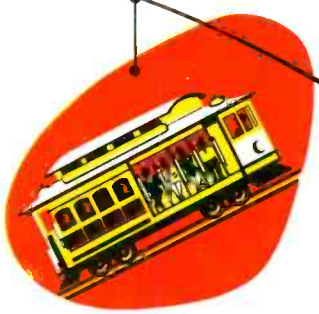
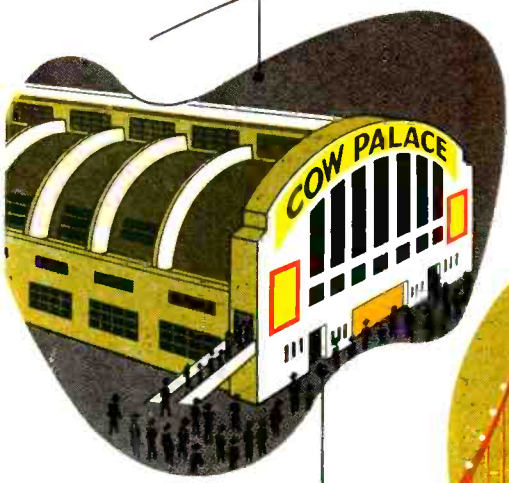
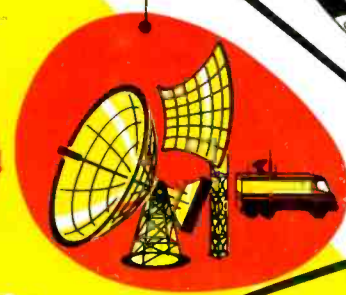
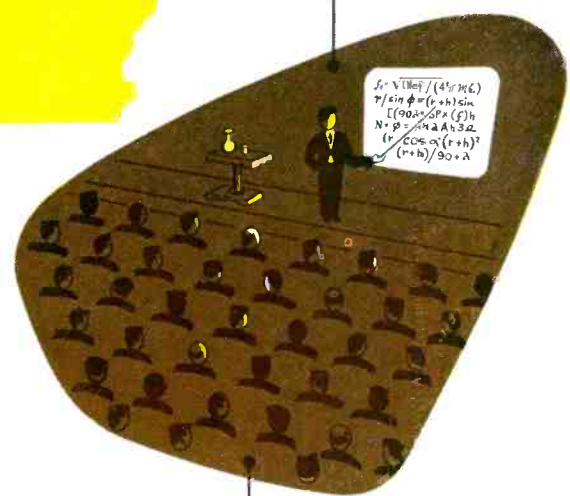
ELECTRONIC INDUSTRIES

WESCON 1959









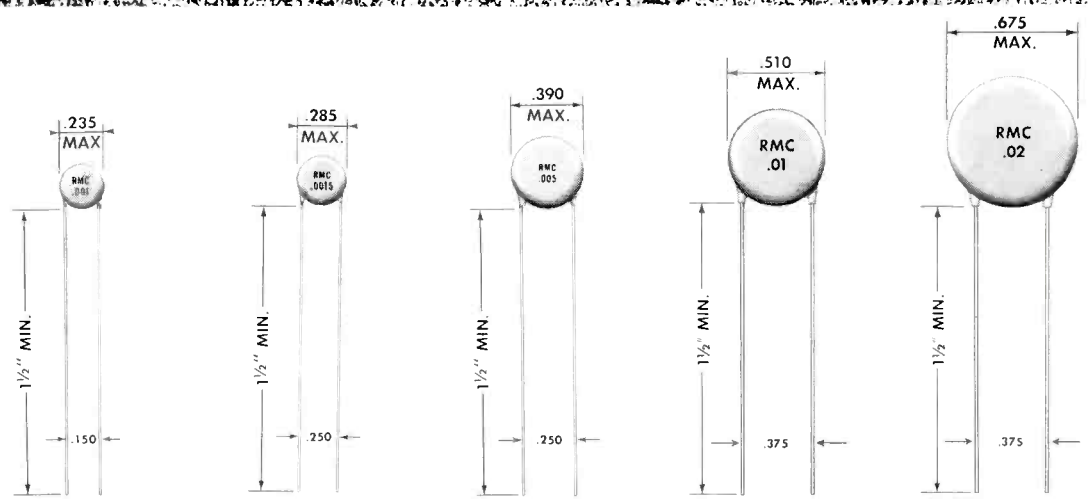
Slightly Higher "East" of the Rockies!

August • 1959

A Chilton Publication

RMC Subminiature DISCAPS

Premium Quality Capacitors for Today's Design Requirements



.001	.0015	.005	.01	.02
Maximum diameter on disc. .235. Measure between leads .150. Capacities available are 800 and .001. Tolerance GMV.	Maximum diameter on disc. .285. Measure between leads .250. Tolerance GMV.	Maximum diameter on disc. .390. Measure between leads .250. Tolerance ±20% +80% —20%.	Maximum diameter on disc. .510. Measure between leads .375. Available +80% —20% or ±20%.	Maximum diameter on disc. .675. Measure between leads .375. Available +80% —20%.

RMC Type SM DISCAPS provide small, low cost capacitors with premium quality standards

Modern electronic design provides less and less space for component parts. In equipment where space is at a premium, Type SM DISCAPS can be specified with assurance of the quality and dependability built in all RMC DISCAPS.

These new DISCAPS meet the specifications of EIA-RS-198 for Z5U ceramic capacitors and are available in values of 800, .001, .0015 GMV; .005 +80% −20% ±20%; .01 +80% −20% ±20% and .02 +80% −20%. SM DISCAPS show minimum capacity change between +10°C and +65°C.

SPECIFICATIONS

POWER FACTOR: 1.5% Max. @ 1 KC (initial)

WORKING VOLTAGE: 500 V.D.C.

TEST VOLTAGE (FLASH): 1000 V.D.C.

LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic (⅛" max. on leads)—vacuum waxed

STAMPING: RMC—Capacity—Z5U

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS COMPANY
A DIVISION OF P. R. MALLORY & CO., INC.
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Circle 1 on Inquiry Card

ELECTRONIC INDUSTRIES

ROBERT E. McKENNA, Publisher • BERNARD F. OSBAHR, Editor

Electronic Growth West and East

WELCOME to our seventh consecutive annual WESCON issue. The growth pattern and rise in national stature of the western electronic industries over the past six years has been truly phenomenal. In 1953, for example, there were only 370 exhibit booths at WESCON and the attendance report was 12,679. Last year there were 911 booths with more than 33,000 in attendance. In our first WESCON issue we listed about 290 active electronic manufacturers in the West Coast directory section, and this year we have some 740. Over the past decade there has been about a 5 to 1 growth in WESCON attendance and nearly an 8 to 1 growth in the number of exhibit booths. The convention to be held at the Cow Palace in San Francisco, August 18-21, this year will be no exception. The growth curve is still rising! On pages 78 and 79 we provide full details describing this important annual event.

And speaking of the western growth pattern, there is a paralleling equally interesting Eastern pattern emerging. H. Myrl Stearns, Chairman of the Board of WESCON in his article "Slightly Higher East of the Rockies" (page 76 this issue) points out that climate alone is not the only factor to help spur Western growth. "A built-in major scientific complex afforded by such universities as Stanford, University of California, and California Institute of Technology was a major inducement to individuals. . . ."

