 1-2-18-23                   | GENERAL RADIO CO                           | 9-20-23              | OPAD ELECTRIC CO                              | 11                   |
|  | 4-5-6-7-8-10-11-13-15-16-17 | GERTSCH PRODUCTS INC                       | 17                   | OPTIMIZED DEVICES INC                         | 1-2-4-8-16-19-21     |
| CALIFORNIA COMPUTER PRODS INC ANAHEIM        | 4-6-10                      | GIRDLER PROCESS EQUIP DIV                  | 20                   | OTIS ELEVATOR CO DEFENSE & INDUSTRIAL DIV     | 1-2-4-6-8-10-15-17   |
|  | 4                           | GRAHAM RESEARCH INC                        | 2-5-8                | OWEN LABS INC                                 | 8-19                 |
| CALIFORNIA COMPUTER PROD INC                 | 4                           | GRASON-STRADLER CO INC                     | 32                   | PACIFIC AUTOMATION PRODUCTS                   | 1-4                  |
| CANADIAN AVIA ELECTS                         | 1-4-15                      | GUARDIAN ELECTRIC MFG CO                   | 1-4-6-11             | PACD ELECTRONICS CO INC                       | 2-3-4-7-8-19-20      |
| CANADIAN RESEARCH INSTITUE                   | 1-4-5-11-21                 | HALLICRAFTERS CO CHICAGO                   | 20                   | PARSONS CD RALPH M ELECTRONICS DIV            | 10                   |
| C R C ELECTRONICS CO                         | 4-20                        | HAMILTON WATCH CO INDUSTRIAL PRODS DIV     | 32                   | PEARCE SIMPSON CO                             | 4                    |
| CENTRAL COIL CORP                            | 1-4                         | HARRIS REFRIGERATION CO                    | 25                   | PEBSHEL ELECTRONICS INC                       | 1-4-11               |
| CENTRAL ELECTRONICS INC                      | 3                           | HARVEY HUBBELL INC                         | 4                    | PHAOSTRON INSTRUMENT & ELECTRONIC CO          | 4                    |
| CENTRAL SCIENTIFIC CO OF CANADA LTD          | 30                          | THE A W HAYDON CO CULVER CITY              | 1-4-11               | PHILCO CORP SIERRA ELECTRONIC DIV             | 19                   |
| CENTROL ENG CO                               | 1-4-16                      | HEATH CO SUB OF DAYSTROM INC B HARBOR      | 2-3-6-9              | PHOTO-TRONIC PRODUCTS CORP                    | 1                    |
| CENTURY COIL CORP                            | 1-11                        | HEATH CO DIV OF DAYSTROM INC ST JOS        | 8-19-20              | PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV     | 1                    |
| C E S ELECTRONIC PRODUCTS INC                | 2                           | HELLIGE INC                                | 32                   | PIONEER GEN-E-MOTOR CORP                      | 28-29                |
| CHADWICK-HELMUTH CO                          | 9-23                        | HICKOK ELECTRICAL INSTRUMENT CO            | 19-20-21             | MCGRAW EDISON CO PITTSBURGH LECTRODRYER DIV   | 28-29                |
| CHATILLON SONS JOHN                          | 14                          | HIEATT ENGG CO                             | 25                   |   |                      |
| CHRISTIAN PRECISION MFG                      | 17                          | HILL & CO E VERNON                         | 2                    | PLANETRONICS INC                              | 1                    |
| CINCINNATI SUB-ZERO PRODUCTS                 | 25-26-30                    | HOOVER ELECTRONICS CO                      | 4                    | PLUG IN INSTRUMENTS INC                       | 19                   |
| CAMPAGNIE GENERALE DE METROLOGIE             | 19-20                       | HURLETRON INC WHEATON ENG DIV              | 19                   | POLARAD ELECTRONICS CORP                      | 12-13-15             |
| COMPUTER CONTROL CO INC EASTERN DIV          | 4-8                         | HUYCK SYSTEMS CO DV OF HUYCK CORP          | 6-10-15-             | PRECISE ELECTRONICS & DEVELOPMENT CORP        | 20                   |
| COMPUTER LOGIC CORP                          | 6-16                        |  | 17                   | PRECISION SCIENTIFIC CO                       | 30                   |
| COMPUTER TEST CORP                           | 6                           | HYCON MFG CO                               | 10-13                | PROBESCOPE CO INC                             | 9-23                 |
| CONRAD INC                                   | 25                          | IDFAL INDUSTRIES INC SYCAMORE              | 4                    | PROFEXRAY INC                                 | 32                   |
| CONSOLIDATED AIRBORNE SYSTEMS INC            | 17                          | INDAMER ELECTRONICS                        | 8-19                 | QUAN TECH LAB INC                             | 2-8-9-19-23          |
| CONSOLIDATED AVIONICS CORP                   | 4-6                         | INDIKON CO                                 | 8                    | QUIK CHEK CORP                                | 20                   |
| CONSOLIDATED ELECTRODYNAMICS CORP            | 4                           | INDUSTRIAL CONTROL CO                      | 10                   | RADAR ENGINEERS                               | 1                    |
| CONTROL LOGIC INC                            | 26-                         | INDUSTRIAL INSTRUMENTS INC                 | 1                    | RADAR MEASUREMENTS CORP                       | 13-14-15             |
| CONTROLLED ATMOSPHERE ENCLOSURES MFG CO      | 28                          | INDUSTRIAL TEST EQUIPMENT CO               | 11-17                | RADIATION AT STANFORD                         | 12-13-20             |
|  |                             | INSTRON ENGG CORP                          | 16                   | RCA ELECTRN TUBE DIV INDIAHAPLS               | 20                   |
| CONTROL INDICATING CORP                      | 16                          | INSTRUMENT LABS CORPORATION                | 1-4                  | RCA DEFENSE ELECT PRODS CAMDEN                | 13                   |
| CONTRONOMAG LABS                             | 3                           | INTERNATIONAL ELECTRIC INDUSTRIES INC      | 1                    | RCA ELECTRN TUBE DIV HARRISON                 | 20                   |
| CONTRONICS IN                                | 1-4-6-8-19                  | INTERNATIONAL RADIANT CORP                 | 25-26-30             | RCA ELECTRN TUBE DIV WOODBRIDGE               | 20                   |
| COOK TECHNOLOGICAL CENTER DIV                | 19                          | INTERNATIONAL RESEARCH & DEVELOPMENT CORP  | 23                   | RCA ELECT TUBE DIV CINN                       | 20                   |
| CORBETT SCIENCE LABS F W                     | 1-2-4-8                     | I-T-E CIRCUIT BREAKER CO                   | 13                   | RCA ELECTRN TUBE DIV LANCASTER                | 20                   |
| CORDIN CO THE                                |                             | ITT FEDERAL LABS FT WAYNE                  | 1-10-13-15-16        | RADIO FREQUENCY LABS INC                      | 7                    |
| CRAFT LABS                                   | 16                          | ITT FEDERAL LABS NUTLEY                    | 15-19                | REEVES INSTRUMENT CORP                        | 7                    |
| CRANE ELECTRONICS CO                         | 16                          | JACK INDUSTRIES BILL                       | 8                    | REGENCY ELECTRONICS INC                       | 19                   |
| CRESCENT COMMUNICATIONS CORP                 | 0                           | JACKSON ELECTRICAL INSTRUMENT CO           | 1-2-20               | REMANCO INC                                   | 10-13-15             |
| CROWN TOOL & INST INC                        | 5                           | JAN HARDWARE MFG CO                        | 23                   | REMINGTON RAND UNIVAC ST PAUL                 | 6-8-19               |
| CUNNINGHAM SON & CO INC JAMES HONEYE FALLS   | 1                           | JANCO CORP                                 | 11                   | RESEARCH INDUSTRIAL LAB OF ELECTRONICS        | 3-4-20               |
|  |                             | JARVIS ELECTRONICS CORP                    | 19                   |   |                      |
|  |                             | JETRONIC INDUSTRIES                        | 4                    | RFS ENGINEERING CO                            | 6                    |
| CURTISS WRIGHT CORP                          | 1-4-8                       | KAMAN AIRCRAFT CORP                        | 4                    | RIL ELECTRONICS CORP                          | 3                    |
| CUSTOM SCIENTIFIC INSTRUMENTS INC            | 11-19                       | KARTRON                                    | 5                    | ROBERTSON ELEC CO INC                         | 16                   |
| CYBETRONICS INC                              | 6                           | KAY ELECTRIC CO                            | 4-13-15-19-23        | ROBERTSON INSTRUMENT CO                       | 1                    |
| DALLONS LABS                                 | 8-11                        | KEARFOOT CO INC PASADENA                   | 30                   | ROBINAIR MANUF CORP                           | 2-4-14               |
| DALLONS SEMICONDUCTORS DIV DALLONS LABS INC  |                             | KELL STROM TOOL CO INC ELECT DIV           | 1-4                  | RODALE ELECTRONICS INC                        | 1-4-10               |
|  |                             | KENSICO                                    | 1-11                 | RODALE MFG CO                                 | 4                    |
| DATASCAN INC                                 | 1-3-8-19-20-21              | KENRUCO TUBE CO DIV                        | 20                   | ROHDE & SCHWARZ                               | 9                    |
| DAYMARC CORP                                 | 8                           | KNOPP INC                                  | 4-11-16              | ROTOTEST LABS INC                             | 23                   |
| DAYSTROM INCORPORATED WESTON INSTRUMENTS DIV | 4-11-20                     | KOLLSMAN INST CORP STD KOLLSMAN IND INC    | 1-                   | ROWAN CONTROLLER CO RED BANK                  | 11-19                |
|  |                             | KOLLSMAN INSTRUMENT CORP                   | 4-6-8-10-14-16-17-19 | RUE PRODUCTS                                  | 4                    |
| DELSER CORP                                  | 11                          | SUB STANDARD KOLLSMAN IND                  | 1-4-6-8-10-14-       | RUTHERFORD RESEARCH PRODS CO                  | 11                   |
| DELTRON INC PHILA                            | 19                          |  | 16-17-19             | SANBORN CO                                    | 32                   |
| DERO ELECTRONICS                             | 3                           | KORFUND CO INC                             | 23                   | SCHAFFER AIR INDUSTRIES                       | 4-10                 |
| DESIGN TOOL CO                               | 1-2                         | LAB CORP                                   | 23                   | SCHMELING ELECTRONICS DIV RARITAN INDS CORP   | 16                   |
| DEVELOPMENT ENGG CO                          | 25                          | LABLINE INC                                | 16                   | SCHOENE ELECTRONICS LABORATORY                | 20-21                |
| DI-AN CONTROLS INC                           | 6                           | LABORATORY FOR ELECTRONICS INC             | 13-15                | SCIENTIFIC ELECTRIC INC                       | 11                   |
| DICE CO J W                                  | 18                          | LAVOIE LABS INC                            | 1-2-4-5-8-10-16      | SECO ELECTRONICS INC                          | 3-4-19-20-21         |
| DIELECTRIC PRODUCTS ENGG CDRAVYMOND          | 29                          | LEBOW ASSOCIATES                           | 14                   | SECO ELECTRONICS INC                          | 7-8-19-20            |
| DIGITAL DESIGN CORP                          | 6-19                        | LEEDAL INC                                 | 32                   | SERVICE INSTRUMENTS WESTGATE DR               | 2-3-4-8-19-20        |
| DIGITAL ELECTRONICS INC                      | 19                          | LEEDS & NORTHRUP CO                        | 11                   | SERVICE INSTRUMENT CORP OFFICIAL RD           | 4-8-19-20            |
| DISC INSTRUMENTS INC                         | 8                           | LIBRASCOPE DIV GENERAL PRECISION INC       | 2-6-8-               | SERVO CORP OF AMERICA                         | 6-10                 |
| DIT-MCO INC ELECTRONICS DIV                  | 1-4-10-11-16                |  | 19                   | SERVOMECHANISMS INC EL SEGUNDO                | 6                    |
| DI-TRAN CORPORATION                          | 1-2-4-8-11-16-19            | LING-ELECTRONICS DIV LING-TEMCO VOUGHT     | 23                   | SHELL ELECTRONIC MFG CORP                     | 20                   |
| DOUGLAS MICROWAVE CO                         | 13-15                       | LINK DIV GENERAL PRECISION INC             | 1-4-6-15             | SIERRA ELECTRONIC DIV PHILCO CORP             | 19                   |
| DUMONT LABS INC ALLEN B                      | 13-15                       | LUCKENBACH & CO PAUL                       | 32                   | SIMPSON ELECTRIC CO DIV AMER GAGE & MACH CO   | 1-2-3-4-5-8-14-19-20 |
| DYMEC DIV OF HEWLETT PACKARD CO              | 8-19                        | LUMATRON ELECTRONICS INC                   | 19                   | SINGER METRICS DIV SINGER MFG CO              | 1-4                  |
| DYNATRON LAB                                 | 8-19                        | MAGNAFLUX CORP                             | 18                   | SITTLER CORP                                  | 4-16                 |
| DYTRONICS CO                                 | 16-23                       | MAGNAVOX CO LOS ANG                        | 4-6                  | SLAUGHTER CO                                  | 1-4-5-11-16          |
| EAGLE ELECTRIC MFG CO                        | 4                           | MAGNETIC RESEARCH CORP                     | 19                   | SMITH-FLORENCE INC                            | 1                    |
| EASTERN SPECIALTY CO                         | 4-11-16                     | MANSON LABORATORIES INC                    | 12-20-21             | THE SOLARTRON ELECTRONIC GROUP LTD            | 19                   |
| ECLIPSE-PIONEER DIV BENDIX CORP              | 17                          | MATTERN CORPORATION                        | 1-19                 | SONEX INC                                     | 19                   |
| E H RESEARCH LAB INC                         | 8-19                        | MAXSON ELECTRONICS CORP ELECTRONIC DES DIV | 9-10-13-14           | SOERSENEN INDUSTRIAL ELECTRONIC CO            | 1-4-5-7-             |
| EISLER TRANSFORMER CO INC                    | 1-11-14                     |  |                      |   | 11-16-19             |
| ELECTRAMATIC INC                             | 2-4-8-19-20-21-22-23        | MB ELECT VIBRATION ENGG PLANT              | 23                   | SOUTHWESTERN INDUSTRIAL ELECT CO              | 31                   |
| ELECTRO IMPULSE LAB INC                      | 13                          | MCDONNELL AIRCRAFT CORP                    | 10                   | SPEC TOOL CO                                  | 23                   |
| ELECTROMATIC EQUIP CO                        | 5                           | MEASUREMENT ENGG LTD                       | 8                    | SPECTRAL DYNAMICS CORP OF SAN DIEGO           | 9-23                 |
| ELECTRONEX INDUSTRIAL LABORATORIES           | 3                           | MEASUREMENTS DIV MC GRAW-EDISON CO         | 7-8-19               | SPERRY MICROWAVE ELECT INC                    | 12-13-15             |
| ELECTROSPACE CORP                            | 11                          | MELPAR INC                                 | 32                   | SPERRY UTAH CO DV SPERRY RAND CORP            | 6-10                 |
| ELECTRONIC ASSEMBLY CO INC                   | 0                           | MERIDIAN METALCRAFT INC                    | 13                   | SPRAGUE ELECTRIC CO N ADAMS                   | 2                    |
| ELECTRONIC BRAZING CO                        | 11                          | MESUR MATIC ELECTRONICS CORP               | 24                   | STEPHENS TRU-SONIC INC                        | 23                   |
| ELECTRONIC COUNTERS INC                      | 6-16                        | METER MAKERS INC                           | 14                   | STRAND LABS INC                               | 13                   |
| ELECTRONIC INSTRUMENT CO INC                 | 3-19-20                     | METERS INC                                 | 11                   | STRATOCON CORP                                | 4                    |
| ELECTRONIC MEASUREMENTS CORP N Y             | 2-19-20                     | MICRO INSTRUMENT CO                        | 2-8-19               | SUMMERS & MILLS INC                           | 19                   |
| ELECTRONIC MEMORIES INC                      | 6                           | MICRO METRICS INC                          | 1-6-10-17            | SUN ELECTRIC CORP                             | 1-2-3-4-5-11-14      |
| ELECTRONIC RESEARCH ASSOCIATES INC           | 19                          | MICRONETICS INC                            | 13                   | SUNSHINE SCIENTIFIC INSTRUMENT                | 1-5-11               |
| ELLIS ASSOCIATES                             |                             | MID-EASTERN ELECTRONICS INC                | 11                   | SUPREME ELECTRONICS CORP                      | 20                   |
| ELSCO SYSTEMS INC                            | 20-21                       | MILLITEST CORP                             | 6-17                 | SURFACE COMBUSTION CORP                       | 28                   |
| EMERSON ELECTRIC ST LOUIS                    | 4-6-10-15                   | MILWAUKEE ELECTRONICS CORP                 | 11                   | SYLVANIA ELECTRIC PRODS INC                   | 8-19                 |
| ENDEVCO CORP                                 | 23                          | MINNEAPOLIS-HONEYWELL BOSTON DIV           | 10                   | SYLVANIA ELECTRIC PROD INC PARTS DIV          | 22                   |
| ENSCO INC                                    | 19                          | MINNEAPOLIS-HONEYWELL ORDANCE DIV          | 2-4-8-15-            | SYSTEMS DEVELOPMENT INC                       | 1                    |
| ENVIRONMENTAL EQUIPMENT CO                   | 25                          |  | 5-17                 | SYSTEMS INC                                   | 7                    |
| EPA DYNAMICS                                 | 19                          | MINNEAPOLIS-HONEYWELL RUBICON DIV          | 25                   | TAKK CORP                                     | 11                   |
| EPCONA CORP                                  | 32                          | MISSISSIPPI RESEARCH LABORATORIES INC      | 15                   | TAPCO GROUP THOMPSON RAMO WOODRIDGE INC       | 32                   |
| EPDCO ENGG CORP                              | 1                           | MISSOURI RESEARCH LABORATORIES INC         | 32                   | TECHNICAL PRODUCTS CO INSTRUMENT DIV          | 23                   |
| EFWOOD INC                                   | 23                          | MONAGHAM CO J J                            | 9-19                 | TECHNI RITE ELECTRONICS INC                   | 19                   |
| FARRALL INSTRUMENT CO                        | 32                          | MONITOR SYSTEMS INC                        | 17                   | TELECOMPUTING CORP ELECTR SYS & DATA INST DIV | 10                   |
| FISCHER & CO R A                             | 32                          | MUIRHEAD & CO LTD                          | 1-17-23              | TELETRON INDUSTRIES CORP                      | 6                    |
| FISHER SCIENTIFIC CO INSTRUMENT DIV          | 32                          | MUIRHEAD INSTRUMENTS INC                   | 19                   | TELEMETRICS INC                               | 4                    |
| FLEETWOOD LABS INC                           | 16                          | MULLARD EQUIPMENT LTD                      | 19                   | TELETST INSTRUMENT CORP                       | 2-3-5-20-21          |
| FORDHAM MFG CO                               | 4                           | MULTI AMP ELECT CORP                       | 1-11-16              | TELETRON ENGG CO                              | 20                   |
| FORWAY INDUSTRIES INC                        | 20                          | NARDA MICROWAVE CORP                       | 6                    | TELEVISION SPECIALTY CO DIV F M E             | 0                    |
| FREED TRANSFORMER CO                         | 11                          | NAVIGATION COMPUTER CORP                   | 6                    | TEL-INSTRUMENT ELECTRONICS CORP               | 23                   |
| FREQUENCY ENGG LABS                          | 13                          | NETWORK INDUSTRIES INC                     | 1                    | TEMPERATURE ENGG CORP                         | 25-26-28-30          |
| GAVIN INSTRUMENTS INC                        | 17                          | NEW LONDON INST CO INC                     | 20                   | TERADYNE INC                                  | 2-8-19               |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 2-4-8-19-20-21-22-23        | NICHOLS PRODUCTS CO                        | 15                   | TEST EQUIPMENT CORP                           | 2-8-19               |
|  |                             | NORTH ATLANTIC INDUST INC                  | 17                   | TESTING MACHINES INC                          | 1-11-23              |
| GENERAL COMMUNICATION CO                     | 15                          | NORTHEAST ELECT CORP                       | 1                    | TEXAS INSTRUMENTS INC APPARATUS DIV           | 2-8-19               |
| GENERAL DYNAMICS ELECT INFDRM TECH DIV       | 3-                          | NORTH ELECTRIC CO                          | 1-4-11-16-19         | THETA INSTRUMENT CORP                         | 9-17                 |
|  | 5-6                         | NORTH HILLS ELECTRONICS INC                | 8-16                 | TOWACO ELECTRONICS                            | 9                    |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER       | 1-                          | NORTHROP CORP                              | 4-6-10-15            |   |                      |
|  | 10-14-15                    | NUCLEONIC CORP OF AMERICA                  | 32                   |   |                      |
| GENERAL ELECTRIC DIST TRANSFORMER DEPT       | 1-                          | NUTRON DIV WESTMORE INC                    | 20                   |   |                      |
|  | 11-20                       | OMEGA LABS INC                             | 13                   |   |                      |
| GENERAL ELECT CO SPECIALTY DEVICES OPER      | 4                           |  |                      |   |                      |
| GENERAL MICROWAVE CORP                       | 13-15                       |  |                      |   |                      |