Along these lines, Herman Fialkov, President of General Transistor Corp. before the June meeting of the Long Island Electronic Manufacturers Council has suggested a program for the further development of an academically based research center on Long Island. Pointing out that there are well over 3700 electronic engineers in this area, and that it is becoming increasingly difficult for these men to contact the educational institutions in New York City proper, Mr. Fialkov is urging the local manufacturers to support and help expand the Research Center started at Adelphi College in 1957. Dr. Francis K. Ballaine, Executive Director, outlines ARC as 1. An academic based research center. 2. A graduate science school. 3. A center for scientific meetings, etc. 4. A specialized library. 5. A center for management training programs.

Dr. Ballaine also points out that according to the figures provided him by the Federal Small Business Administration, in Nassau county alone there were 386 small businesses as of November 1, 1954. As of the first quarter of 1956 there were 1155 for a gain of some 300% over a two-year period. The growth trend is still rising.

Long Island manufacturers supporting the program with contributions (ranging from $500 each) are offered the following advantages: 1. The privilege of preconsulting with the faculty and staff of the ARC, free of charge, to explore basic research areas. 2. Priority of access over non-members to the research facilities and consulting services of the Center, including use of the analog computing center. 3. Associates will receive a yearly report on the work of the Center, which will take the form of an all-day workshop meeting. 4. Associates may send representatives free of charge to special workshops, seminars, science lectures and other meetings as may be scheduled. 5. Associates may use their affiliation with the Adelphi Research Center in their promotional material.

We heartily endorse this development for it is truly part of the pattern of today's growing electronic industries. The manufacturer - educational complexes have been highly successful in such areas as Los Angeles, San Francisco, and Route 128 in Boston. Long Island will be no exception!

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ELECTRONIC INDUSTRIES, August, 1959. Vol. 18, No. 8. A monthly publication of Chilton Company. Executive, Editorial & Advertising offices at Chestnut & 56th Sts., Phila. 39, Pa. Accepted as controlled circulation publication at Phila., Pa. $1 a copy; Directory issue (June), $5.00 a copy. Subscription rates U. S. and U. S. Possessions: 1 yr. $10.00; 2 yrs. $18.00. Canada 1 year, $12.00; 2 yrs. $20.00. All other countries 1 yr. $18.00; 2 yrs. $30.00.

ELECTRONIC INDUSTRIES

Vol. 18, No. 8 August, 1959

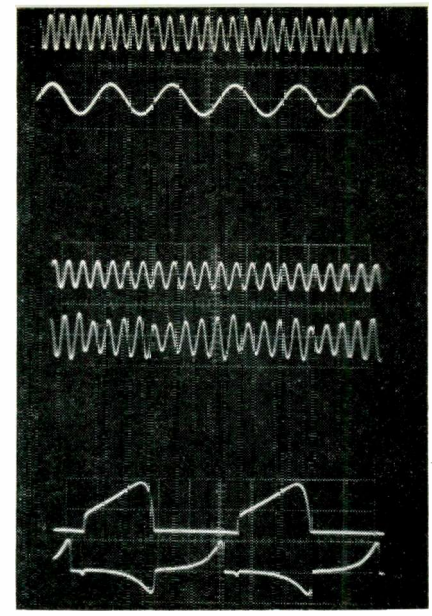
MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

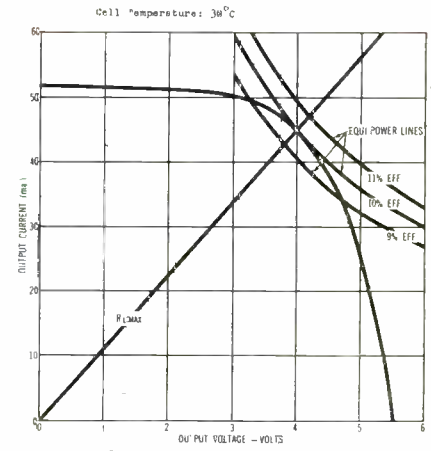
DEPARTMENTS

Highlights

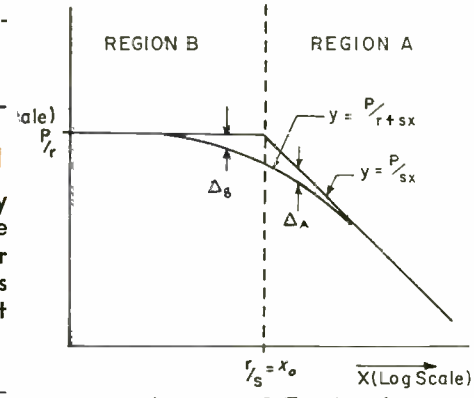
Of This Issue



Frequency Multiplication

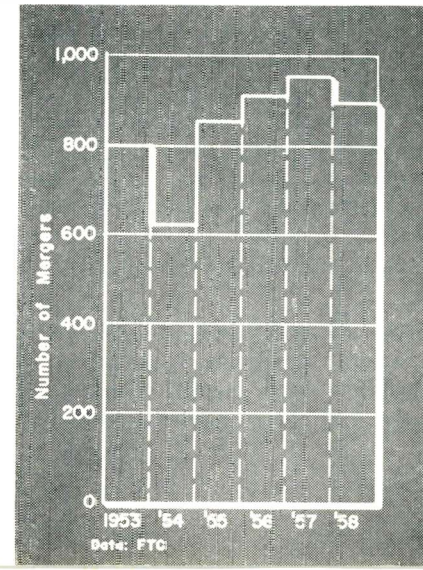


Silicon Photovoltaic Cells



Asymptotes & Transistors!

Why Companies Merge!



RADARSCOPE

MEASURING PLASMA TEMPERATURE

Scientist at the Avco Research and Advanced Development Div. in Wilmington uses an ultrasonic pulse system to measure the temperature of the new plasma jet developed by Avco. The quartz probes transmit sound pulses which are converted to temperature readings.

U. S.-EUROPE TV LINK is foreseen within 5 years by relaying the signals via the moon. A spokesman for Britain's Pye Telecommunication Ltd. says the first experiments would transmit live transatlantic TV pictures via 100 ft. metal plastic balloons capable of reflecting the wide band frequency used in present transmissions. He says that narrow band TV transmissions will have to be developed before TV pictures can be relayed via the moon.

NEW COMPUTING TECHNIQUE under development by RCA is said to step up computer speeds 1000 times over present systems. As described by Dr. Jan A. Rajchman of the David Sarnoff Research Center, the method involves a combination of microwave and solid state techniques in a system based on the use of super-high-frequency principles. Such a computing system could handle information in the form of frequency pulses varying from 1 to 10 KMC. The computer signals would be in the form of electrical oscillations at these frequencies. Oscillation in one phase represents the digit "1," while a signal 180° out-of-phase would represent "0."

THE AEROSPACE INDUSTRIES ASSOCIATION predicts a marked increase in the use of inertial guidance and control systems during the next 10 years and a proportionate decrease in non-inertial systems. They predict that Doppler-inertial and stellar-inertial systems will be in considerable use by 1965 in both second generation missiles and space vehicles. At the same time they predict an increase in the use of infrared guidance systems for manned aircraft during the 1960's but a sharp drop off by 1970.