# Test Equipment—Testers • Tools, Hand • Transformers

|  |                 |
|--|-----------------|
| TRACERLAB INC WALTHAM                      | 32              |
| TRANE CO                                   | 28              |
| TRANS ELECTRONICS DIV BURTON MFG CO        | 8               |
| TRANSICOIL CORP                            | 17              |
| TRANSISTOR AUTOMATION CORP                 | 8               |
| TRANSISTOR ELECTRONICS CO                  | 8-19            |
| TRIPLETT ELECTRICAL INST BLUFFTON          | 3-19-20         |
| TURBO MACHINE CO                           | 13              |
| TV UTILITIES CORP DIV NORO PHOTOCOPY CO    | 0               |
| U S DYNAMICS CORP                          | 25-26-28-29     |
| U S ELECTRONICS CORP ALEXANDRIA            | 12              |
| U S PLYWOOD CORP                           | 25-26           |
| ULTRAUDIO DIV OBERLINE INC                 | 4               |
| UNHOLTZ DICKIE CORP                        | 30              |
| UNITED AIRCRAFT PRODUCTS INC N Y           | 23              |
| UNITED CONTROL CORP OVERLAKE INDUSTRIAL PK | 30              |
| UNITED PROCESS MACHINERY CO                | 25              |
| UNIVERSAL INSTRUMENTS CORP                 | 0               |
| VALOR ELECTRONICS CORP                     | 2-8-19          |
| VARO INC                                   | 19              |
| VIBRATION ENGINEERING PLANT                | 4-23            |
| VICTOREEN INSTRUMENT CO TULLAMORE DIV      | 23              |
| VIRGINIA ELECTRONICS CO                    | 32              |
| VOLTRON PRODUCTS                           | 1               |
| VORON ELECTRONICS CORP                     | 6               |
| WABASH MAGNETICS INC                       | 0               |
| WALLSON ASSOC INC                          | 5               |
| WALTHAM ELECTRONICS CORP                   | 2-8-19-20       |
| WATSCO INC                                 | 2-8             |
| WAVELABS INC                               | 23              |
| WAVELINE INC                               | 13              |
| WELTRONIC CO                               | 4-20            |
| WESTERN ELECTRODYNAMICS                    | 0               |
| WESTINGHOUSE ELEC CORP ELEC TUBE DIV       | 12-13-          |
|  | 20              |
| WESTMORE INC                               | 19-20           |
| WHITEHALL ELECTRONICS CORP                 | 0-32            |
| WILEY ELECTRONIC PROD CO                   | 1-11            |
| WILTRON CO                                 | 19              |
| WINDSOR ELECTRONICS INC                    | 3               |
| WINSLOW PRODUCT ENGG CORP                  | 0               |
| WRIGHT EQUIPMENT CORP                      | 3-8-12-14-19-21 |
| WYLE MANUFACTURING DIV OF WYLE LABS        | 23-25-          |
|  | 26-30           |
| ZACHARIAS ELECTRONICS CORP                 | 1               |

## TOOLS, HAND 6400

|                            |    |
|----------------------------|----|
| Alignment tools            | 1  |
| Cutters, hole              | 2  |
| Cutters, metal             | 3  |
| Cutters, wire              | 4  |
| Drills, electric           | 5  |
| Drills, hand               | 6  |
| Drills, twist              | 7  |
| Etchers, electric          | 8  |
| Files                      | 9  |
| Hammers                    | 10 |
| Holders, chassis           | 11 |
| Knob pullers               | 12 |
| Lenses, inspection         | 13 |
| Marking stamps             | 14 |
| Micrometers                | 15 |
| Mirrors, inspection        | 16 |
| Pliers                     | 17 |
| Punches                    | 18 |
| Ratchet wrenches           | 19 |
| Rivet tools                | 20 |
| Saws                       | 21 |
| Scales & tapes             | 22 |
| Scissors                   | 23 |
| Screwdrivers               | 24 |
| Shears, squaring           | 25 |
| Snips                      | 26 |
| Solder pots                | 27 |
| Soldering guns             | 28 |
| Soldering iron stands      | 29 |
| Soldering irons            | 30 |
| Splicing tools             | 31 |
| Staplers                   | 32 |
| Terminal lug swagiers      | 33 |
| Tube pin straighteners     | 34 |
| Tube pullers               | 35 |
| Tweezers                   | 36 |
| Vises                      | 37 |
| Wire strippers, mechanical | 38 |
| Wrenches                   | 39 |

ACROMARK CO 14  
ACRO TOOL & DIE WORKS 11-14

|  |                                |
|--|--------------------------------|
| AIR O TRONICS ENG CO                         | 29                             |
| ALDEN PRODUCTS CO                            | 33                             |
| ALDEN SYSTEMS CO                             | 27                             |
| ALVA ALLEN INDUSTRIES                        | 37                             |
| AMATON ELECTRONIC HARDWARE CO INC            | 1-33-37                        |
| AMERICAN CYSTOSCOPE MAKERS INC               | 13                             |
| AMERICAN ELECTRIC CABLE CO                   | 4                              |
| AMERICAN ELECTRICAL HEATER CO                | 29-30                          |
| AMERICAN FELDUMHELE CORP                     | 3                              |
| AMERICAN OPTICAL                             | 13                             |
| AMP INCORPORATED HARRISBURG                  | 33                             |
| ANNIS CO R B                                 | 8                              |
| APCO MOSSBERG CO                             | 39                             |
| AUDIOTEX MFG CO/DIV G C TEXTRON INC          | 24-30-                         |
|  | 36-38                          |
| BALCRANK INC MACHINE TOOL DIV                | 12                             |
| BAUSCH & LOMB INCORP                         | 13                             |
| BLACK & DECKER MFG CO                        | 2-5-6-7-10-21-24-25            |
| BLACK & WEBSTER INC                          | 4-10-18-33                     |
| BLOWERS INC                                  | 16                             |
| BOW SOLDER PRODUCTS CO                       | 28-30                          |
| BROWN & SHARPE MFG CO                        | 3-15-18                        |
| BUCHANAN ELECTRICAL PROD CORP                | 31-33                          |
| BUHL OPTICAL CO                              | 13-16                          |
| BY-BUK CO                                    | 1                              |
| CAIG LABS INC                                | 27-30                          |
| CARPENTER MFG CO INC                         | 38                             |
| CHAMPION DEARMOUNT TOOL CO                   | 4-10-17                        |
| CHASE MTL SERV DIV CHASE BRASS & COPPER CO   | 30                             |
| CIRCON COMPONENTS CORP                       | 20-22                          |
| CITY MARKING DEVICES CORP                    | 14                             |
| CLAUSSE CUTLERY CO                           | 4-36                           |
| COLUMBIAN ROPE CO                            | 22                             |
| CUMMINS PORTABLE TOOLS DIV JOHN OSTER MFG CO | 5-28                           |
| DEE ELECTRIC CO                              | 27                             |
| DESMOND STEPHAN MFG CO                       | 37                             |
| DIAMOND TOOL & HORSESHOE CO                  | 17-26-39                       |
| DIHLE MFG CO                                 | 5-6                            |
| DITTMORE FREEMUTH CORP                       | 27-31                          |
| THE DOALL CO                                 | 3-7-9-15-21                    |
| DORMEYER CORP                                | 5-21                           |
| DURAMIC PRODUCTS INC                         | 1-14                           |
| DYMO CORP                                    | 13                             |
| EDROY PRODUCTS CO                            | 13                             |
| ELECTRAMATIC INC                             | 1-2-3-4-11-12-13-16-17-18-     |
|  | 19                             |
| ELECTRIC SOLDERING IRON CO                   | 27-28-29-30                    |
| ELECTRO PRODUCTS LABS INC                    | 15                             |
| EMMERT MFG CO                                | 37                             |
| ERASER CO                                    | 38                             |
| ERIKSON SPECIALIZED TOOL CO                  | 1-4-6-17-19-21-                |
|  | 30-38                          |
| ERWOOD INC                                   | 21                             |
| E T C INCORPORATED                           | 33                             |
| EYELET TOOL CO                               | 20                             |
| FOREDOM ELECTRIC CO INC                      | 5-24                           |
| FORSBERG MFG CO                              | 5-6-21-24                      |
| GARDNER-DENVER CO                            | 6-19-24                        |
| G C ELECTRONICS COMPANY CHEMICAL & TOOL DIV  | 1-2-4-11-12-13-16-17-18-19-24- |
|  | 34-36-38-39                    |
| GC ELECTRONICS CO DIV TEXTRON ELECTRONICS    | 1-2-3-4-11-12-13-16-17-18-19   |
| GENERAL ELECTRIC CO SHELBYVILLE              | 27-30                          |
| GENERAL SCIENTIFIC EQUIP CO                  | 16-36                          |
| GEORGE GORTON MACHINE CO                     | 2-3-8                          |
| GREM ENGG CO                                 | 23                             |
| HARRITON SHARPE CORP                         | 0                              |
| HAVIR MFG CO                                 | 3-25                           |
| HEATH CO DIV OF OAYSTROM INC                 | 30                             |
| HEXACON ELECTRIC CO                          | 27-28-29-30                    |
| HOBBS CORP JOHN W DIV STEWART-WARNER CORP    | 13                             |
| HOLUB INDUSTRIES INC                         | 38                             |
| HUGHES AIRCRAFT CO ELEC PROD DIV             | 33                             |
| HUNTER TOOLS                                 | 1-10-17-24-35-36-37-38-39      |
| IDEAL INDUSTRIES INC SYCAMORE                | 4-8-17-38                      |
| IDEAL INDUSTRIES                             | 28-30-38                       |
| INDUSTRIAL WINDING MACHINERY CORP            | 7                              |
| INSTRUMENT CASE DIV TA MFG CORP              | 17                             |
| INT EASTERN CO                               | 14                             |
| JFD ELECTRONIC CORP                          | 1                              |
| JO-LINE TOOLS INC                            | 24-39                          |
| GEORGE E KAERCHER CO                         | 20                             |
| KEMODE MFG CO                                | 30                             |
| KERN INSTRUMENTS INC                         | 1                              |
| KESTER SOLDER CO CHICAGO                     | 27-28-29-30                    |
| KEYSTONE ELECTRONICS CORP N Y                | 1-33                           |
| KINGSLEY MACHINE CO                          | 14                             |
| KLEIN & SONS MATHIAS                         | 1-17-23-24-26-31-39            |
| KRAEUTER & CO                                | 6-17-18-26                     |
| KRENGEL MFG CO                               | 10-14-32                       |
| KWIKHEAT MFG CO                              | 20-29                          |
| LENK MFG CO                                  | 28-30                          |
| LERCO ELECTRONICS INC                        | 33                             |
| LUFKIN RULE CO                               | 15-18-22                       |
| LUXO LAMP CORP PORT CHESTER                  | 13-16                          |
| LUXO LAMP CORP SAN FRAN                      | 13-16                          |
| LYN TRON INC                                 | 33                             |
| MACDONALD AND COMPANY                        | 4-29                           |
| MARQUETTE DIV CURTISS-WRIGHT CORP            | 19                             |
| MASK O MATIC INC                             | 2-18                           |
| MATTHEWS & CO JAS                            | 14                             |
| MICROELECTRON INC                            | 30                             |
| MICRONICS CORP OF AMERICA                    | 1-4-11-17                      |
| MILLITEST CORP                               | 1                              |
| MINI-TOOL TECHNICAL INDUSTRY INC             | 4-5-6-7-9-                     |
|  | 11-13-15-16-17-21-22-23-24-25- |
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| MONODY INC                                   | 8-14                           |
| MOODY MACHINE PRODUCTS CO INC                | 24-39                          |
| MORRIS CO J I                                | 3-4-7                          |
| MULTICORE SOLDERS LTO                        | 4-31                           |
| NEDMAC INC                                   | 13                             |
| NEUSES INC P K                               | 14-16                          |