TWO-COLOR TV SYSTEM may be possible, according to Dr. Edwin Land, President of Polaroid Corp. While he admits that there are many obstacles in the past of this kind of simplified TV color, he feels that it very definitely possible to give the full range of colors in only two basic color sources. Some experimentation has already been done with rudimentary two-color processes. Bell Labs' experience has been that the two-color process turns out good looking pictures some of the time but it is difficult to insure natural color all through the complete sequence.

THE "TUNNEL DIODE" announced last month by RCA is described as "an extremely simple and potentially cheap device that will be capable of operating over a wide range of frequencies in virtually any type of circuit that now employs low power tubes or transistors." The experimental units have been operated at frequencies to 1000 MC and a potential range is seen to beyond 10,000 mc. It is described as having characteristics similar to those of the parametric amplifiers, but much simpler circuitry.

SHOOTING STARS

At Sperry's "Ashore Polaris Navigation Center," designed to check out navigation equipment going into the Polaris-launching submarines, two technicians run check on operation of 1-ton stabilized periscope which will take star fixes while submarine is submerged.

JAPANESE TV INDUSTRY is growing phenomenally. The 6 year old medium, which uses American standards of transmission, has mushroomed to more than 2 million sets, 34 stations. Station equipment is predominantly Japanese manufactured.

PAY TELEVISION

PAY TV IS FAR FROM DEAD. International Telemeter Co., Div. of Paramount Pictures, announced last month they were installing closed-circuit cable facilities in a suburb of Toronto, Canada. The first public demonstration is scheduled for the Fall. The wire paid TV system will offer three channels. Telemeter officials explained their decision: (1) cable facilities are already in wide use in more than 500 community antenna systems in the U. S. and about 200 in Canada, serving over half million homes (2) the economics of a wire paid TV system offering 3 channels are much more favorable than a broadcast paid TV system on one channel (3) a wire system permits the continuous rerunning of a program several times in the day or evening to suit the convenience of the customer, where broadcasting over the air on this basis would be prohibitively costly (4) the "break-even" point on a wire system is substantially below that of a broadcast system, though at a certain point of saturation in a large market the economics of a broadcast system can be more favorable. Plans call for at least 5 installations of at least 5000 home units during the Fall and Winter months.

FOREIGN TRADE

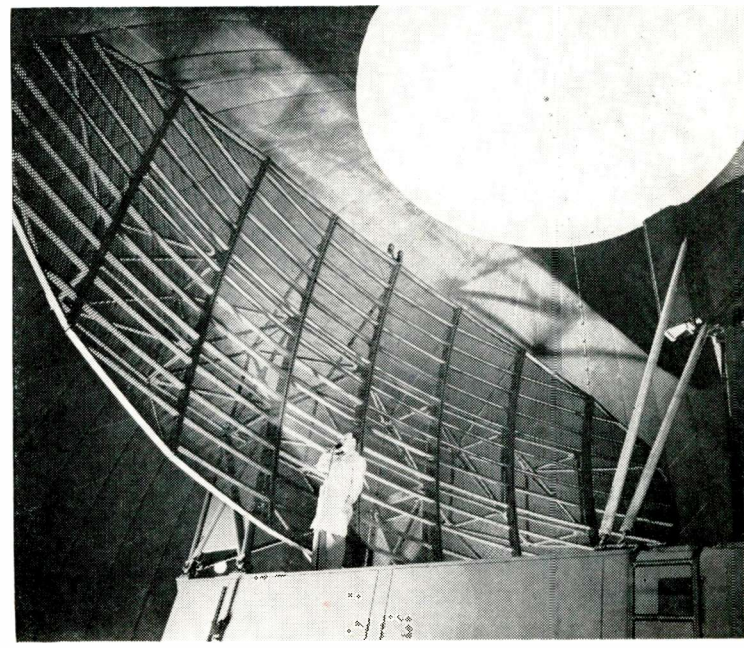
JAPANESE ELECTRONIC INDUSTRY is probing cautiously to find the least obtrusive way of invading the U. S. electronic market. The initial ground work has been laid during the past few years through rigid quality control of Japanese exports. The Japanese reputation for shoddy, inferior products has been largely dispelled and in its place there is a very considerable regard for Japanese engineering ability. In fact, in certain phases of electronics—notably microwave—the Nipponese are already in the front rank of development. Exactly how this can be exploited, however, without arousing the American electronic industry to angry reprisals is a dilemma. For the moment attempts are being made to supply only items for equipment that U. S. manufacturers do not make, but this containment must certainly be short-lived. Japanese manufacturers are even happy to split the profits with American manufacturers by shipping in components for assembly by American firms. But this arrangement, too, must be considered temporary for inevitably some firms will break the ice by shipping in complete pieces of equipment and the flood will certainly follow. This vulnerability of American industry must continue so long as labor costs represent such a large slice of equipment cost.

ENGINEERING EDUCATION

THE UNIVERSITY-AND-INDUSTRY TIEUP that has proved so successful in Boston and San Francisco areas is being studied by a group of electronic manufacturers in Long Island, New York, with the hope that some type of similar arrangement can be established. It is becoming increasingly clear that the intellectual stimulation and research-mindedness that the university atmosphere creates is an absolute necessity for an area planning long term participation in the electronic field. The need basically is for engineers—more specifically for creative engineers—and the most imaginative engineers are found in those areas where ample opportunities are available for post graduate courses and general research study. This has been amply demonstrated in Boston where MIT serves as the intellectual center for the engineering community, and in San Francisco where Stanford Research Institute is serving a similar role. The Long Island engineering community is particularly knowledgeable in production techniques. Most of the larger firms in the area are production-wise companies. But if the area is ever to achieve first rank in the electronic industry, facilities must be made available to stimulate new ideas. The proposal now under consideration would expand the presently existing Adelphi Research Center in Garden City, Long Island. The electronic firms throughout the area are being called on to contribute towards the project in accordance with their ability. Herman Fialkov, President of Transistor Corp. is leading the movement.

FOR AIR DEFENSE

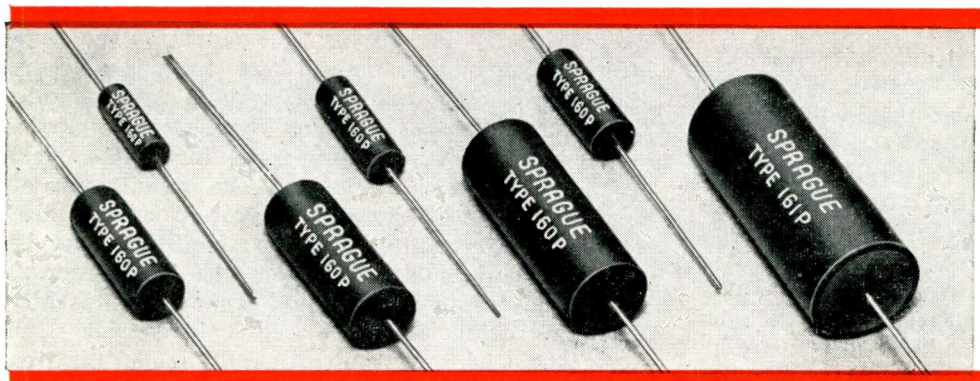
New FPS-7 multi-beam radar system by GE's Heavy Military Electronics detects air targets at greater ranges and higher altitudes than present radars. It will be used in the SAGE system. Antenna screen measures 40 x 18 ft. The assembly weighs more than 7 tons.