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| NEWMAN CORP M M                          | 30                        |
| NEW YORK TWIST DRILL CO INC CHICAGO      | 7                         |
| N Y TWIST DRILL MFG CORP WESTBURY        | 7                         |
| NIAGARA MACH & TOOL WKS                  | 2-3-10-18-25-26           |
| NOBLE & WESTBROOK MFG CO                 | 14                        |
| NORWALK CUTTER SHARPENING CO             | 3-21                      |
| OPTIC ELECTRONIC CORP                    | 13-16                     |
| ORBIT INDUSTRIES                         | 36                        |
| OVERLOAD CONTROL CO                      | 24                        |
| PACIFIC UNIVERSAL PROD CORP              | 16                        |
| PORTER INC H K                           | 3-4-24                    |
| PRECISION METAL PRODUCTS CO              | 20                        |
| PRICE & RUTZBECK                         | 2-3-21                    |
| PROVO TOOL CO LOS ANGELES CALIF          | 10-17-18-                 |
|  | 19-24-39                  |
| ROBINAIR MANUF CORP                      | 1                         |
| ROSS METALS CO MILTON                    | 34                        |
| SIMONOS SAW & STEEL CO                   | 2-21                      |
| SKIL CORP                                | 2-3-5-9-24                |
| SLOCOMB CO J T                           | 15                        |
| SMITH INC HERMAN H                       | 34-38                     |
| SPACEONICS & PORTABLE ELECTRIC TOOLS INC | 5-                        |
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| SPEC TOOL CO                             | 1-18-39                   |
| STANDARD GLOVE CO OF N J                 | 0                         |
| STURTEVANT CO P A                        | 39                        |
| TECHNICAL DEVICES CO                     | 11                        |
| TECHNICRAFT CO                           | 2-30                      |
| TEMPRESS RESEARCH INC                    | 30                        |
| TERRY CO GEORGE A                        | 5-6                       |
| TOPAZ TRANSFORMER PRODUCTS INC           | 20                        |
| TORQUE CONTROLS INC                      | 24-39                     |
| TRENT INC                                | 27                        |
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| TRITON MFG CO                            | 28-30-38                  |
| TUBULAR RIVET & STUD CO                  | 20                        |
| TUCK MFG CO                              | 24                        |
| UNBRAKO SOCKET SCREW CO LTO              | 24                        |
| UNGAR ELECT TOOL INC                     | 30                        |
| VACO PRODUCTS CO                         | 1-10-17-24-33             |
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| VULCAN ELECTRIC CO                       | 27-29-30                  |
| WALDES KOHNHOOR INC                      | 17                        |
| WALDOM ELECTRONICS INC                   | 33                        |
| WALES STRIPPIT INC AKRON                 | 38                        |
| WALL MFG CO P                            | 28-30                     |
| WALSCO ELECTRONICS MFG CO                | 1-2-4-11-12-24-           |
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| WATSCO INC                               | 39                        |
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| WILDER MFG CO                            | 29                        |
| WILKENS INC ALWIN FR                     | 14                        |
| WILMINGTON FIBRE SPECIALTY CO            | 1-24                      |
| WYZENBEEK & STAFF INC                    | 2                         |
| X-ACTO INC                               | 37-4-6-7-9-17-18-21-24-36 |
| XCELITE INC                              | 24-39                     |

## TRANSFORMERS 7000

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|----------------------------------|----|
| Brighteners, TV tube             | 1  |
| Transformers, antenna matching   | 2  |
| Transformers, audio              | 3  |
| Transformers, autotransformer    | 4  |
| Transformers, bias               | 5  |
| Transformers, current            | 6  |
| Transformers, filament           | 7  |
| Transformers, flyback            | 8  |
| Transformers, 400 cycle          | 9  |
| Transformers, HV                 | 10 |
| Transformers, instrument         | 11 |
| Transformers, isolation          | 12 |
| Transformers, microwave          | 13 |
| Transformers, modulation         | 14 |
| Transformers, plate              | 15 |
| Transformers, power              | 16 |
| Transformers, precision matched  | 17 |
| Transformers, voltage dividing   | 18 |
| Transformers, pulse              | 19 |
| Transformers, RF-IF              | 20 |
| Transformers, toroidal           | 21 |
| Transformers, transistor         | 22 |
| Transformers, ultrasonic         | 23 |
| Transformers, variable           | 24 |
| Transformers, vibrator           | 25 |
| Transformers, voltage regulating | 26 |
| Transformer, velocity            | 27 |

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|--|-------------------------------|
| ABBOTT TRANSISTOR LABS INC             | 9-10-16-20                    |
| ABTRONICS INC                          | 11                            |
| ACOC ELECTRONICS INC                   | 2-3-4-5-6-7-9-10-11-          |
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| AC ELECTRONICS INC                     | 3-4-5-6-7-9-11-12-14-15-      |
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| ACF ELECTRONICS DIV ACF INDUSTRIES INC | 13-                           |
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ACRO PRODUCTS CO 3-7-12-15-16-19-25  
AC SPARK PLUG ELECT DIV GMC 3-6-9-11-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27  
A C TRANSFORMER CORP 4-7-10-12-15-16-24-26  
ADC PRODUCTS DIV OF MAGNETIC CONTROLS 3-4-5-7-9-10-11-12-14-15-16-17-18-19-21-22-23-25-26  
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AIRPAX ELECT INC SEMINOLE DIV 3-9  
AIRPAX ELECTRONICS INC CAMBRIDGE 3-4-7-9-11-16-19-21-24-25-26  
AIRPAX ELECTRONICS PACIFIC DIV 3-6-7-9-11-15-16-21  
AIRPAX ELECTRONICS INC PASADENA 3-4-5-6-7-9-10-11-12-14-15-16-17-18-21-22-23  
AIRPAX PRODUCTS CO 4-7-16  
ALADDIN ELECTRONICS DIV ALADDIN INDUSTRIES 19-20  
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AMERICAN ELECTRONICS CO MINN 4-12-16-26  
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AMERICAN MISSILE PROD CO INC 21  
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MFRS RICHARDSON ALLEN POWER SUPPLIES 4-6-9-12-16-18-26  
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ASSOCIATED RESEARCH INC 6-10  
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ATELERS DE MONTAGES ELECT 2-20  
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ATLAS COIL CORP 1-2-3-4-5-6-7-8-9-10-11-12-13-14-15-16-17-18-19-20-21-22-23-24-25-26-27  
ATLAS ENG CO 3-4-6-7-8-9-11-12-13-14-15-16-17-18-19-21-23-25-26-27  
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BARRY ELECTRONICS CORP NEW YORK 3-6-7-14-15-16  
BARWOOD ELECTRONICS INC 3-4-5-6-7-9-11-22  
BASHER ELECTRIC CO 3-4-6-7-9-12-14-15-16-18-21-24-26  
BECKLEY MFG CO 20  
BELLAIRE ELECTRONICS INC 20  
BELZ INDUSTRIES DIV EL TRONICS INC 13  
BERKELEY INSTRUMENT CO 19  
BERKSHIRE LABS 21  
BERKSHIRE TRANSFORMER CORP 3-4-5-6-7-9-10-11-12-13-14-15-16-17-18-22-23-25  
BETTER COIL & TRANSFORMER CORP 3-4-7-11-12-14-15-16-17-22-25  
BLACKBURN ELECTRONIC CORP 6-9-16-19-20-21  
BOGART MFG CORP 13  
BRAD THOMPSON INDUST INC 10  
BRIGHT RADIO LABS INC 20  
BROWN ENG CO INC 0  
BUDD STANLEY CO 13  
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BUNDY ELECTRONICS CORP 19-21  
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BUSH TRANSFORMER CORP 3-4-5-6-7-9-10-11-12-14-15-16-17-18-19-20-21-22-23-25-26  
CADELL-BURNS MFG CO 2-11-20  
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CALIF MAGNETIC CONTROL CORP 3-4-5-6-7-9-10-11-12-14-15-16-18-19-21-22-25-26  
CALMAG DIV CALIF MAGNETIC CONT CORP 3-4-5-6-7-9-10-11-12-14-15-16-17-18-19-21-22-23-25-26  
CAMPBELL X RAY CORP 4-6-7-9-10-12-15-16  
CANADIAN MARCONI CO 2-3-4-7-9-12-14-15-16-17-19-20-21-22-23-25  
CANADIAN RESEARCH INSTITUTE 6-11  
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CARAD CORP 7-10-12-15-18-19-21  
CAROL ELECT DIV WEECD INC 6-7-12-17-25  
CARSON MFG CO INC 0  
C B C ELECTRONICS CO 1-19-26  
CELCO CONSTANTINE ENG LABS CO 0  
CENTRAL TRANSFORMER CO 3-4-5-6-7-9-10-11-12-13-14-15-16-23-24-25-26  
CENTRAL TRANSFORMER CORP 2-4-5-6-7-9-10-11-12-14-15-16-17-18-22-23-24-26  
CENTURY COIL CORP 4-6-7-9-10-11-12-16-18-26  
CHEM ELECTRO RESEARCH INC 3-6-7-9-11-12-16-19-21-22  
CHICAGO ELECTRONIC ENGG CO 3-4-7-9-11-12-15-16-17  
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CIRCUITDYNE CORP 3-4-5-6-7-9-12-16-17-21-22-23-25  
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CDAST COIL CO 3-4-5-6-7-9-11-12-16-17-18-21  
COHU ELECTRONICS INC KIN TEL DIV 17-21  
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COIL ENG & MFG CO ROANOKE 2-4-7-12-15-25-26  
COILCRAFT INC 19-20-21-22-24  
COLIN CAMPBELL CO INC 2-3-4-5-6-7-9-10-11-12-14-15-16-17-18-19-21-22-23  
COLLINS CORP G L 18  
COLUMBIA RESEARCH LABS 24  
COLUMBUS PROCESS CO 3-4-6-7-9-10-12-13-14-15-16-18-22-25  
COMMUNICATION ACCESSORIES CO 10-11-12-14-15-17-18-19-21-22  
COMPONENTS FOR RESEARCH INC 7-10-12-21-22  
COMPUTER ENGG ASSOC AFF SUSQUEHANNA INC 11-12  
CONTINENTAL X RAY CORP 10-12-16  
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CP ELECTRONICS INC 3-4-6-7-9-10-13-14-15-16-21-22-25  
CRESCENT ENGG & RESEARCH CO 24  
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CRITTENDEN TRANSFORMER WORKS 4-6-7-9-12-15  
CROWN CONTROLS CORP 1-4-7-12  
CYCLE TRANSFORMER CORP 3-4-5-7-9-10-12-15-16-22-23-25-26  
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DEVELOPMENTAL ELECT CORP 19  
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DITTMORE FREIMUTH CORP 11  
DONGAN ELECTRIC MFG CO 0  
DORMEYER INDUSTRIES CHICAGO 7  
DORMEYER INDUSTRIES KENTLAND 4-7-12-16  
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GENERAL INSTRUMENT CORP F W SICKLES DIV 8-15-19-20-21  
GENERAL MAGNETICS INC MINN 3-4-5-6-7-9-10-11-12-14-16-17-18-19-20-21-22-26  
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GRAND TRANSFORMERS INC GRAND HAVEN 1-3-4-5-6-7-9-11-12-14-15-16-17-18-22-25-26  
GRAND TRANSFORMERS INC BENTON HARBOR 1-3-4-5-6-7-9-10-11-12-14-15-16-17-18-22-25-26  
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GUDEMAN CO OF CALIF 12-19-21  
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| GENERAL DEVICES INC                            | 32  |
| GENERAL DYNAMICS ELECT INFORM TECH DIV         | 19  |
| GENERAL DYNAMICS ELECTRONICS ROCHESTER         | 6-11-17-20-21-22-23-24-25-26-27-28-29-30  |
| GENERAL ELECTRIC COMMUNICATION PROD DEPT       | 22-23-29-30                               |
| GENERAL ELECTRONIC LABS INC                    | 13-22-28                                  |
| GENERAL ELECTRONIC LAB INC                     | 12-32                                     |
| GENERAL INSTR CORP HARRIS A S W DIV            | 27  |
| GENERAL INSTRUMENT CORP RADIO RECEPTOR DIV     | 28  |
| DEF & ENGG PRODS GRP                           | 20-21-22-24-26-28-29-30                   |
| GENERAL MAGNETICS INC BLOOMFIELD               | 4   |
| GENERAL MICROWAVE CORP                         | 5-6                                       |
| GENERAL RADIO CO                               | 8   |
| GOMBOS INC CO JOHN                             | 22  |
| GPL DIV GENERAL PRECISION INC                  | 22  |
| GRANGER ASSOC                                  | 11-20-21-22-24                            |
| GRAY GAINER ELECTRONICS                        | 10-16                                     |
| GULTON INDUSTRIES INC METUCHEN                 | 27-28                                     |
| GULTON INDUSTRIES INC CG ELECTS DIV            | 28  |
| HALLICRAFTERS PACIFIC DIV                      | 28  |
| HALLICRAFTERS CO CHICAGO                       | 16-20                                     |
| HALLMARK INST CORP                             | 10-16-20-21-26                            |
| HAMMARLUND MFG CO INC MARS HILL                | 21-26                                     |
| HARKINS RADIO INC                              | 13  |
| HEATH CO SUB OF DAYSTROM INC                   | 10-16-17-20-21-23-26-32                   |
| H HARBOR                                       | 21-23-26-32                               |
| HEATH CO DIV OF DAYSTROM INC ST JOSIO-16-23-26 | 20-21-22-23-24-25-26-28                   |
| HOFFMAN ELECTRONICS CORP INDUSTRIAL PROD DIV   | 20-21-23-28                               |
| HOGAN FAXIMILE CORP                            | 19  |
| HYCON MFG CO                                   | 17  |
| HYSON MFG CO PASADENA                          | 23-29-30                                  |
| INDUSTRIAL RADIO CORP                          | 21-23                                     |
| INTERNATIONAL RADIO ELECTRONICS CORP           | 12-13                                     |
| INTL RADIO & ELECTRON                          | 0   |
| INTERSTATE ELECTRONICS CORP                    | 28  |
| ITA ELECTRONICS CORP                           | 2-8-12-13-14-15-20-21-25-26-29-30         |
| ITT FEDERAL LABS NUTLEY                        | 3-4-5-6-7-8-11-19-20-21-22-23-24-25-26-28 |
| ITT KELLOGG COMM SYSTEMS DEPT                  | 22-23                                     |
| JERROLD ELECTRONICS CORP                       | 22  |
| KAAR ENGG CORP                                 | 1-16-20-21-23-29-30                       |
| KAHN RESEARCH LABS                             | 12-26                                     |
| KAY ELECTRIC CO                                | 15  |
| KING RADIO CORP                                | 11-20-21-30                               |
| KINNELECTRONICS CORP                           | 1-8-20-28-29-30                           |
| KLEER-TRONICS INC                              | 16  |
| LABORATORY FOR ELECTRONICS INC                 | 22  |
| LEAR INC ASTRONICS DIV                         | 0   |
| LING-TEMCO VOUGHT INC ELECT DIV                | 11-20-21-22-23-24-28                      |
| LINK DIV GENERAL PRECISION INC                 | 28  |
| LITTON INDUSTRIES MARYLAND DIV                 | 25  |
| MACKAY RADIO & TELEGRAPH CO MARINE DIV         | 26  |
| MADIGAN CORP                                   | 11-23-26-30                               |
| MADIGAN ELECTRONIC CORP                        | 26  |
| MAGNADYNE CORP                                 | 10-11-12-13-17-20-23-25-26-29-30          |
| MANSON LABORATORIES INC                        | 22-24-26-29-30-31                         |
| MASTER MOBILE MOUNTS INC                       | 10-23-26-29                               |
| MCMARTIN INDUSTRIES INC                        | 8   |
| MEASUREMENT ENGG LTD                           | 2-3-21-25-30                              |
| MELABS   | 3-6-20-22-23-28                           |
| METROTEK ELECTRONICS INC                       | 10-16-21-23                               |
| MICROMEGA CORPORATION                          | 22-28-29-30                               |
| MICRONETICS INC                                | 22-24                                     |
| MILLEN MFG CO JAMES                            | 30  |
| MINNEAPOLIS-HONEYWELL ORDNANCE DIV             | 22-27                                     |
| MINNEAPOLIS-HONEYWELL BROWN INST DIV           | 28  |
| MIRATEL INC NEW BRIGHTON                       | 0   |
| MOBIL ELECTRONICS MFG CO                       | 16  |
| MODEL ENGG & MFG INC                           | 3-11-20-21-23-27-28-29-30                 |
| MOSLER RESEARCH PROD INC                       | 23  |
| MOTOROLA COMMUNICATIONS & ELECT INC            | 22-23-29-30                               |
| MOTOROLA INC SOLID STATE SYSTEMS DIV           | 4   |
| MUIRHEAD & CO LTD                              | 19  |
| MUIRHEAD INSTRUMENTS INC                       | 19  |
| MULLARD EQUIPMENT LTD                          | 26  |
| MULTI-PRODUCTS CO                              | 1   |
| NATIONAL AERONAUTICAL CORP                     | 11  |
| NATIONAL ELECTRONICS LABS INC                  | 20-23-30                                  |
| NEICO MICROWAVE CO                             | 5-6                                       |
| NORTHEASTERN ENG INC                           | 9   |
| NORTHERN RADIO CO                              | 3-5-6-7                                   |
| NYTRONICS INC LEXINGTON                        | 2-5-6                                     |
| PACO ELECTRONICS CO INC                        | 10  |
| PALOMAR EQUIP CO                               | 22-24                                     |
| PAN FAX INC                                    | 19-28                                     |
| PARSONS CO RALPH M ELECTRONICS DIV             | 28  |
| PEER INC PROFESSIONAL ELECT ENG                | 2-12-20-21-26-29-30                       |
| P & M ELECTRONICS                              | 10-26-29-30                               |
| PHILCO CORP PHILA                              | 11-22-24-27-28-29-30                      |
| PHILCO CORP COMMUNICATIONS & WEAPONS DIV       | 11-22-24-27-28-29-30                      |
| PHILMORE MFG CO INC                            | 10  |
| PITOMETER LOG CORP                             | 32  |
| PORT D VOX CORP                                | 23  |
| PRATT ALBERT                                   | 10-16-21-22-23                            |
| PRINCETON DIV ELECTRO MECHANICAL RESCH INC     | 7-28                                      |
| PRODUCTS & INDUSTRIAL ENGRG CORP               | 23  |
| PYE CANADA LTD                                 | 11-20-21-22-23-30                         |
| QUINDAR ELECTRONICS INC                        | 3-7-28                                    |
| RACAL ELECTRONICS LTD                          | 26  |
| RADIAPHONE CO                                  | 20-23-28-29                               |
| RADIATION AT STANFORD                          | 13-14-18-22-24-29-30                      |