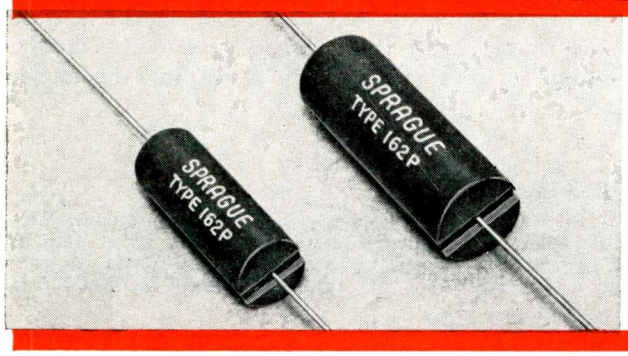
DIFILM® DUAL DIELECTRIC

gives new BLACK BEAUTY® series of small, low-cost capacitors outstanding performance characteristics

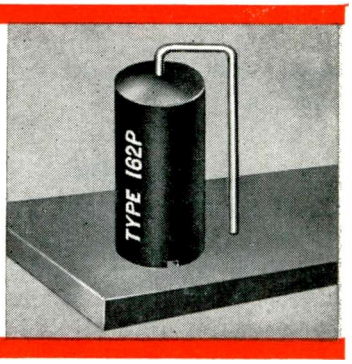
- withstand 105C operation with no voltage derating
- moderate capacitance change with temperature
- excellent retrace under temperature cycling
- superior long-term capacitance stability
- very high insulation resistance



NEW!... DIFILM Type 160P fully-molded case and Type 161P pre-molded case capacitors in 5/16" to 1" diameters for general commercial and entertainment electronics.



NEW!... DIFILM Type 162P slotted-base multi-purpose molded case capacitors for auto radios and other severe vibration applications. Slot prevents collection of moisture around leads when capacitor is end-mounted against chassis.



● New DIFILM Black Beauty Capacitors represent a basic advance in paper tubular capacitor design. DIFILM Capacitors combine the proven long life of paper capacitors with the effective moisture protection of plastic capacitors . . . by using a *dual dielectric of both cellulose and polyester film that's superior to all others for small, yet low cost, capacitors.*

● Just check the characteristics listed above. This overall performance is fully protected by HCX®, an exclusive Sprague hydrocarbon material which impregnates the windings, filling all voids and pinholes before it polymerizes. The result is a solid rock-hard capacitor section, further protected by an outer molding of humidity-resistant phenolic. *These capacitors are designed for operating temperatures ranging up to 105°C (221°F) . . . at high humidity levels . . . without voltage derating!*

For complete specifications on DIFILM Black Beauty Capacitors, write for Bulletin 2025 to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

SPRAGUE®
THE MARK OF RELIABILITY

SPRAGUE COMPONENTS:

CAPACITORS • RESISTORS • MAGNETIC COMPONENTS • TRANSISTORS • INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • CERAMIC-BASE PRINTED NETWORKS • PACKAGED COMPONENT ASSEMBLIES

As We Go To Press...

See Computers Using Coded Light Signals

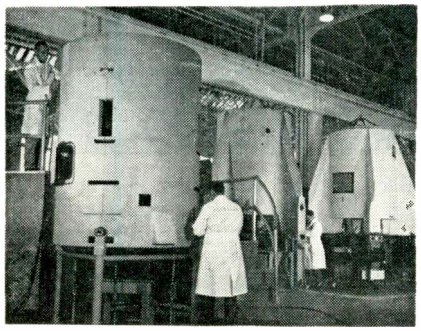
High-speed data-handling systems that "read" print or pictures in the manner of the human eye and process information in the form of coded light signals, may ultimately result from new optical-electronic techniques.

The new methods, being explored at RCA's David Sarnoff Research Center, Princeton, N. J., and other laboratories, are based upon the use of light-sensitive and light-emitting devices linked in networks to perform the coding, switching and information storage functions basic to electronic computing and data-processing.

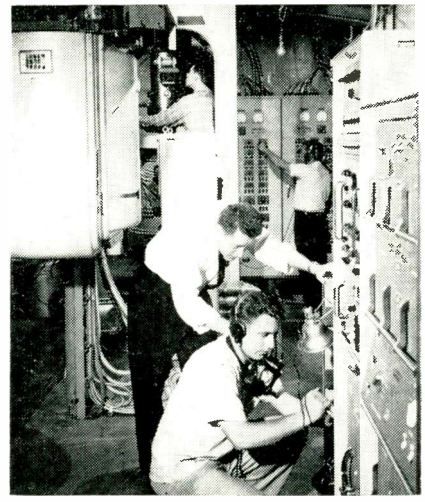
Such systems might be constructed with various arrangements of image processing panels comprised of photoconductive units, which permit passage of current when they are exposed to light, and electroluminescent elements, which emit light upon direct application of a current. Both types of units are extremely small and consume little power, permitting the ultimate use of many such elements in compact and economical systems.

The flow of information would be controlled by the direction of light along optically selected directions to influence the photoconductor cells, which would act as "gates" controlling the flow of current to the electroluminescent units. In successive stages, the electroluminescent cells would themselves be the sources of light controlling further photoconductor cells and their associated electroluminescent units, creating a versatile network.

PROJECT MERCURY



Tail sections for the ballistic rocket that will carry man into space are nearing completion at Reynolds Metals, Sheffield, Ala.



Sperry specialists run test navigation problem on their new "Navigation Island"

'Print Reader' Scans 200 Characters/Sec

The U. S. Air Force Air Research and Development Command has developed a new information machine which reads typewritten pages and translates them into electrical signals at the rate of 200 characters/second. The new machine, the first of its kind, was developed by the Intelligent Machines Research Div. of Farrington Mfg. Co., Arlington, Va.

The Print Reader MX-2021 is based in part on the techniques used in Farrington's commercial print reading machines but it is far more advanced than any existing commercial installation in that it reads ordinary typewritten sheets having both upper- and lower-case alphabetical characters; numerals which are self-checking for accuracy; and even reads the punctuation symbols.

As it scans a line at a time, it reads the information one character at a time, and upon identification, using stored electronic logic, it instantaneously converts the information into electrical signals at the rate of 200 characters per second.

The Air Force interest in the Print Reader centers upon a never-ending maintenance of millions of pages of information which must be processed before being used. All technical information must be indexed and abstracted so scientists will know the information exists and locate the information when they need it.

"Polaris" Sub Controls Duplicated On Land

An exact replica of a "Polaris" missile launching submarine's navigational control center has been put into operation by Sperry Gyroscope Co. at their Syosset, L. I., plant.

The navigational instruments that will guide all Navy's Polaris submarines are being system-tested in a control center identical to that aboard a submarine. Precise underseas navigation is imperative to assure a successful trajectory of the missile over the eventually planned 1500-mile range.

Officially called the "Ashore Polaris Navigation Center," it is more commonly referred to as the "Navigation Island."

Among the major instruments and systems to be tested in the Ashore Polaris Navigation Center are: NAVDAC (The Navigation Data Assimilation Center, a master computer), SINS (the Ship's Inertial Navigation System), the Type 11 Stabilized Periscope System (permitting celestial navigation while submerged) and other systems, still highly classified.

The dimensions, shape and cabling of the sub's navigation control center have been reproduced exactly in the ashore test facility. The simulated hull section is a duplicate of the sub's navigation center.

Although much of this equipment has been used on other ships (i.e.: inertial navigators and NAVDAC aboard Navy's test ships OBSERVATION ISLAND and COMPASS ISLAND) this will be the first time that all of the instruments will be working in concert as a complete system in the confined area available on a submarine.

Sperry expects to uncover a wealth of information on the very intricate installation and operation of the maze of wiring and cabling needed for submarine navigational equipment.

In addition, Sperry will develop casualty control procedures for emergency operation in the event of an injury to personnel or damage to equipment.

MORE NEWS ON PAGE 10

THE HUGHES 21″ TONOTRON® tube offers you greater viewing area for your radar read-out applications. This new 21″ tube is especially suited to jet-age air traffic control. Its giant display area enables air controllers to locate and track high-speed aircraft with an accuracy never before attained.

This new TONOTRON tube provides high light output, integration abilities, full gray scale, controllable persistence, and a very large display area—all in one envelope!

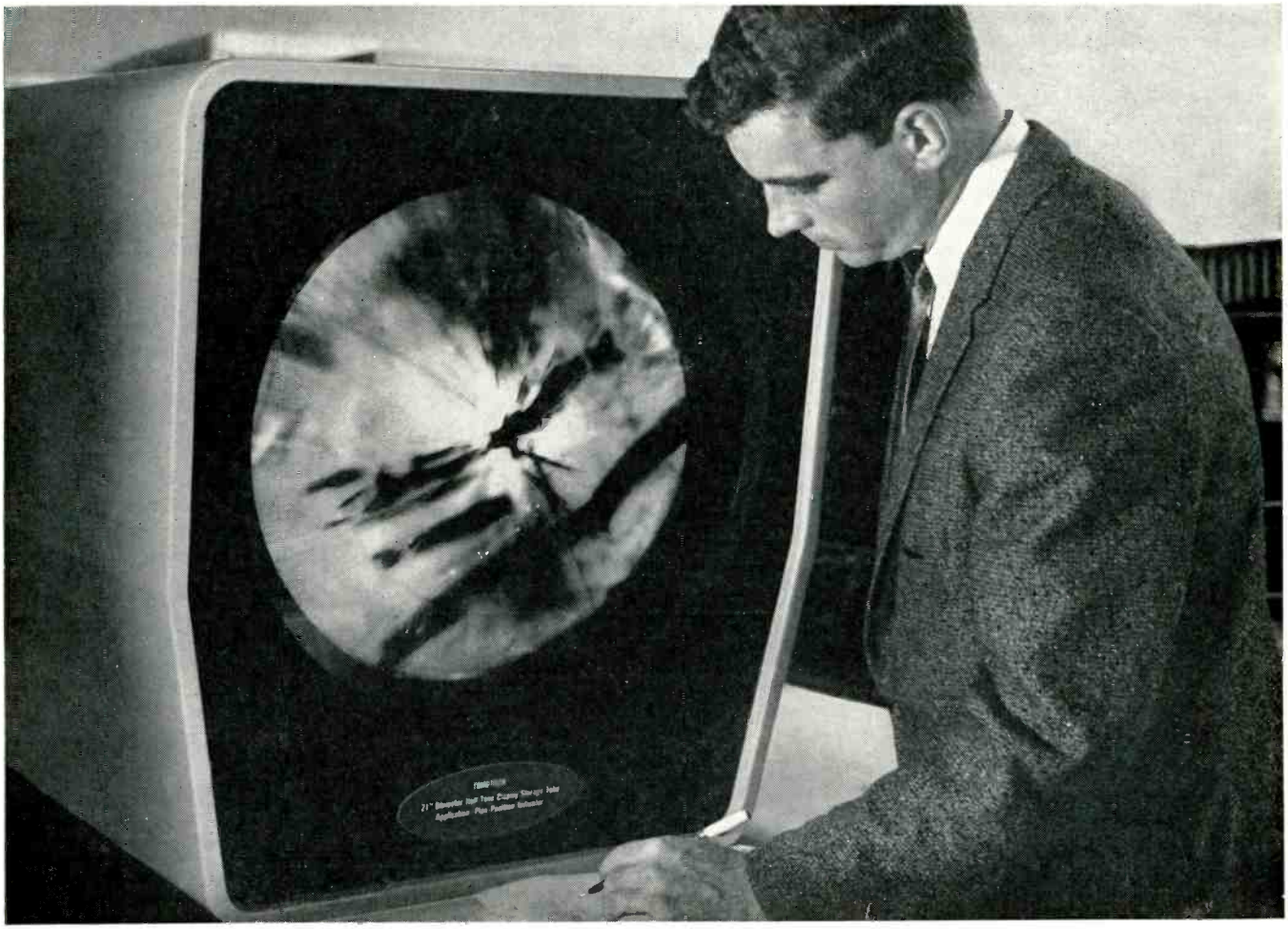
Other applications for this advanced 21″ storage tube include: combat situation plotting, radars, large-scale read-out, medical diagnosis, industrial television and slow-scan displays.

Available also from Hughes is a 21″ character-writing TYPOTRON® storage tube, which gives you the *added* capability of high-speed character and spot writing displays in addition to the full gray scale. The Hughes 21″ TYPOTRON tube is ideally suited for any of your complex digital read-out requirements.

Both the 21″ TONOTRON tube and the 21″ TYPOTRON tube are now available for delivery. For additional information regarding these tubes please write: Hughes Products, Electron Tubes, International Airport Station, Los Angeles 45, California.

For Export information write: Hughes International, Culver City, California.