|  |   |
|--|---|
| RADIATION INC                                | 28  |
| RCA BRDCST & COMM PRODS DIV CAMDEN           | 1-2-5-8-12-13-14-15-16-18-20-21-22-26-29-30 |
| RCA BRDCST & COMM PRODS DIV MEADOW LANDS     | 1-2-5-8-12-13-14-15-16-18-20-21-22-26-29-30 |
| RADIO ENG LABS INC                           | 29-30                                       |
| RADIO FREQUENCY LABS INC                     | 3-6-28                                      |
| REGENCY ELECTRONICS INC                      | 16  |
| REMANCO INC                                  | 22-24                                       |
| REPUBLIC ELECT INDUST CORP                   | 26  |
| RESEARCH MFG CORP                            | 27  |
| RF COMMUNICATIONS ASSOCIATES INC             | 20-21-23-26                                 |
| RHG ELECTRONICS LAB INC                      | 29-30                                       |
| RIKER INDUSTRIES INC                         | 18-28                                       |
| ROCHESTER INSTRUMENT SYS INC                 | 17-28                                       |
| ROUGE ELECTRONICS CO                         | 20-28-30                                    |
| R S ELECTRONICS CORP                         | 28  |
| SABINE EQUIPMENT LAB HARRY T                 | 20  |
| SANDERS ASSOCIATES                           | 24  |
| SARKES TARZIAN INC                           | 31  |
| SECO ELECTRONICS INC                         | 8   |
| SEG ELECTRONICS CO INC                       | 10  |
| SIERRA ELECTRONIC DIV PHILCO CORP            | 22  |
| SIMMONDS PRECISION PRODS TARRYTOWN           | 29-30                                       |
| SIMPLEX TIME RECORDER CO                     | 17-20                                       |
| SONAR RADIO CORP                             | 10-16-26                                    |
| SORENSEN INDUSTRIAL ELECTRONIC CO            | 10-16-23-26                                 |
| SOUTHWESTERN INDUSTRIAL ELECT CO             | 32  |
| SPACE CONTROL CORP                           | 25  |
| SPERRY GYROSCOPE CO DIV SPERRY RAND CORP     | 25  |
| SPERRY MICROWAVE ELECT INC                   | 5-6   |
| SPERRY PHOENIX CO DV                         | 22-24-28                                    |
| SPERRY UTAH CO DV SPERRY RAND CORP           | 28  |
| STANDARD ELECTRONICS                         | 5-13-18-26-30                               |
| SULLIVAN LTD H W                             | 32  |
| SNYVL DEV CTR SPRY PHOENIX CO SPRY RAND CORP | 28-29-30                                    |
| SWAN ENGINEERING CO                          | 10-20-21-23-26-30                           |
| SYLVANIA ELECTRIC PRODS INC WALTHAM LABS     | 22-24                                       |
| TAPCO GROUP THOMPSON RAND WOOLDRIDGE INC     | 28  |
| TELECHROME MFG CORP                          | 10-16-18-26                                 |
| TELECOMPUTING CORP ELECTR SYS & DATA INST DV | 22  |
| TELECONTROL CORPORATION                      | 22-28-29-30                                 |
| TELEDYNE PRECISION INC                       | 32  |
| TELEMET CO                                   | 28  |
| TELERAD DIV OF THE LIONEL CORP               | 3-7   |
| TELE-SIGNAL CORP                             | 3-7   |
| TELETRONIX ENG CO                            | 13  |
| TEXAS INSTRUMENTS INC APPARATUS DIV          | 28  |
| TEXTRONIX ENG CO                             | 12  |
| THAKOL CHEMICAL CORP NATL ELECTRONICS DIV    | 20-29-30                                    |
| TOPPING ELECTRONICS LTD F V                  | 3-7   |
| TRAK MICROWAVE CORP                          | 22-28-29                                    |
| TRANSITEL INTERNATIONAL CORP                 | 28  |
| U S SCIENCE CORP                             | 29-30                                       |
| VECTOR MFG CO SO HAMPTON                     | 28  |
| VITRO LABORATORIES                           | 17  |
| WAVELINE INC                                 | 5-6   |
| WERCOR INC                                   | 16  |
| WEBSTER MFG                                  | 16  |
| WEITERMANN ELECTRONICS                       | 10-20-26-30                                 |
| WESTREX CO DIV OF LITTON SYS INC             | 3-7-19-20-26-27                             |
| WHEELER ELECTRONIC CORP SUB SPERRY RAND CORP | 11-29-30                                    |
| WILCOX ELECTRIC CO INC                       | 7-20-21-24-26-27-28-29-30                   |
| WILEY ELECTRONIC PROD CO                     | 28  |
| WILLIAMS SHIP RADIO CO                       | 23  |
| WOODLAND ELECTRONICS CO INC                  | 19  |
| YOUNG SPRING & WIRE CORP GONSET DIV          | 10-14-16-17-20-21-26-29-30                  |
| ZIMNEY CORP                                  | 28  |

|                            |    |
|----------------------------|----|
| <b>TUBES 7200</b>          |    |
| <b>GENERAL PURPOSE</b>     |    |
| Tubes, ampliton            | 1  |
| Tubes, ATR                 | 2  |
| Tubes, backward wave       | 3  |
| Tubes, ballast             | 4  |
| Tubes, cathode-ray         | 5  |
| Tubes, ceramic             | 6  |
| Tubes, color TV picture    | 7  |
| Tubes, counting            | 8  |
| Tubes, electron multiplier | 9  |
| Tubes, gamma ray           | 10 |
| Tubes, gas                 | 11 |
| Tubes, geiger counter      | 12 |
| Tubes, glow or discharge   | 13 |
| Tubes, ignitron            | 14 |
| Tubes, infrared            | 15 |
| Tubes, klystron            | 16 |

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|--|--------------------------------|
| Tubes, magnetron                             | 17                             |
| Tubes, noise                                 | 18                             |
| Tubes, photo                                 | 19                             |
| Tubes, pirani                                | 20                             |
| Tubes, power amplifier                       | 21                             |
| Tubes, projection                            | 22                             |
| Tubes, receiving                             | 23                             |
| Tubes, rectifying, industrial                | 24                             |
| Tubes, scintillation                         | 25                             |
| Tubes, sparkgap                              | 26                             |
| Tubes, special purpose                       | 27                             |
| Tubes, stroboscope                           | 28                             |
| Tubes, switching                             | 29                             |
| Tubes, thyratron                             | 30                             |
| Tubes, TR                                    | 31                             |
| Tubes, transmitting                          | 32                             |
| Tubes, traveling wave                        | 33                             |
| Tubes, TV camera image orthicons             | 34                             |
| Tubes, TV picture                            | 35                             |
| Tubes, ultra violet                          | 36                             |
| Tubes, voltage regulators                    | 37                             |
| Tubes, X-ray                                 | 38                             |
| Cathodes                                     | 39                             |
| Electron guns                                | 40                             |
| Tube shields                                 | 41                             |
| Tube sockets                                 | 42                             |
| Tubes, testing                               | 43                             |
| Tubes, indicating                            | 44                             |
| Tubes, rectifying transmitting               | 45                             |
|  |                                |
| ABTRONICS INC                                | 5-19-27                        |
| AC RAY ELECTRONICS INC                       | 35                             |
| ALLEN ELECTRONICS CORP                       | 35                             |
| ALLSTATE ELECTRONICS INC                     | 5-35                           |
| AMGLO CORP                                   | 11-13-27-28-36                 |
| AMPEREX ELECTRONIC CORP HICKSVILLE           | 5-6-8-                         |
|  | 9-10-11-12-13-14-15-16-17-19-  |
|  | 21-23-24-25-27-29-30-32-33-34- |
|  | 37-38                          |
| AMPERITE CO                                  | 4                              |
| ANTON ELECTRONICS LABS                       | 8-12-37                        |
| ANTON MACHINE WORKS                          | 0                              |
| ASSOCIATED ELEC INO LTD ELEC APPARATUS DIV   | 2-11-14-16-17-18-19-24-26-30-  |
|  | 31                             |
| ATOMIC ACCESSORIES INC                       | 12-25                          |
| AVNET CORP LOS ANG                           | 33                             |
| AVO LTD                                      | 43                             |
| BARRY ELECTRONICS CORP NEW YORK              | 1-2-3-4-5-                     |
|  | 6-7-8-9-10-11-12-13-14-15-16-  |
|  | 17-18-19-20-21-22-23-24-25-26- |
|  | 27-28-29-30-31-32-33-34-35-36- |
|  | 37-38                          |
| BENDIX CORP RED BANK DIV                     | 3-11-13-16-21-23-              |
|  | 24-26-27-30-31-33-37           |
| BOMAC LABS INC                               | 2-11-16-17-18-27-31            |
| BON DE ELECTRONIC LABS INC                   | 13                             |
| B & R TOOL & DIE CO                          | 16-27-33                       |
| H M BUGGIE DIV BURNDY CORP                   | 42                             |
| BURROUGHS CORP ELEC COMP DIV                 | 8-18-27-29                     |
| CALVERT ELECTRONICS INC                      | 1-38                           |
| CALVIDEO ELECTRONICS INC                     | 5-27-35                        |
| CANADIAN MARCONI CO                          | 2-17-23-31-33-34-35            |
| CATHODEON                                    | 34                             |
| CENTRAL ELECTRONIC MFRS                      | 6-11-12-13-18-21-              |
|  | 24-27-29-32-37                 |
| CERAMICS INTERNATIONAL CORP                  | 6                              |
| CERBERUS AG WERK ELEKTRONENTEchnik           | 6-8-11-                        |
|  | 29-30-37                       |
| CETRON ELECTRONIC CORP GENEVA                | 11-13-15-19-                   |
|  | 20-21-22-24                    |
| CHATHAM ELECTRONICS DIV-TUNG-SOL ELECTRIC IS | 4-6-11-13-18-19-21-23-24-27-   |
|  | 29-30-32-37                    |
| COMET LTD                                    | 38                             |
| CONDOR ELECTRONICS INC                       | 6-21-23-24-27-32               |
| CONNOLLY & CO WALLACE E                      | 37                             |
| CONSOLIDATED VACUUM CORP                     | 20                             |
| CONTINENTAL ELECTRONICS CORP LOS ANG         | 5-22-                          |
|  | 27-35                          |
| CONTINENTAL ELEC CORP OF CALIF               | 5-22-27-35                     |
| DALLONS LABS                                 | 5                              |
| DEMINT LABS                                  | 15-36                          |
| DIEMENS INC                                  | 13-27                          |
| DORF CO JOHN L                               | 42                             |
| DU-CO CERAMICS CO                            | 6                              |
| DUMONT LABS INC ALLEN B                      | 5-9-19-27-35                   |
| DUNLEE CORP                                  | 38                             |
| EDGERTON GERMESHAUSEN & GRIER BOSTON         | 5-6-                           |
|  | 11-19-26-28-29-30              |
| EITEL-MC CULLOUGH INC SAN CARLOS             | 6-11-13-                       |
|  | 14-16-17-20-21-24-27-29-30-32- |
|  | 33-37                          |
| EITEL-MCCULLOUGH INC SAN BRUNO               | 16                             |
| ELECTRICAL REFRACTORIES CO                   | 6                              |
| ELECTRO CERAMICS INC SALT LAKE               | 6                              |
| ELECTRONIC ENTERPRISES INC                   | 21-24-27-30-32                 |
| ELECTRONIC INDUST INC                        | 8-11-13-18-26-27-29-           |
|  | 30-37                          |
| ELECTRONIC PRODUCTS CO DIV VICTOREEN         | 11-                            |
|  | 12-13-27-37                    |
| ELECTRONIC SPECIALTIES MFG CORP              | 35                             |
| ELECTRONIC TUBE & INST DIV                   |                                |
| GENERAL ATRONICS CORP                        | 5                              |
| ELFTRONICS INC NEWARK                        | 24-30                          |
| ELECTRONICS INC                              | 24-30                          |
| ELECTRON TECHNOLOGY INC                      | 5-11-19-20-27                  |
| EMI/US NO HOLLYWOOD                          | 16-17-33                       |
| RESITRON LABS INC                            | 3-5-6-11-13-                   |
| ENGLISH ELECTRIC VALVE CO LTD                | 14-16-17-21-22-24-26-30-32-33- |
|  | 34-37                          |