THE BIG PICTURE FOR RADAR DISPLAYS

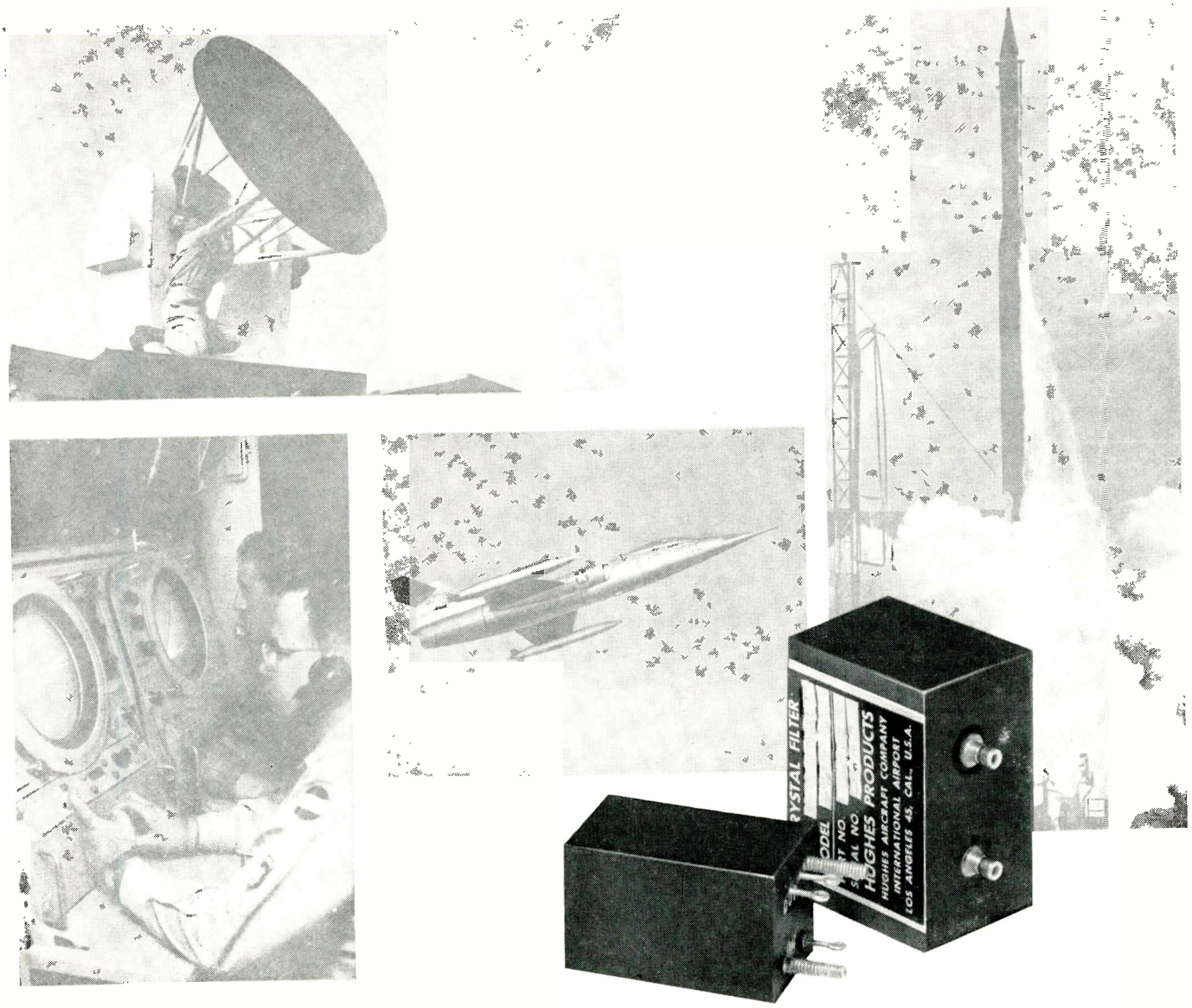


See the new Hughes 21″ TONOTRON tube in action at WESCON (Booths 3012-3018)

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

SEMICONDUCTOR DEVICES · STORAGE TUBES AND DEVICES · MICROWAVE TUBES · VACUUM TUBES AND COMPONENTS · CRYSTAL FILTERS · MEMO-SCOPE® OSCILLOSCOPES · INDUSTRIAL CONTROL SYSTEMS



If you're looking for a high-performance crystal filter

At your service is a group of highly talented Hughes Crystal Filter engineers who specialize in solving difficult network problems. These men can design and produce a crystal filter to meet your most exacting requirements! In addition, Hughes offers you tremendous production capacity—over 10,000 filters per month of a single type. With Hughes Crystal Filters you get:

Precise Selectivity—Eliminates cross talk between channels, makes new systems possible.

Small Size—Reduces overall equipment size, makes filter more reliable by eliminating air space, results in higher stress factor.

High Frequency—Saves circuit costs, eliminates the need for double conversion. Center frequencies 30 kc to 40 mc.

Low Passband Ripple—Eliminates errors in information, enables end equipment to be more precise.

Wide Temperature Stability—Provides flexibility of use, contributes to high reliability.

Low Insertion Loss—Enables system to operate on low signal level—thereby combating noise and cutting circuit costs.

To avail yourself of the Hughes applications engineering service, or for additional information concerning performance levels please write: HUGHES PRODUCTS, *Industrial Systems Division, Marketing Dept., International Airport Station, Los Angeles 45, California. For Export, write: Hughes International, Culver City, California.*

See Crystal Filters and other Hughes Products at WESCON: Booths 3012-18.

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SEMICONDUCTOR DEVICES • STORAGE TUBES AND DEVICES • MICROWAVE TUBES • VACUUM TUBES AND COMPONENTS • CRYSTAL FILTERS • MEMO-SCOPE® OSCILLOSCOPES • INDUSTRIAL CONTROL SYSTEMS

ELECTRONIC SHORTS

▸ An advanced radar mapping system is being seriously considered by the U. S. Army. Development on the project is under way at Goodyear Aircraft Corp., Arizona Div. The project involves a study of the application of airborne radar sensing and applicable data reduction procedures to establish design parameters and military characteristics for a complete, integrated topographic mapping radar system.

▸ Other aerial projects by the Army include a reconnaissance system capable of taking, processing, and transmitting aerial photographs from an airborne vehicle to a ground station for immediate viewing. Fairchild Camera and Instrument Co. is doing the development. This first fully automatic system will produce a photographic reproduction on the ground within two minutes after an aerial photograph is taken from an airborne vehicle. It is being designed for use in either manned or unmanned vehicles by all the services.

▸ The FAA has formed a new group to probe airborne anti-collision systems and to contribute research on the problems of collision prevention. Members of the Collision Prevention Advisory Group have been chosen from six major fields representing civil and military aviation and will work with the FAA's Bureau of Research and Development. Objective of the group is to assist in the development of suitable airborne collision prevention devices in a minimum amount of time through the most efficient use of available funds, personnel and facilities.

▸ The Navy has awarded a contract for more than $11-million to the Military Div. of Remington Rand Univac for fabrication and production of advanced shipboard computing systems. The transistorized computer has been designed to meet rigid military requirements even under extreme environmental conditions. The basic computer is contained in a single cabinet about the size of a businesman's desk. Total power consumption is no greater than that of a common household iron.

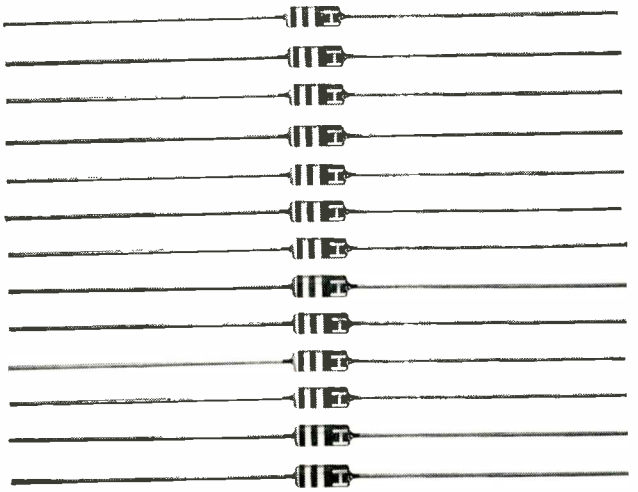
▸ Two appointments in the Willow Run Laboratories of The University of Michigan have been approved. Wray Smith, an administrative associate in the laboratories, is now assistant director. Dr. Louis J. Cutrona, professor of electrical engineering, becomes a research engineer, and will serve as head of the Willow Run Radar Laboratory.