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|--|--------------------------------|
| EON CORP                                     | 10-12-13-36-37                 |
| EUREKA X-RAY TUBE CORP                       | 36                             |
| FIELD EMISSION CORP                          | 27-38                          |
| FRANKLIN MFG CO                              | 17                             |
| FREELAND PRODUCTS CO                         | 32                             |
| GEF LAR MFG CO                               | 0                              |
| GENERAL ATRONICS CORP ELECT TUBE & INST      | 5-                             |
|  | 22                             |
| GENERAL DYNAMICS ELEC INFORM TECH DIV        | 5                              |
| GENERAL ELECTRIC CO POWER TUBE DEPT          | 16-21-                         |
|  | 32-33                          |
| GENERAL ELECTRIC CO RECEIVING TUBE DEPT      | 6-                             |
|  | 19-23-27-30                    |
| GENERAL ELECTRIC CO POWER TUBE DEPT          | 6-13-                          |
|  | 14-16-17-21-24-30-32-37        |
| GENERAL ELECTRIC CO CATHODE RAY TUBE DEPT    | 5-22-27-34-35                  |
| GENERAL ELECTRIC CO TELEVISION RECEIVER DEPT | 5-35                           |
| GENERAL ELECTRIC CO CLEVELAND                | 0                              |
| GENERAL ELECTRODYNAMICS CORP                 | 15-27-34-36                    |
| GENERAL ELECTRONICS INC                      | 4-5-11-21-24-27-28-            |
|  | 32-37                          |
| GENERAL VACUUM CORP                          | 5                              |
| GLADDING MCBEAM & CO LOS ANG                 | 6                              |
| GLADDING MCBEAM & CO MONROVIA                | 6                              |
| GORDOS CORP                                  | 11-13-24-36                    |
| GREENE CORP G G                              | 42                             |
| HEATH CO SUB OF DAYSTROM INC                 | 43                             |
| HUGGINS LABS INC                             | 3-33                           |
| HUGHES AIRCRAFT CO VACUUM TUBE PROD DIV      | 5-                             |
|  | 27                             |
| HUGHES AIRCRAFT CO MICROWAVE TUBE DIV        | 3-33                           |
| I H MFG CO                                   | 23-32                          |
| IND HARDWARE MFG CO INC                      | 42                             |
| INSTRUMENTS INC                              | 10-12                          |
| INTERNATIONAL ELECTRONICS CORP               | 23-27                          |
| ISOLANTITE MFG CORP                          | 6                              |
| ITT COMPONENTS DIV CLIFTON                   | 3-5-6-11-15-19-                |
|  | 21-24-27-30-32-33-42           |
| ITT COMPONENTS DIV ROANOKE                   | 3-27-33                        |
| ITT FEDERAL LABS NUTLEY                      | 3-5-6-9-13-16-19-              |
|  | 27-33-34-36                    |
| KEMLITE LABS INC                             | 11-13-15-27-28-36              |
| KENTUCKY ELECTRONICS INC                     | 39-40                          |
| KFR CORP                                     | 7                              |
| KING LABS INC                                |                                |
| KIP ELECTRONICS CORP                         | 44                             |
| KRISSE ELECTRONICS INC                       | 5-7-27-35                      |
| KUTHE LABS                                   | 6-11-24-26-27-29-30            |
| LANCASTER GLASS CORP                         | 0                              |
| LEWIS & KAUFMAN ELECTRONICS TUBE DIV         | 3-16-                          |
|  | 33                             |
| LIONEL CORP LIONEL ELECTRONIC LABS DIV       | 0-27                           |
| LITTON ENGG LABS                             | 6-21-24-27                     |
| LITTON INDUSTRIES ELECTRON TUBE DIVISION     | 3-                             |
|  | 5-6-7-16-17-18-27-29-33-35     |
| LOUTHAN MFG CO DIV FERRO CORP                | 6                              |
| MACHLETT LABS INC                            | 0                              |
| MACKAY RESEARCH LABS                         | 5-9-15-17-27                   |
| METOX  | 42                             |
| MICROWAVE ELECTRONIC TUBE CO INC             | 2-3-16-17-                     |
|  | 18-26-27-31-33                 |
| MICROWAVE ELEC CORP                          | 3-6-18-27-33                   |
| MURA CORP THE                                | 23-28                          |
| NATIONAL BERYLLIA CORP                       | 6-16                           |
| NATIONAL ELECTRONICS INC                     | 14-24-27-30                    |
| NATL RADIAC INC                              | 25                             |
| NATL TELEVISION TUBE INC                     | 5-35                           |
| NATIONAL TELEVISION TUBE INC                 | 5-35                           |
| NATIONAL UNION ELEC CORP ELECT DIV           | 5-8-27-                        |
|  | 37                             |
| NATIONAL VIDEO CORP                          | 5                              |
| NP KFR CORP                                  | 5-27-35                        |
| NUCLEAR CORP OF AMER DENVER                  | 6-11-12-13-                    |
|  | 18-21-24-27-29-32-37           |
| NUCLEAR DEVELOPMENT LAB INC                  | 10-12                          |
| PACO PRECISION                               | 43                             |
| PEK LABS INC                                 | 13-24-28-36-38                 |
| PENTA LAB INC                                | 21-30-32                       |
| PHILCO CORP LANSDALE DIV                     | 5-7-35                         |
| PHILIPS ELECTRONIC INSTRUMENTS               | 12-25-38                       |
| PHOENIX PRECISION INSTRUMENT CO              | 19                             |
| PHOTO - CRYSTALS                             | 19                             |
| PRECISION APPARATUS CO                       | 43                             |
| PRINCETON DIV ELECTRO MECHANICAL RESCH INC   | 25-27                          |
| RADIATION COUNTER LABS INC                   | 12-25                          |
| RADIATION INSTRUMENT DEVELOPMENT LAB INC     | 25                             |
| RCA ELECTRN TUBE DIV INDIANAPLS              | 5-6-7-11-                      |
|  | 13-14-15-16-17-19-20-21-22-23- |
|  | 24-25-27-30-31-33-34-35-36-37  |
| RCA ELECTRN TUBE DIV MARION                  | 5-6-7-11-13-14-                |
|  | 15-16-19-20-21-22-23-24-25-27- |
|  | 30-32-33-34-35-36-37           |
| RCA ELECTRN TUBE DIV HARRISON                | 5-6-7-11-13-                   |
|  | 14-15-16-17-19-20-21-22-23-24- |
|  | 25-27-30-32-33-34-35-36-37     |
| RCA ELECTRN TUBE DIV WOODBRIDGE              | 5-6-7-11-                      |
|  | 13-14-15-16-17-19-20-21-22-23- |
|  | 24-25-30-32-33-34-35-36-37     |
| RCA ELECT TUBE DIV CINN                      | 5-6-7-11-13-14-15-             |
|  | 16-17-19-20-21-22-23-24-25-27- |
|  | 30                             |
| RCA ELECTRN TUBE DIV LANCASTER               | 5-6-7-11-13-                   |
|  | 14-15-16-17-19-20-21-22-23-24- |
|  | 25-27-30-31-33-34-35-36-37     |
| RAULAND CORP                                 | 5-27-35                        |
| RAYTHEON CO MICROWAVE & POWER TUBE DIVISION  | 1-3-15-16-17-33                |
| RAYTHEON CO INDUSTRIAL COMPONENTS DIV        | 5-6-                           |
|  | 8-11-12-13-21-23-24-26-27-30-  |
|  | 32-37                          |
| RESITRON LABS LOS ANG                        | 5-20-27-31-32-34-35-38         |
| RESITRON LABS INC                            | 5-6-11-15-26-27-29-32-34-      |
|  | SANTA MONICA                   |
|  | 36-38                          |
| SAXONBURG CERAMICS INC                       | 6-27                           |

|   |                                |
|---|--------------------------------|
| SCIENTIFIC ELECTRONIC LABS INC              | 11-13-26                       |
| SKIATRON ELECTRONICS TV CORP                | 5                              |
| SKYTRON ELECTRONICS                         | 35                             |
| SONOTONE CORP ELMFSORD                      | 23-27                          |
| SPERRY ELECTRONIC TUBE DIV SPERRY RAND CORP | 3-16-21                        |
| SPERRY GYROSCOPE CO DIV SPERRY RAND CORP    | 16-33                          |
| SPERRY ELECTRONIC TUBE DIV                  |                                |
| SPERRY RAND CORP                            | 3-9-16-18-21-23-38             |
| STANOARD TELEVISION & TUBE CORP             | 35                             |
| STANDARD T V TUBE CORP                      | 35                             |
| STEWART ENGG CO                             | 3                              |
| STROBLITE CO INC                            | 36                             |
| SUPERIOR ELECTRONICS CORP                   | 0                              |
| SYLVANIA ELECTRIC PROD INC FULLERTON        | 5                              |
| SYLVANIA ELEC PRODS MICROWAVE DEVICE DIV    | 16-33                          |
| SYLVANIA ELECTRIC PRODS WILLIAMSPORT        | 3-16-                          |
|   | 33                             |
| SYLVANIS ELECTRIC PRODS SENECA FALLS        | 5-7-35                         |
| SYLVANIA ELECTRIC PRODS S EMPORIUM          | 8-11-18-                       |
|   | 23-32                          |
| TECHNICAL APPARATUS BUILDERS                | 0-27                           |
| TEXTRON ELEGT GENERAL CEMENT CO             | 0                              |
| THERMAL AMERICAN FUSED QUARTZ CO            | 0                              |
| THERMOSEN INC                               | 24-27-37                       |
| THOMAS ELECTRONICS INC                      | 5-27                           |
| TRG INCORPORATED BOSTON                     | 5                              |
| TUCOR INC                                   | 2-3-6-11-16-17-18-20-29-31-33  |
| TUNG-SOL ELECTRIC INC BLOOMFIELD            | 23                             |
| TUNG SOL ELECTRIC INC NEWARK                | 4-5-9-11-14-                   |
|   | 18-19-21-23-24-27-29-30        |
| TUNG SOL ELECT ORANGE                       | 5                              |
| ULMER CO THE DIV MICROTRON INDUSTRIES INC   | 20-27                          |
| ULTRA-VIOLET PRODUCTS INC                   | 36                             |
| UNITED ELECTRONICS                          | 21-27-32                       |
| VACUUM ELECTRONICS CORP                     | 20                             |
| VARIAN ASSOC PALO ALTO                      | 3-16-33                        |
| VICTOREEN INSTRUMENT CO CLEVELAND           | 8-10-12-                       |
|   | 13-27-37                       |
| VOLTARC TUBES INC                           | 0                              |
| WARNECKE ELECTRON TUBES INC                 | 1-3-5-8-9-11-                  |
|   | 12-13-15-16-17-18-19-21-27-29- |
|   | 30-32-33-37                    |
| WATERMAN PRODUCTS CO                        | 5                              |
| WATKINS-JOHNSON CO APPL ENGRG               | 3-21-32-33                     |
| WAVELINE INC                                | 18                             |
| WESTERN ELEC KANSAS CITY PLANT              | 0-27                           |
| WESTINGHOUSE ELEC CORP ELEC TUBE DIV        | 2-3-9-                         |
|   | 11-14-15-16-17-19-20-21-23-24- |
|   | 26-27-29-30-31-32-33-34-35-36  |
| WINDSOR ELECTRONICS INC                     | 5-7-13-15-28-35                |
| N WOOD COUNTER LAB INC                      | 5-8-10-12-25                   |
| ZENITH RADIO RES CORP                       | 38                             |

ULTRASONICS 7300

|                                 |    |
|---------------------------------|----|
| Brazers, ultrasonic             | 1  |
| Cleaning equipment, ultrasonic  | 2  |
| Detectors, ultrasonic           | 3  |
| Fish finders, ultrasonic        | 4  |
| Gauges, ultrasonic thickness    | 5  |
| Generators, ultrasonic          | 6  |
| Machining equipment, ultrasonic | 7  |
| Transducers                     | 8  |
| Welders, ultrasonic             | 9  |
| Vibrators, ultrasonic           | 10 |

|                                     |              |
|-------------------------------------|--------------|
| ACOUSTICA ASSOCIATES INC            | 2-3-6-8      |
| ACOUSTICA ASSOCIATES                | 2-6-7-8-9-10 |
| ALCAR INSTRUMENTS INC               | 1-2-3-6-8-10 |
| ALLOYD ELECTRONICS CORP             | 9            |
| AMERICAN BOSCH CORP                 | 8            |
| AMERICAN TIME PROD INC              | 6            |
| ANDREA RADIO CORP                   | 6-10         |
| ARENBERG ULTRASONIC LABORATORY INC  | 6            |
| ASTROSONICS INC                     | 6-8          |
| ATOMIC ACCESSORIES INC              | 2            |
| ATOMIC LABS INC                     | 6            |
| AUTOMATED CONTROLS                  | 6            |
| BEARING INSPECTION INC              | 2            |
| BENDIX CORP THE POINEER CENTRAL DIV | 2-6-8        |
| BENDIX CORP THE SHEFFIELD CORP SUB  | 7            |
| BLACKSTONE CORP                     | 1-2-6-8      |
| BRANSON INSTRUMENTS INC             | 2-5          |
| BREW & CO RICHARD D                 | 3-8          |
| CANADIAN RESEARCH INSTITUTE         | 2            |
| CHANNEL INDUSTRIES INC              | 8            |
| CHESAPEAKE INSTRUMENT CORP          | 3-6-8        |
| COMMUNICATION MEASUREMENTS LABS     | 6            |
| CONNECTICUT VALLEY CHEMICALS INC    | 1-2          |
| COOPER CO D C                       | 2            |
| CREST ULTRASONICS CORP              | 2-6-8        |
| DALLONS LABS                        | 2            |
| DELCON CORP                         | 3            |
| DELTA SONICS INC                    | 1-2-6-9      |
| DICE CO J W                         | 5            |
| DIGITool CORP                       | 8            |
| DIGITROL SYSTEMS INC                | 3            |
| DYNASONICS CORPORATION              | 2-6-8-10     |
| ELECTRO CERAMICS INC SALT LAKE      | 8            |
| ELECTRONIC ASSISTANCE CORP          | 2-6-8        |
| ELECTRONIC ENTERPRISES INC          | 2-6          |
| ELION INSTRUMENTS INC               | 3-6-8        |
| ERIE RESISTOR CORP                  | 8            |
| FERROXUCUBE CORP OF MAER            | 8            |



# PRODUCTS & MANUFACTURERS

|  |                 |
|--|-----------------|
| GENERAL COIL PRODUCTS CORP                   | 4               |
| GENERAL INSTR CORP HARRIS A S W DIV          | 2-8             |
| GENERAL INSTRUMENT CORP NEWARK               | 2-8             |
| GENERAL KINETICS INC                         | 2-6-8-10        |
| GENERAL RADIO CO                             | 6               |
| GENERAL RAILWAY SIGNAL CO                    | 3               |
| GEOSCIENCE INSTRUMENTS CORP                  | 2               |
| GPL DIV GENERAL PRECISION INC                | 3               |
| GUILD ELECTRONICS INC                        | 6-9             |
| GULTON INDUSTRIES INC METUCHEN               | 2-3-6-7         |
| HOUSTON FEARLESS CORP WESTWOOD DIV           | 9               |
| INJECTORALL CO                               | 2               |
| INSTRUMENTATION ASSOCIATES                   | 10              |
| INTERELECTRONICS CORP                        | 6               |
| INTERNATIONAL ELECTRONICS CORP               | 2-6-8           |
| KIDDE & CO WALTER                            | 3               |
| KIDDE ULTRASONIC & DETECTION ALARMS INC      | 3-8             |
| LIONEL - WADSWORTH ULTRASONICS INC           | 2-8-10          |
| L & R MFG CO                                 | 2-6-8           |
| MAGNAFLUX CORP                               | 3-5             |
| MCKENNA LABORATORIES                         | 2-6-8-10        |
| MICROMECH MFG CO                             | 2-6-8           |
| MICRONICS CORP OF AMERICA                    | 2               |
| MINI-TOOL TECHNICAL INDUST INC               | 2               |
| MINNEAPOLIS-HONEYWELL ORDNANCE DIV           | 4-8             |
| MISSILE TRONICS CORP                         | 2               |
| MITCHELL CAMERA CORP ASTROMICS DIV           | 8               |
| MOTOROLA INC SOLID STATE SYSTEMS DIV         | 8               |
| MULLARD EQUIPMENT LTD                        | 2-6-7-8-9       |
| NATL ULTRASONIC CORP                         | 2-6-8-10        |
| NATIONAL ULTRASONIC CORP                     | 2-6-8           |
| NORWOOD CONTROLS UNIT DETROIT CONTROLS DIV   | 8               |
| PELTON & CRANE CO THE                        | 2               |
| POWERTON ULTRASONICS CORP                    | 1-2-3-4-5-6-7-8 |
| RAYTHEON CO                                  | 8               |
| RAYTHEON CO COMM APPARATUS & SYSTEMS         | 1-9             |
| REED RESEARCH INC                            | 3               |
| RESEARCH MFG CORP                            | 3-4-6-8         |
| RICH ELECTRONICS INC                         | 3-4             |
| RIVERBANK LABS ENGG DEPT                     | 6               |
| R W S ASSOCIATES INC                         | 6               |
| SCHIRMER-NATIONAL ALARM CORP                 | 3               |
| SHEFFIELD CORP SUB THE BENDIX CORP           | 7               |
| SONOBOND CORP SUB OF AEROPROJECTS INC        | 9               |
| SPRAGUE ELECTRIC CO N ADAMS                  | 8               |
| STATES ELECTRONICS CORP BLUDWORTH MARINE DIV | 3-4-8           |
| STEPHENS TRU-SONIC INC                       | 8               |
| SUMMERS & MILLS INC                          | 7               |
| TECHNICAL DYNAMICS DIV JAMIESON IND INC      | 8               |
| TELETRON CO                                  | 4               |
| TELERAD DIV OF THE LIONEL CORP               | 2-6             |
| TURCO PRODUCTS INC                           | 2               |
| ULTRASONIC ENGG CO                           | 2-6             |
| ULTRASONIC DEVICES INC                       | 1-2-3-6-7-8     |
| ULTRASONIC INDUSTRIES INC                    | 2-6-7-8-9-10    |
| ULTRASONIC MACHINING CO                      | 7               |
| UNION ULTRA-SONICS CORP                      | 2-6-8           |
| WEBSTER MFG                                  | 6-8             |
| WELTRONIC CO                                 | 2-6-8           |
| WESTERN COIL & ELECTRICAL CO                 | 6               |
| ZENITH OPTICAL LAB                           | 7               |

## WIRE, CABLE & ACCESSORIES 7400

|                                 |    |
|---------------------------------|----|
| Bus bar                         | 1  |
| Cable assemblies                | 2  |
| Cable clamps & clips            | 3  |
| Cable, coaxial                  | 4  |
| Cable, flat woven               | 5  |
| Cable, insulated                | 6  |
| Cable, low capacitance          | 7  |
| Cable, microphone               | 8  |
| Cable, shielded                 | 9  |
| Cable, solid dielectric         | 10 |
| Cable, telephone                | 11 |
| Cable, UHF                      | 12 |
| Code & tab markers              | 13 |
| Cords, attachment               | 14 |
| Cords, line                     | 15 |
| Cords, resistance               | 16 |
| Jumpers                         | 17 |
| Spaghetti                       | 18 |
| Lacing cords & tape             | 19 |
| Test leads                      | 20 |
| Transmission line               | 21 |
| Transmission line, TV twin-lead | 22 |
| Wire, aluminum                  | 23 |
| Wire, aluminum bronze           | 24 |
| Wire, asbestos insulated        | 25 |
| Wire, beryllium copper          | 26 |
| Wire, cadmium bronze            | 27 |
| Wire, ceramic insulated         | 28 |
| Wire, cloth                     | 31 |
| Wire, columbium                 | 32 |
| Wire, copper, bare              | 63 |
| Wire, copper, clad              | 64 |

|                          |    |
|--------------------------|----|
| Wire, copper insulated   | 33 |
| Wire, enameled           | 34 |
| Wire, glass insulated    | 35 |
| Wire, gold plated        | 36 |
| Wire, guy                | 37 |
| Wire, harnesses          | 38 |
| Wire, high voltage       | 39 |
| Wire, hookup             | 40 |
| Wire, litz               | 41 |
| Wire, magnet             | 42 |
| Wire, metal shielded     | 43 |
| Wire, molybdenum         | 44 |
| Wire, monel              | 45 |
| Wire, nickel-clad copper | 46 |
| Wire, phosphor bronze    | 47 |
| Wire, plastic insulated  | 48 |
| Wire, platinum           | 49 |
| Wire reels               | 50 |
| Wire, resistance         | 51 |
| Wire, shielded           | 52 |
| Wire, silicon bronze     | 53 |
| Wire, silver plated      | 54 |
| Wire, stainless steel    | 55 |
| Wire, steel              | 56 |
| Wire, tantalum           | 57 |
| Wire, teflon insulated   | 58 |
| Wire, thermocouple       | 59 |
| Wire, titanium           | 60 |
| Wire, tungsten           | 61 |
| Wire, zirconium          | 62 |

|  |  |
|--|--|
| AAA WIRE WORKS INC                     | 6-8-15-40-48   |
| ABALON PRECASUON MFG CORP              | 1  |
| ACF ELECTRONICS DIV ACF INDUSTRIES INC | 2-12   |
| ACME WIRE CO                           | 34-42  |
| ACOPAIN TECHNICAL CO                   | 2  |
| ACROMARK CO                            | 13   |
| ACRO TOOL & DIE WORKS                  | 13   |
| ACTIONCRAFT PRODUCTS                   | 13   |
| ADVANCED ELECTRONICS INC               | 2-3  |
| AEROLITE ELECTRONICS CORP              | 59   |
| AERO RESEARCH INSTRUMENT CO            | 2-6-7-9-38   |
| AIR BORNE CONTROLS INC                 | 2  |
| AIRCRAFT ELECT SPEC                    | 2-5-17-20-35-38-52   |
| AIRCRAFT ELECT CO                      | 2  |
| AIR O TRONICS INC                      | 2-4-6-7-8-9-11-14-15-17-20-33-35-38-39-40-43-48-52                                   |
| A K MFG CO INC                         | 2  |
| A L D INDUSTRIES INC                   | 2  |
| ALDEN PRODUCTS CO                      | 2-15   |
| ALERT PRODUCTS INC                     | 2-17-20  |
| ALLEGANY INSTRUMENT CO                 | 2  |
| ALLOY METAL WIRE WORKS                 | 61   |
| ALL STAINLESS INC                      | 55   |
| ALMOR DEVELOPMENT CO INC               | 2-38   |
| ALPHA WIRE CORP                        | 1-2-6-8-9-11-13-14-15-18-19-20-21-22-23-33-34-37-38-39-40-41-42-43-46-47-48-52-54-58 |
| ALPHADUCT WIRE & CABLE CO              | 0  |
| ALUMINUM CO OF AMERICA PITTSBURG       | 1-2-6-21-23-34-39-40-42  |
| ALUMINUM CO OF AMER REA MAGNET WIRE CO | 42   |
| AMERICAN AVIONICS INC                  | 2-38   |
| AMERICAN ELECTRIC CABLE CO             | 2-3-4-6-8-9-11-25-33-35-39-40-42-43-47-48-51-52-58-59                                |
| AMERICAN MOLDED PRODS CO               | 49   |
| AMERICAN SILVER CO                     | 50   |
| AMERICAN SUPER TEMPERATURES WIRES INC  | 58-59  |
| DIV OF HAVEG INDUST                    | 4-6-7-9-10-12-25-28-33-34-35-39-40-41-42-43-48-52                                    |
| AMETEK INC HUNTER SPRING DIV           | 3  |
| AMP INC CAPITRON DIV                   | 2  |
| AMPEREX ELECTRONIC CORP HICKSVILLE     | 59   |
| AMPHENOL CONNECTOR                     | 2  |
| AMPHENOL WESTERN DIV                   | 2  |
| AMPOWER PROD INC                       | 2-17-20-38   |
| ANACONDA WIRE & CABLE CO NEW YORK      | 4-6-9-11-12-15-21-22-23-25-33-34-35-39-40-42-43-48-51-52-58                          |
| ANACONDA WIRE & CABLE HAST-ON-HUDSON   | 4-6-10-11-23-33-40-48  |
| ANCHOR ALLOYS INC                      | 23-36-49-57-60   |
| ANDREW ANTENNA CORP                    | 4-21   |
| ANDREW CALIF CORP                      | 4-12-21  |
| ANDREW CORP                            | 4-12-21  |
| ANGLER INDUSTRIES                      | 2-17-20  |
| ANDROYNE INC                           | 2  |
| ANSONIA WIRE & CABLE CO                | 4-6-7-8-9-11-48-52   |
| ANTENNA SPECIALISTS CO                 | 2  |
| ANTHONY & CO J L                       | 36-45-46-47-57   |
| AOTO SWAGE PRODS INC                   | 20   |
| APEX WIRE CABLE CORP                   | 2-6-14-15-33-40-48   |
| APPLETON CO INC HARRY                  | 2-6-7-9-10-38-39-40-46-52  |
| APPLIED TECHNOLOGY CORP                | 2-38   |
| ARLIN MFG CO                           | 19   |

# Ultrasonics • Wire, Cable & Accessories

|  |   |
|--|---|
| ARMCO STEEL CORP                             | 55  |
| ART WIRE & STAMPING CO                       | 17  |
| ASSOCIATED ENG CORP BROOKLINE                | 17  |
| A T ELECTRONICS INC                          | 4-12  |
| ATLANTIC & PACIFIC WIRE & CABLE CO           | 0   |
| AUBURN INDUSTRIAL PARK                       | 0   |
| AUDIO ACCESSORIES                            | 14  |
| AUTO-SWAGE PRODUCTS INC                      | 20  |
| AVCO CORP ORDNANCE DIV RICHMOND              | 2   |
| AVIONICS INC                                 | 2-38  |
| AVNET CORP LOS ANG                           | 4   |
| BARBER-COLMAN CO                             | 59  |
| BARNETT INST CO                              | 2-20  |
| BARRY ELECTRONICS CORP NEW YORK              | 4-6-7   |
| B & B ELECTRONICS CORP                       | 2-6-8-9-11-38-48-52   |
| B & C INSULATION PRODUCTS INC                | 18  |
| BELDEN MFG CO                                | 1-2-4-5-6-7-8-9-12-33-34-35-39-40-41-42-52-59   |
| BENDIX CORP/SCINTILLA DIV                    | 2   |
| BENRUS WATCH CO INC                          | 2   |
| BENTLEY HARRIS MFG CO                        | 18-19   |
| BERGEN WIRE ROPE CO                          | 37  |
| BEVIN WILCOX LINE CO                         | 15  |
| BORDEN CHEMICAL CO DIV COMPTON               | 19  |
| BOSTON INSULATED WIRE & CABLE CO             | 4-6-7-8-9-10-19-28-30-48-58-59  |
| BRACH MFG CORP DIV GEN BRONZE CORP           | 38  |
| BRADY CO W H                                 | 13  |
| BRAININ CORP C S                             | 36-46   |
| BRAM METALLURGICAL-CHEMICAL CO               | 1-23-26-27-29-32-33-36-41-44-45-46-47-49-51-54-55-57-59-60-61-62                              |
| BRAND REX DIV AMER ENKA CORP GARDENA         | 4-5   |
| BRAND REX DIV AMER ENKA CORP N WINDHAM       | 4-5   |
| BRAND REX DIV AMER ENKA CORP W ACTON         | 4-5   |
| BRIDGEPORT BRASS CO                          | 6-7-9-10-11-12-40-43-48-52-58   |
| BROWN ENG CO INC                             | 1-23-47-53-63   |
| BRUSH BERYLLIUM CO READING DIV               | 0   |
| BUCKBEE MEARS CO                             | 26  |
| BULOVA WATCH CO ELECT DIV                    | 9-31  |
| CABLE DESIGNS INC                            | 3   |
| CABLE SPEC OF CONN                           | 2-4-3-6-9-35-39-42-43-52  |
| CADRE INDUSTRIES CORP                        | 2-38  |
| CALBEST ELECTRONICS CO                       | 2-14-19-38  |
| CALCON MFG CO                                | 2   |
| CANNON ELECTRIC CO PHOENIX                   | 2-4-6-7-8-9-10-11-12-21-33-38-39-40-48-56   |
| CAROL ELECT DIV WEECO                        | 2   |
| CAROL CABLE DIV CRESCENT CO INC              | 2-15-20-8-9-11-14-33-48   |
| CAROLINA INDUST PLASTICS DIV ESSEX WIRE CORP | 33-48   |
| CAROLINA WELDS PLANT                         | 38-40-51  |
| CARPENTER STEEL CO READING                   | 20-64   |
| C B C ELECTRONICS CO                         | 55  |
| CENTRAL COIL CORP                            | 2-8-14-20   |
| CONTROL ENG CO                               | 2   |
| CFI CORP                                     | 2-38  |
| CHANNEL MASTER CORP                          | 30  |
| CHASE BRASS & COPPER CO MILL DIV             | 22-37   |
| CHASE MTL SERV DIV CHASE BRASS & COPPER CO   | 1-4-7-53  |
| CHESTER CABLE CORP                           | 1-23-24-31-47-53-55   |
| CHICAGO DYNAMIC INDUSTRIES INC               | 4-5-6-7-8-9-10-11-12-15-33-35-39-40-43-48-52-58   |
| CHICAGO GASKET CO                            | 2   |
| CICOIL CORP                                  | 19  |
| CIMCO WIRE & CABLE CO                        | 2-6-9-38  |
| CINCH MFG CO CINCH JONES DIV                 | 7-9-18-58   |
| CLARKE H JOY CO                              | 3   |
| COLEMAN CABLE & WIRE CO                      | 3   |
| COLLYER INSULATED WIRE CO                    | 4-6-7-8-9-11-12-23-39   |
| COLUMBIA WIRE & SUPPLY CO                    | 6-9-23-25-33-39-43-52   |
| COMMERCIAL PLASTICS & SUPPLY CO              | 1-2-4-5-6-7-8-9-10-11-12-14-15-16-17-20-21-22-23-25-33-34-35-37-38-39-40-42-43-46-48-51-52-58 |
| COMMUNICATIONS PRODUCTS CO                   | 18  |
| COMPUTER EQUIPMENT CORP                      | 38  |
| CONNOR SPRING MFG CO                         | 4-7-10-12-21  |
| CONSOLIDATED REACTIVE METLS INC              | 2-38  |
| CONSOLIDATED WIRE & ASSOCIATED COS           | 3   |
| CONTINENTAL SENSING INC                      | 34-35-36-46-49-51-54-55-59  |
| CONTINENTAL WIRE CORP                        | 1-2-4-5-6-7-8-9-10-11-12-15-16-21-22-25-26-27-33-34-35-39-40-41-42-43-47-48-51-54-58-59       |
| CO-OPERATIVE INDUSTRIES INC                  | 43-47-48-51-54-58-59  |
| COOPER & SONS INC JOSEPH B                   | 2-4-6-30-38-43-58-59  |
| COPPERWELD STEEL CO FLEXO WIRE DIV           | 59  |
| CORNISH WIRE CO DIV GENERAL CABLE CORP       | 4-6-7-8-9-10-12-23-33-39-42-51  |
| CRESCENT CO                                  | 2-4-9-38-43-52  |
| CROWN CONTROLS CORP                          | 36-49   |
| CUSH CRAFT                                   | 23-27-  |
| DALE ELECTRONICS INC COLUMBUS                | 37-46-47-54-55  |
| DALWELD CO INC                               | 2-6-  |
| DAWELD CO INC                                | 8-9-14-15-40-52   |
| DAYSTROM WESTON INDUST DIV DAYSTROM INC      | 33  |
| DAYTON AIRCRAFT PRODUCTS INC                 | 2-17-20   |
| DELTA ELECT CO                               | 4   |
| DETROIT DESIGNING & ENG CO                   | 2   |
| DIAMOND ANTENNA & MICROWAVE CORP             | 2   |
| DILL PRODUCTS INC                            | 2   |
| DI-TRAN CORPORATION                          | 2   |