▸ The House Committee on Science and Astronautics is making a study of the contracts and contracting procedures of the National Aeronautics and Space Administration and the other government agencies over which the Committee has jurisdiction. The Committee is interested in determining the actions being taken by the NASA, and the National Science Foundation in their research and development programs with regard to contracts, with special emphasis on the contracting procedures being employed by the agencies.

▸ A profitable 2200-mph transport can be built and certificated as early as 1965, according to Lockheed Aircraft Corp. Design studies and testing indicate solution of all major technical problems which previously blocked development of a Mach. 3.0-to-3.5 airliner.

▸ The NATO partners—Belgium, France, the Federal Republic of Germany, Italy and The Netherlands—expect to procure more than $400,000,000 worth of HAWKs from their own production. A European prime contractor, the Societe Europeene de Teleguidage, has been set up in Paris by the major electronics industries of the five countries concerned. The Societe, in turn will sub-contract to other firms in the five-nation group.

▸ Allan F. Donovan, vice president and director of Advanced Systems Planning at Space Technology Laboratories, Inc., has been named a delegate to a panel of technical experts which will advise the U. S. Committee on Nuclear Testing. One of the nation's top figures in the space technology field, Donovan will advise the Committee on the possibilities of using space vehicles to carry out undetected nuclear tests in outer space.



HIGH VOLTAGE RECTIFIERS

in reliable, subminiaturized packages

You'll find Hughes silicon rectifiers ideally suited to design problems which combine high voltage with small size. In fact, Hughes rectifiers can handle **more** voltage than **any** rectifiers of comparable size.

You also get high reliability. Packaged in the Hughes glass envelope—proven dependable throughout many years of testing and use—this rectifier will stand up under highly adverse operating conditions.

Hughes silicon rectifiers are also packaged in modules in various configurations, such as: ring modulators, matched pairs and quads, etc.

The complete line of Hughes rectifiers ...with 50 to 1000 volt ratings at 50 to 200 mA...is available for immediate delivery—and in large volume quantities. For additional information, you are invited to write or phone the Hughes Semiconductor sales office or distributor nearest you. Or write: Hughes Products, Marketing Department, **SEMICONDUCTOR DIVISION, NEWPORT BEACH, CALIFORNIA.**

For export write: Hughes International, Culver City, California.

RATINGS AND SPECIFICATIONS: Absolute Maximum Ratings at 25° C.

JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)
1N846	50	35	200	2A
1N847	100	70	200	2A
1N848	200	140	200	2A
1N849	300	210	200	2A
1N850	400	280	200	2A
1N851	500	350	200	2A
1N852	600	420	200	2A
1N853	700	490	200	2A
1N854	800	560	200	2A
1N855	900	630	200	2A
1N856	1000	700	200	2A
1N857	50	35	150	1.5
1N858	100	70	150	1.5
1N859	200	140	150	1.5
1N860	300	210	150	1.5
1N861	400	280	150	1.5
1N862	500	350	150	1.5
1N863	600	420	150	1.5
1N864	700	490	150	1.5
1N865	800	560	150	1.5
1N866	900	630	150	1.5
1N867	1000	700	150	1.5

JEDEC No.	PIV	RMS Volts	Max. Average Rectified Current mA	Max. Surge Current One Cycle (amp)
1N868	50	35	100	1.0
1N869	100	70	100	1.0
1N870	200	140	100	1.0
1N871	300	210	100	1.0
1N872	400	280	100	1.0
1N873	500	350	100	1.0
1N874	600	420	100	1.0
1N875	700	490	100	1.0
1N876	800	560	100	1.0
1N877	900	630	100	1.0
1N878	1000	700	100	1.0
1N879	50	35	50	.5
1N880	100	70	50	.5
1N881	200	140	50	.5
1N882	300	210	50	.5
1N883	400	280	50	.5
1N884	500	350	50	.5
1N885	600	420	50	.5
1N886	700	490	50	.5
1N887	800	560	50	.5
1N888	900	630	50	.5
1N889	1000	700	50	.5

Storage temp. −65° to +200°C.
Max. Leakage current full cycle average 20μA.

Typical Full Load Forward Voltage Drop Full Cycle .6 Volts.

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Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period August-October that are of special interest to electronic engineers

Aug. 3-6: 25th Annual Convention, Associated Police Communications Officers, Inc., Shirley Savoy Hotel, Denver, Colo.

Aug. 4-5: Annual Western National Meeting, American Astronautical Society; Los Angeles, Calif.

Aug. 9-12: Heat Transfer Conference, ASME; University of Connecticut, Storrs, Conn.

Aug. 10-17: Meeting International Assoc. of Electrical Leagues; El Cortez Hotel, San Diego, Calif.

Aug. 17: 1st National Ultrasonics Symposium, IRE (PGUE); Stanford University, Stanford, Calif.

Aug. 18-21: WESCON, West Coast Electronic Manufacturers Assoc., 7th Region IRE; Cow Palace, San Francisco, Calif.

Aug. 20-24: Annual Convention, Nat'l Alliance of TV & Electronic Service Assoc.; Congress Hotel, Chicago, Ill.

Aug. 24-26: Meeting, American Rocket Society; Evanston, Ill.

Aug. 27-29: Meeting, American Physical Society, AIP; Hawaii.

Aug. 31-Sept. 2: Army-Navy Instrumentation Program, Symposium and Industry Briefing, Statler Hilton Hotel, Dallas, Tex.

Aug. 31-Sept. 2: Conference on Semiconductors, Metallurgical Society of AIME, Statler Hotel, Boston, Mass.

Sept. 1: 6th International Meeting, Institute of Management Sciences; Paris, France.

Sept. 5-6: New England Division Convention, American Radio Relay League; Hartford, Conn. (Tent.)

Sept. 10-11: Midwest Sections Conf., SPI; Sheraton Hotel, French Lick, Ind.

Sept. 10-21: Radio, TV, and Records Exhibition, Federation Nationale Des Industries Electroniques; Exhibition Park, Porte de Versailles, Paris, France.

Sept. 12-21: 6th European Machine Tool Exhibition, Rond-Point de la Defense, Puteaux (Seine), Paris, France.

Sept. 13-16: 11th Electronic Industry Conf., Electronic Representatives Assoc.; Excelsior Springs, Missouri.

Sept. 15: Conf. on Photosensitive Materials and Silk Screen Processes, Western Assoc. of Circuit Manufacturers; Rodger Young Aud., Los Angeles, Calif.

Sept. 16-18: Engineering Management Conference, ASME; Statler Hilton Hotel, Los Angeles, Calif.

Sept. 17-18: Engineering Writing & Speech Symposium, IRE (PEGWS); Boston & Los Angeles.