# Wire, Cable & Accessories

|  |  |
|--|--|
| DITTMORE FREIMUTH CORP                     | 2-38   |
| DOUGE FIBERS CORP                          | 19   |
| DOSSERT MFG CORP                           | 3-5  |
| DRAKE MFG CO                               | 38   |
| DRIVER CO WILBUR B                         | 34-35-51-55-59   |
| DRIVER HARRIS CO                           | 34-35-45-48-51-56-58-59  |
| DURO MATIC PRODUCTS CO                     | 2  |
| DYNATRONICS CABLE ENGG CORP                | 2  |
| EAGLE ELECTRIC MFG CO                      | 14-15-33-40-48   |
| EAGLE ELECTRIC MFG CO INC                  | 13-33-40-48-51   |
| EASTERN SMELTING & REFINING CORP           | 49   |
| EASTERN SPECIALTY CO                       | 2-20   |
| ERY CO H H                                 | 2  |
| EITSLER TRANSFORMER CO INC                 | 17   |
| ELDRE COMPONENTS INC                       | 1  |
| ELECTRALAB PRINTED ELECT ENCINITAS         | 17-38  |
| ELECTRAMATIC INC                           | 2-3-7-8-9-13-17-18-19-20-37-38   |
| ELECTRI WIRE ASSEMBLIES                    | 2-14-15-17-38  |
| ELECTRIC AUTO-LITE CO PORT HURON           | 4-5-6-7-9-33-34-35-39-40-42-43-46-48-52-54-58  |
| ELECTRIC AUTOLITE CO THE EL SEGUNDO        | 2-6-9-9-33-40-43-48-52   |
| THE ELECTRIC AUTOLITE CO HAZLETON          | 4-6-7-9-9-33-40-48-52-54-58  |
| ELECTRIC CORDS & SUPPLY CORP               | 2-14-15-38   |
| ELECTRICAL SPECIALTY CO LOS ANG            | 18-19-42-51-58   |
| ELECTRICAL SPECIALTY CO SAN FRAN           | 18-19-42-51-58   |
| ELECTRO PHYSICS CO                         | 2  |
| ELECTROSPACE CORP                          | 2-11   |
| ELECTRONIC CONNECTORS INC                  | 2  |
| ELECTRONIC CRAFTSMEN INC                   | 2  |
| ELECTRONIC FITTINGS CORP                   | 4  |
| ELECTRONICS INC OF PA                      | 2-20-38  |
| ELECTROPAC INC                             | 38   |
| ELECTROVART INC                            | 3  |
| EMPIRE ELECTRONICS CO INC                  | 2-14-15-20-38  |
| ENFLO CORP                                 | 18-38  |
| ENGELHARD INDUSTRIES                       |  |
| INDUST EQUIPT DIV                          | 59   |
| ENGELHARD INDUSTRIES INC                   | 36-49-51-54-59-61  |
| ENGINEERED PLASTICS INC                    | 19   |
| ENTRON INC                                 | 2  |
| ERICSON MFG CO                             | 2-14-15  |
| ESPEY MFG & ELECTRONICS CORP               | 1  |
| ESSEX WIRE CORP                            | 42   |
| E T C INCORPORATED                         | 17-18  |
| E-Z-HOOK TEST PRODUCTS                     | 3-17-20  |
| FAIRBANKS WIRE CO                          | 6-9-33-35-40-41-42-48-58   |
| FANSTEEL METALLURGICAL CORP                | 32-44-57   |
| FINNEY CO                                  | 22   |
| FIRST ELECTRONICS CORP                     | 2  |
| FLEXO WIRE DIV COPPERWELD STEEL CO         | 0  |
| FORT WAYNE METALS INC                      | 45-55  |
| FREDERICK ELECT CORP                       | 2  |
| GARLOCK ELECTRONIC PRODUCTS PRODS PALMYRA  | 18   |
| GAVITT WIRE & CABLE CO DIV OF AMERACE CORP | 2-6-7-9-33-35-38-40-43-48-52-58-59   |
| GAVITT WIRE & CABLE CO PLANT & GEN OFFICE  | 2-4-6-7-8-9-14-17-33-38-40-43-48-52-58-59  |
| GC ELECTRONICS CO DIV TETRON ELECTRONICS   | 2-3-7-8-9-13-17-18-19-20-37-38   |
| GENERAL CABLE CORP QUINCY                  | 2-4-6-7-8-9-10-11-12-14-16-21-22-23-25-30-31-33-34-35-37-38-39-41-42-43-48-51-52-58-63 |
| GENERAL CABLE CORP N Y                     | 2-4-6-7-9-10-11-12-14-15-16-21-23-25-27-28-29-31-34-37-39-40-41-42-48-50-51-52-54-58   |
| GENERAL CABLE CORP PERTH AMBOY             | 2  |
| GENERAL CABLE CORP MEMPHIS                 | 0  |
| GENERAL CABLE CORP ROME                    | 2-6-17-21-23-33-39-40  |
| GENERAL DYNAMICS TELECOMMUNICATION         | 11   |
| GENERAL ELECTRIC CO OAKLAND                | 6-7-9-33-34-35-40-42-43-48-52  |
| GENERAL ELECTRIC CO BRIDGEPORT             | 4-6-7-9-12-25-33-40-41-48-52   |
| GENERAL ELECTRIC CO GOLDSBORO              | 64   |
| GENERAL ELECTRIC CO DOVER WIRE PLT         | 36-44-54   |
| GENERAL ELECT CO WIRING DEVICE DEPT        | 14   |
| GENERAL INSULATED WIRE WORKS INC           | 2-4-6-8-9-11-14-25-33-43-48-52   |
| GENERAL MILLS INC MINN                     | 2  |
| GENERAL PRODUCTS CORP                      | 2  |
| GENERAL RELAY CORP                         | 2  |
| GORDON CO CLOUD S                          | 25-33-35-48-49-51-58-59  |
| GORE & ASSOC INC W L                       | 2-4-9-38-39-40-52-58   |
| GUARD MFG CO                               | 2  |
| GUARDIAN ELECTRIC MFG CO                   | 2  |
| GULTON INDUSTRIES INC METUCHEN             | 2-9  |
| GUNNAR LABS                                | 38   |
| HACKENSACK CABLE CORP                      | 24-27-29-37-47-53-55   |
| HAL HEN CO                                 | 14   |
| HALLETT MFG CO                             | 2-9-17-20-38-43-52   |
| HALOGEN INSULATOR & SEAL CORP              | 18   |
| HANDY & HARMON EL MONTE                    | 2-49   |
| HARRIS MFG CO INC                          | 2-38   |
| HAVEG INDUSTRIES INC                       | 4-6-7-8-9-12-18-19-33-34-39-40-42-48-52-58   |
| HAYNES STELLITE CO                         | 32-57  |
| HEATRON CO                                 | 51   |
| HEYER INDUSTRIES INCORPORATED              | 2-17-20  |
| LAB OF MARQUETTE CORP                      | 2  |
| HITEMP INC                                 | 2-4-5-6-7-9-10-39-40-43-48-52-58-59  |
| HITEMP WIRES INC                           | 4-5-6-9-10-28-33-34-38-40-42-43-48-52-54-58  |
| HOLUP INDUSTRIES INC                       | 3  |
| HOSKINS MFG CO                             | 34-51-57-59-61   |

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| HOUHLIMAN CO T J                             | 2  |
| HUBBARD - SPOOL DIV                          | 50   |
| HUDSON WIRE CO WINSTED DIV                   | 23-33-34-35-40-41-42-54  |
| HUDSON WIRE CO OSSINING                      | 4-23-27-36-43-46-47-51-53-54-55-62   |
| HUGHES AIRCRAFT CO ELECT PROD DIV            | 2  |
| HYSER ELECT MFG CO                           | 1  |
| HYTECH DIV OF BISSETT BERMAN CORP            | 6  |
| IDEAS INC                                    | 14   |
| IDENTIFICATION SERVICE CORP                  | 13   |
| IE MFG                                       | 20-37  |
| IMPROVED SEAMLESS WIRE CO                    | 36-54  |
| INDIANA STEEL & WIRE CO                      | 11-37-55-56  |
| INDUSTRIAL ELECTRICAL WORKS                  | 30-50  |
| INDUSTRIAL WIRE & CABLE CO INC               | 38   |
| INSO ELECT PROD INC                          | 2-4-6-7-9-38-39-40-42-43-52-58-59  |
| INSTRUMENTS INC                              | 4-7  |
| INTERNATIONAL ELECTRIC INDUSTRIES INC        | 2-14-15-16-17-20   |
| INTL ELECTRIC INDUSTRIES INC N Y             | 2-14-15-38   |
| INTERNATIONAL RESISTANCE CO PHILA            | 6-38   |
| ITT FEDERAL LABS NUTLEY                      | 2  |
| ITT SURPRENANT MFG CO                        | 2-4-5-6-7-8-9-10-11-12-17-18-20-21-22-23-24-26-27-29-33-35-36-38-39-40-43-46-48-51-52-53-53-54-55-56-58-59 |
| JAMES PLATING WORKS INC                      | 36-54  |
| JAMPRO ANTENNA CO                            | 21   |
| JAN ENG                                      | 1  |
| JANCO CORP                                   | 1-17   |
| JAVEX ELECTRONICS                            | 20   |
| JEFFERSON ELECTRONIC PRODUCTS CORP           | 2-6-7-9-9-20-21-38   |
| JEFFERSON WIRE & CABLE CORP                  | 4-6-7-8-9-10-11-12-20-21-22-33-35-39-40-43-48-52   |
| JELLIFF MFG CORP C O                         | 31-45-51   |
| JERSEY SPECIALTY CO INC                      | 2-6-12-21-22-33-38-48  |
| JETTRON PRODUCTS                             | 2  |
| JFD ELECTRONIC CORP                          | 15-20-23-37  |
| JFD ELECTRONICS SOUTHERN INC                 | 16-20-22-23-37   |
| JOELIN MFG CO                                | 3  |
| JONES & LAUGHLIN STEEL CORP                  | 2-4-6-9-31-33-37-56-59   |
| JUDD WIRE MFG CORP                           | 2-4-6-7-8-9-11-20-33-39-40-43-48-52-56-58  |
| KANTHAL CORP                                 | 34-45-51-59  |
| KEISER IND INC                               | 2-38   |
| KELL STROM TOOL CO INC ELECT DIV             | 44   |
| KEMET CO DIV UNION CARBIDE CORP              | 4  |
| KENAMETAL INC                                | 57   |
| KERSSILK PRODUCTS INC                        | 31   |
| KRYSTONE ELECTRONICS CORP N Y                | 20   |
| KIRBY INSTRUMENT CO                          | 17-20  |
| KINGSLEY MACHINE CO                          | 13   |
| KOILED KORDS DIV WHITNEY BLAKE CO            | 6-8-9-11-14-15-52  |
| KOONTZ WAGNER ELECT CO INC                   | 2  |
| KULITE TUNGSTEN CO                           | 44-46-61   |
| KUPFRAIN MFG DIV ROBINSON TECH PRODS INC     | 2-17   |
| KURTSTON ELECTRONICS                         | 2-17-20  |
| LABORATORY FOR ELECTRONICS INC               | 4-5  |
| LAP-TRONICS INC                              | 2-6-7-8-9-14-17-20   |
| LANCE ANTENNA MFG CORP                       | 37   |
| LAND AIR INSTRUMENT & ELECT DIV              | 2  |
| LEACH & GARNER CO INDUSTRIAL DIVISION        | 32-36-45-46-47-49-54   |
| LEEDS & NORTHRUP CO                          | 59   |
| LENZ ELECTRIC MFG CO                         | 4-6-7-8-9-10-11-12-33-35-39-40-48-52-54  |
| THE LEWIS ENGINEERING CO                     | 2-4-6-9-25-28-30-33-35-48-52-58-59   |
| LINEN THREAD CO                              | 19   |
| LINK AVIATION INC SUB GEN PREC EQUIP CORP    | 2  |
| LINK DIV GENERAL PRECISION INC               | 2-17   |
| LITTLE FALLS ALLOYS INC                      | 0  |
| LUDLOW-SAYLOR WIRE CLOTH CO                  | 31   |
| MADIGAN CORP                                 | 2  |
| MAGNETIC SHIELD DIV PERFECTION MICA CO       | 9  |
| MAJESTIC EXTRUDERS INC                       | 23-48  |
| MAKEPEACE DIV D ENGLEHARD INDUSTRIES INC     | 27-36-46-49-54   |
| MANDREL INDUSTRIES INC MEG PRODUCTS DIVISIOS | 2-6  |
| MARKEL & SONS LFRANK                         | 4-6-9-18-40-52-58  |
| MASK O MATIC INC                             | 13   |
| MASTER MOBILE MOUNTS INC                     | 2  |
| MASTER TAPE PRINTERS INC                     | 13   |
| MAXSON ELECTRONICS CORP OLD FORGE            | 4-21   |
| MECTRON CO N PLAINFIELD                      | 4-21   |
| MECTRON CO ROSELLE                           | 4  |
| MERCURY ENGG CORP                            | 2-6-9-38   |
| METAL SPECIALTY PRODUCTS CORP                | 2  |
| MICRODOT INC PASADENA                        | 4-7-12-21  |
| MICRODOT INC MAGNETICS DIV                   | 2  |
| MICRO MAGNA ELECTRONICS CORP                 | 2  |
| MICRO SONIC INDUSTRIES INC                   | 14   |
| MINNEAPOLIS-HONEYWELL CERAMIC LAB            | 2  |
| MINNEAPOLIS-HONEYWELL ORDNANCE DIV           | 2-38   |
| MINNESOTA MINING & MFG CO ST PAUL            | 19   |
| MISSILE SYSTEMS CORP CALIFORNIA DIVISION     | 2  |
| MODEL ENGG & MFG INC                         | 2-38   |
| MODELEKTRIC PRODUCTS CORP                    | 2  |
| MOHAWK COMMUNICATIONS INC                    | 2  |
| MOHAWK WIRE & CABLE CORP                     | 4-6-7-8-9-10-11-21-22-33-40-48-52  |
| MOLECU-WIRE CORP                             | 23-30-33-34-35-46-51-54  |
| MONTROSE PRODUCTS CO INC                     | 0  |
| MOORE & CO SAMUEL                            | 6-9-12-48-52-58-59   |
| MOREY CORP                                   | 2-15-20  |
| MRC MFG CO SUB MATERIALS RES CORP            | 32-44-57   |
| NARROW FABRIC CO                             | 19   |
| NATIONAL ELECTRONICS LAB                     | 2  |

# PRODUCTS & MANUFACTURERS

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| NATIONAL STANDARD CO                         | 55-56  |
| NEPTUNE ELECTRONICS CO                       | 2  |
| NESOR ALLOY PRODUCTS CO                      | 20-23-24-26-27-29-34-36-37-38-41-43-44-45-46-47-49-51-52-53-54-55-56-59-61 |
| NETWORK INDUSTRIES INC                       | 2-20   |
| NEWARK WIRE CLOTH CO                         | 31   |
| NEW ENG ELECT WORKS INC                      | 5-6-10-33-40-41-42-43-54-59  |
| NEWMAN CORP M M                              | 19-38  |
| NIPPERT ELECTRIC PRODUCTS CO                 | 62   |
| NOEL MFG CO                                  | 14-15  |
| NONOTUCK MFG CO                              | 40   |
| NYTRONICS INC LEXINGTON                      | 2  |
| OLYMPIC INSTRUMENTS INC                      | 50   |
| PACIFIC AUTOMATION PRODUCTS                  | 2-6-7-9  |
| PANDUIT CORP                                 | 3  |
| PARALEGICS MFG CO INC PMCO CABLES DIV        | 1-2-38   |
| PAUL F H & STEIN BROS INC                    | 23-31-32-57-62   |
| PERFECTION MICA CO MAGNETIC SHIELD DIV       | 7-9-52   |
| PERMONITE MFG CO                             | 2-38   |
| PHALO PLASTICS CORP                          | 2-4-6-7-8-9-10-11-12-14-15-21-22-33-38-39-40-48-52-58                      |
| PHELPS DODGE COPPER PRODS CORP INCA MFG DIV  | 28-33-34-35-42   |
| PHELPS DODGE ELECTRONIC PRODS CORP           | 4  |
| PHILA INSULATED WIRE CO                      | 2-4-5-6-7-8-9-10-11-12-35-40-43-48-58                                      |
| PHILIPS ELMET CORP                           | 36-42-44-61  |
| PHYSICAL SCIENCES CORP                       | 6-28-42  |
| PIASECKI AIRCRAFT CORP MAYFIELD ELECT DIV    | 2-50   |
| PLASTIC WIRE & CABLE CORP                    | 2-4-6-7-8-9-11-14-15-17-20-22-33-38-40-43-48-52                            |
| PLASTOID CORP HAMBURG                        | 4-6-8-9-10-11-12-21-22-23-33-35-40-43-48-52-58                             |
| PLASTOID CORP LI CITY                        | 4-6-7-8-9-10-11-12-21-22-23-33-40-58                                       |
| POMONA ELECTRONICS CO INC                    | 2-17-20  |
| PORTER CO INC H K RIVERSIDE-ALLOY METAL DIV  | 26-47  |
| PRECISION MADE PRODUCTS INC                  | 2-4-6-38-48-58-59  |
| PRECISION TUBE CO                            | 4-9-10-12-21-52  |
| PRENTISS WIRE MILLS                          | 45-47-55-56  |
| PRESTOLE CORP                                | 3  |
| PRODELIN INC                                 | 4-12-21  |
| PROJECTS UNLIMITED INC                       | 2-20   |
| PYROMETER INSTRUMENT CO                      | 59   |
| QUANTATRON INC                               | 2  |
| RADIAPHONE CO                                | 2-6  |
| RADIATION MATERIALS INC                      | 4-5-6-7-9-10-33-39-40-43-48-52   |
| RADIX WIRE CO                                | 9-12-25-33-34-35-40-46-48-58-59  |
| RAYCHEM CORP                                 | 4-5-6-7-9-10-12-18-39-40-43-48-52  |
| NORTHSIDE                                    | 48-52  |
| RAYCHEM CORP                                 | 4-5-6-7-9-10-12-18-33-40-43-48-52  |
| FAIR OAKS                                    | 48-52  |
| RAYTHERM CORP                                | 4-6-7-9-10-12-33-40-43-48-52   |
| REA MAGNET WIRE CO                           | 23-33-34-42  |
| RECTICO INC                                  | 2-15-38  |
| REGENCY ELECTRONICS INC                      | 2  |
| RENWELL ELECTRONICS CORPORATION              | 2  |
| RETICO INC                                   | 2-15-38  |
| REVERE CORP OF AMERICA                       | 2-5-9-25-35-38-40-58-59  |
| REYNOLDS DIV NATIONAL STANDARD CO            | 31   |
| REYNOLDS METALS CO                           | 1-6-9-23-34-42-48  |
| REYNOLDS WIRE DIV NATIONAL STANDARD CO       | 23-31-45-56  |
| RIEGLER PAPER CORP                           | 38   |
| RIVERSIDE ALLOY METAL DIV                    | 26-45-46-47-51-55-56   |
| ROBERTSON ELEC CO INC                        | 20-38  |
| ROBINAIR MANUF CORP                          | 2-15   |
| ROBINS INDUSTRIES CORP                       | 2-15   |
| ROCKBESTOS WIRE & CABLE CO DIV OF CERRO CORP | 4-6-7-9-10-12-25-35-35-40-43-48-52-38-59                                   |
| ROEBLINGS SONS JOHN A DIV                    | 37-56  |
| ROESCH COMMUNICATIONS DOUGLAS                | 8-9-11   |
| ROHN MFG CO                                  | 37   |
| ROLOCK INC                                   | 31   |
| ROME CABLE DIV ALCOA                         | 1-2-3-4-6-9-23-33-34-35-38-39-40-42-43-48-52                               |
| ROSENTHAL ISOLATOREN GMBH OF SELB W GERMA    | 23-32-36-44-49-57-60-61-62   |
| ROWE INDUSTRIES                              | 2  |
| ROYAL ELECTRIC CORP                          | 2-4-6-7-8-9-10-11-12-14-25-33-34-38-43-48-52                               |
| RUNZEL CORD & WIRE CO                        | 33-38-40-52-63   |
| RUTHERFORD RESEARCH PRODS CO                 | 2  |
| SANDERS ASSOCIATES                           | 2-30-48-58   |
| SAXTON PRODUCTS INC                          | 1-4-6-8-9-10-12-21-22-23-25-34-37-39-40-42-47-48-52-56-58                  |
| SCINTILLA DIV BENDIX CORP                    | 2  |
| SEAELECTRO CORP                              | 2  |
| SECON METALS CORP                            | 23-24-26-28-30-34-36-42-46-47-49-51-54-59-60                               |
| SEMI-ALLOYS INC                              | 23-26-29-32-36-44-49-54-57-58-60-61-62                                     |
| SEQUOIA WIRE                                 | 2-4-6-7-8-9-10-11-12-33-35-39-40-42-43-48-52-58-63                         |
| SERCO ELECT RESEARCH CORP                    | 21   |
| SERVICE ASSOCIATED INC                       | 59   |
| SHAMBAN & CO W S CULVER CITY                 | 18   |
| SHELTERED WORKSHOPS INC                      | 2-38   |
| SIGMUND COHN CORP                            | 23-26-34-36-47-49-59-60  |
| SITTLER CORP                                 | 2-5-17-20-38   |
| C SJOBERG & SON                              | 3  |
| SKYRON CORPORATION                           | 2-3-17-20  |

**PRODUCTS & MANUFACTURERS**

**Wire, Cable & Accessories**

|   |                               |   |                                |  |  |
|---|-------------------------------|---|--------------------------------|--|--|
| SMITH INC HERMAN H                          | 3-8-19-20                     | TEVCO INSULATED WIRE                      | 2-4-8-9-11-12-21-22-           | VIDEON CORP                                  | 2  |
| SMITH THERMOTRONICS INC                     | 10-30-59                      |   | 33-40-52                       | VIRGINIA ELECTRONICS CO                      | 2-14-17                                      |
| SOLAR VOLT CO INC                           | 20                            | THERMAL WIRE OF AMERICA                   | 4-6-9-33-40-42-52-             | WABER ELECTRONICS INC                        | 2  |
| SORENSEN INDUSTRIAL ELECTRONIC CO           | 2                             |   | 58                             | WADE ELECTRIC PRODUCTS CO                    | 2  |
| SOUTHWIRE CO                                | 18                            | THERMATICS INC                            | 4-5-6-9-10-18-35-40-46-47-     | WALDOM ELECTRONICS INC                       | 3-15   |
| SPARTA MFG CO                               | 2                             |   | 48-52-54-55-58                 | WALSCO ELECTRONICS MFG CO                    | 18   |
| SPECTRA-STRIP WIRE & CABLE CORP             | 2-4-5-6-7-                    | THERMAX WIRE CORP                         | 6-9-39-40-48-52-58             | WARD PRODUCTS CORP                           | 2-3-4-9-38                                   |
|   | 8-9-33-34-38-39-40-42-48-52   | THOR CERAMICS INC                         | 17-18                          | WARREN WIRE CO                               | 1-6-9-19-25-28-30-33-34-40-42-43-46-52-54-58 |
| SPERTI FARADAY INC                          | 2-14                          | TIMES WIRE & CABLE DIV THE INTL SILVER CO |                                |  |  |
| STANDARO PLASTICS CO INC                    | 3-38                          |   | 2-4-6-7-8-9-10-12-21-36-38-40- | WATERS CONLEY CO INC                         | 2  |
| STAR-A ELECTRIC MFG CO INC                  | 2-15-38                       |   | 43-48-52-54-58                 | THE WATERS CORP                              | 2-17-38                                      |
| STRATOCON CORP                              | 2                             | TINNERMAN PRODUCTS INC                    |                                | WAVELABS INC                                 | 2  |
| SUPA INSULATIONS INC                        | 4-6-7-8-9-10-33-39-40-        | TOUCH-PLATE MFG CORP                      | 6-33                           | WECKESSER                                    | 3  |
|   | 43-48-52-58                   | TRI ACRE ELECTRONICS                      | 2-38                           | WELTRONIC CO                                 | 2-38   |
| SUPERIOR CABLE CORP                         | 2-4-6-7-8-9-10-11-12-         | TRI-DEX ELECTRONICS                       | 2                              | WESTERN GOLO & PLATINUM CO                   | 49-59  |
|   | 21-33-38-39-40-43-48-52-58    | TRINITY EQUIPMENT CORP                    | 43-59                          | WESTERN INSULATED WIRE CO                    | 6-8-9-15-25-33-39-48-52                      |
| SUPERIOR INSULATED WIRE CO                  | 2-4-6-8-9-10-11-              | U S PLASTIC HOLDING CORP                  | 2                              |  |  |
|   | 12-21-33-40-47-48-52          | U S STEEL AMER STEEL & WIRE DIV           | 0                              | WESTERN INTL CO                              | 1-2-4-7-8-11-12-15-21-33-40-54-58            |
| SURFACE CONDUCTION INC                      | 4-12-21-22-33-48-56           | UCINITE CO DIV UNITED CARR FASTENER CORP  | 2-                             |  |  |
| SWIFT TEXTILE METALLIZING & LAMINATING CORP | 13                            |   | 20-38                          | WESTERN SKY INDUSTRIES                       | 3  |
|   | 2                             | UNIFORM TUBES INC MICRO DELAY DIV         | 4-10-43-                       | WESTLINE PRODUCTS DIV WESTERN LITHOGRAPH CO  | 13   |
| SWITCHCRAFT INC                             | 2                             |   | 52                             |  |  |
| SYLVANIA ELECT PROOS CHEM & METALLURG DIV   |                               | UNIQUE WIRE WEAVING CO INC                | 31                             | WESTWOOD CABLE CORP                          | 2-4-5-6-8-14-15-38-52-                       |
|   | 36-44-54-61                   | UNITEO AERO PRODUCTS CORP                 |                                |  | 59   |
| SYLVANIA ELECTRIC PROD INC PARTS DIV        | 36-45-                        | OIV AERO CHATILLON CORP                   | 2-4                            | WHEELER ELECTRONIC CORP SUB SPERRY RAND CORP | 2  |
|   | 46-53-54-55-56                | UNITED SENSOR & CONTROL CORP              | 59                             |  |  |
| TAFFET ELECTRONICS INC                      | 2                             | UNITED WIRE & SUPPLY CORP                 | 23-33                          | WHITAKER CABLE CORP                          | 2-4-5-6-8-9-14-15-17-                        |
| TA MFG CORP                                 | 3                             | UNIVOX CORP LOS ANG                       | 2-4-7-14                       |  | 33-35-38-40-41-51-52                         |
| TAMAR ELECTRONICS INC                       | 2                             | UNIVOX CORP N Y                           | 2-17-38                        | WILCOX ELECTRIC CO INC                       | 2  |
| TAPE CABLE CORP                             | 6-7-9-11-21-48                | UTILITIES SERVICE CO                      | 3-37                           | WILKINSON CO                                 | 23-26-44-47-49-55                            |
| TECHNICAL APPLIANCE CORP                    | 21                            | VARFLEX CORP                              | 18                             | WIRE CO OF AMER POWNAL                       | 30-43-52                                     |
| TELCON METALS TELCON WORKS                  | 26-42-51-55-59                | VECTOR MANUFACTURING CO HOUSTON           | 2-3-4-5-6-                     | WIRE CO OF AMER GOLETA                       | 4-6-7-9-10-30-33-34-                         |
| TELKOR INC                                  | 2                             |   | 7-8-9-10-11                    |  | 35-39-40-42-43-48-52-54-58                   |
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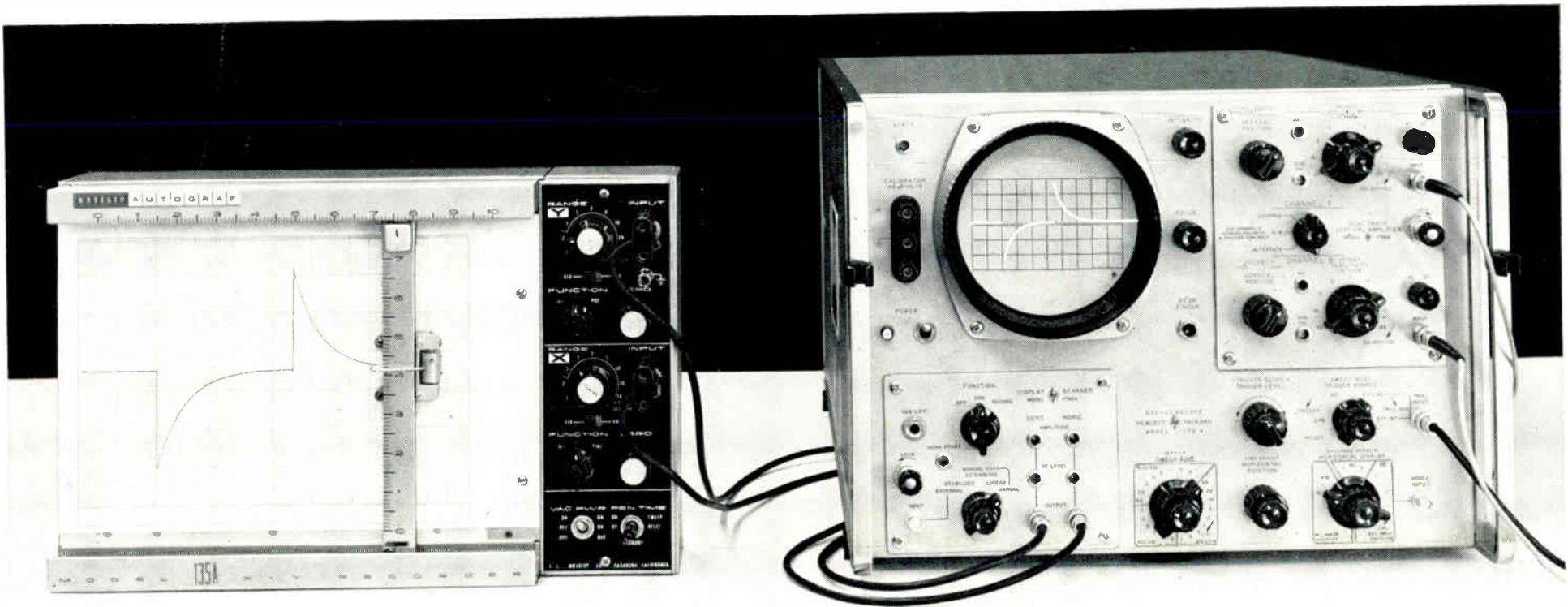
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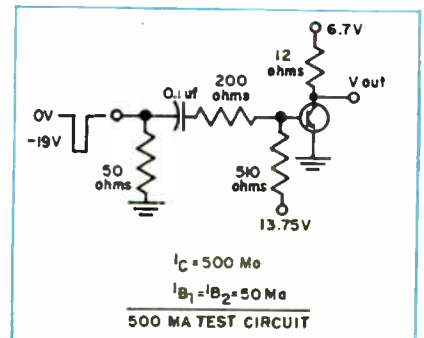
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