Sept. 17-18: 2nd Conf. on Nuclear Radiation Effects on Semiconductor Devices, Materials, and Circuits, ODR, Advisory Group on Electron Tubes; Western Union Auditorium, New York City.

Sept. 18: Dinner Meeting, Association of Electronic Parts & Equipment Manufacturers, Chicago, Ill.

Sept. 20-23: Petroleum Mech. Engrg. Conf., ASME; Rice, Houston, Tex.

Sept. 21-22: 8th Annual Meeting, Investment in Survival, Standards Engineering Society; Somerset Hotel, Boston, Mass.

Sept. 21-23: 8th Annual Meeting, Standards Engineers Society; Somerset Hotel, Boston, Mass.

Sept. 21-25: 14th Annual Instrument-Automation Conf. & Exhibition, ISA; International Amphitheater, Chicago, Ill.

Sept. 22-24: Quarterly Conf., Electronic Industries Assoc., Plaza Hotel, New York City

Sept. 22-24: 3rd Industrial Nuclear Technology Conf. ARF, AEC; Morrison Hotel, Chicago, Ill.

Sept. 23-25: 4th Annual Special Technical Conf. on Non-linear Magnetics & Magnetic Amplifiers, AIEE, IRE; Shoreham Hotel, Washington, D. C.

Sept. 28-30: National Symposium on Telemetering, IRE (PGTRC); Civic Auditorium and Whitcomb Hotel, San Francisco, Calif.

Sept. 28-Oct. 1: National Fall Meeting, American Welding Society; Sheraton-Cadillac Hotel, Detroit, Mich.

Sept. 30-Oct. 1: Industrial Electronics Symposium, IRE, AIEE; Mellon Institute, Pittsburgh, Pa.

Oct. 1-2: 15th New England Section Conf., SPI; Wentworth-by-the-Sea, Portsmouth, N. H.

Oct. 5-7: 5th National Communications Symposium, IRE; Hotel Utica, Utica, N. Y.

Oct. 5-9: 11th Annual Convention, Audio Engineering Society; Hotel New Yorker, New York, N. Y.

Oct. 5-9: 86th Semiannual Convention, including Equipment Exhibit, Society of Motion Picture & TV Engineers; Statler Hotel, New York, N. Y.

Oct. 5-16: 7th Anglo-American Conference, IAS, Royal Aeronautical Society, Canadian Aeronautical Institute, Institute of the Aeronautical Sciences; Hotel Astor, New York, N. Y.

Oct. 6-7: Value Engineering Symposium, EIA; University of Pennsylvania, Phila., Pa.

Oct. 6-8: 5th Conf. on Radio-Interference Reduction, Armour Research Foundation, IRE, U. S. Army Signal Research and Development Labs; Chicago, Ill.

Oct. 6-9: 2nd International Symposium on High Temperature Technology, Stanford Research Institute; Asilomar Conference Grounds, Cal.

Oct. 7-9: National Symposium on Vac. Tech., American Vacuum Society; Hotel Sheraton, Phila., Pa.

Oct. 7-9: Canadian Convention, IRE; Toronto, Canada.

Oct. 8-10: Meeting, Optical Society of America; Chateau Laurier, Ottawa, Canada.

Oct. 11-15: 3rd Pacific Area National Meeting, ASTM; Sheraton-Palace Hotel, San Francisco, Calif.

Oct. 11-16: Fall General Meeting, AIEE; Morrison Hotel, Chicago, Ill.

Oct. 12-14: Annual Conference, National Electronics Conference, IRE, AIEE, EIA, SMPTE; Hotel Sherman, Chicago, Ill.

Oct. 13.14: Technical Conference, Society of Plastics Engineers, Southern Calif. section; Ambassador Hotel, Los Angeles, Calif.

Oct. 13-16: Midyear Meeting of Lab Apparatus & Optical Sections; Scientific Apparatus Makers Assoc.; The Cavalier, Virginia Beach, Va.

Oct. 15-17: Fall Meeting, National Society of Professional Engineers, Olympic Hotel, Seattle, Wash.

Oct. 17-25: International Fair of Plastics Ind., Dusseldorf, Germany.

Oct. 18-22: Meeting, The Electrochemical Society, Inc., Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21: Fall Meeting, URSI, IRE; Balboa Park, San Diego, Calif.

Oct. 19-22: 6th Annual Conf. Int'l Municipal Signal Assoc.; Stardust Hotel, Las Vegas, Nev.

Oct. 20: Plating Techniques as Applied to Printed Circuitry, Western Assoc. of Circuit Manufacturers; Rodger Young Aud., Los Angeles, Calif.

Abbreviations

AIEE: American Institute of Electrical Engineers
AIME: American Institute of Mining & Metallurgical Engineers
AIP: American Institute of Physics
ARF: Armour Research Foundation
AEC: Atomic Energy Commission
ASME: American Society for Mechanical Engineers
ASTM: American Society for Testing Materials
EIA: Electronic Industries Association
IRE: Institute of Radio Engineers
ODR: Office of Director of Defense Research
SMPTE: Society of Motion Picture & TV Engineers

RELIABILITY IN THE PALM OF YOUR HAND...

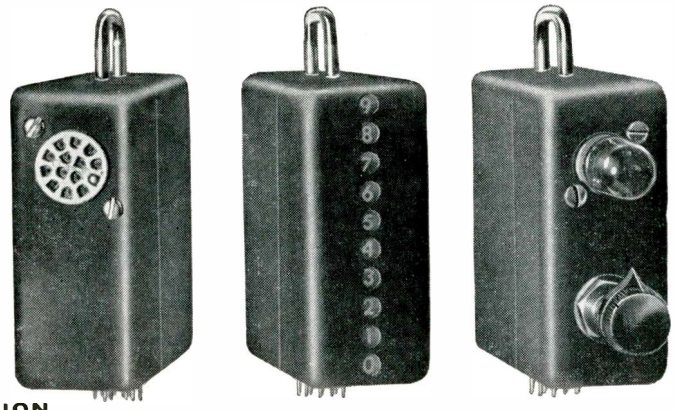
NEW

EECO N-Series *Transistorized* DECADES

for extremely reliable pulse-counting and frequency-division applications in the frequency range of 0 to 250,000 pulses per second.

FEATURES

The new EECO N-Series miniaturized and transistorized plug-in decimal counters feature simple power-supply requirements, low power consumption, small size, and extreme reliability. Saturation techniques, along with consistent derating of component tolerances result in a group of Transistorized Decades that will work dependably from 0 - 250 kcs even under adverse conditions of environment and power supply variations. All units are completely compatible with EECO T-Series Germanium plug-in circuits. In addition, an auxiliary 9-step staircase output is available. Most units are designed to plug into a special 13-pin miniature tube socket; other units plug into a standard 29-pin socket (Continental No. MM-29-22S). Mating socket is furnished with each decade.



ONE-HALF ACTUAL SIZE

WIDE SELECTION

EECO N-Series plug-in Transistorized Decades are available in a wide range of models. The counting circuitry is standardized for the various models. Provisions for visual readout and/or preset controls are as follows:

MODEL	DESCRIPTION
N-101	No readout.
N-102	Incandescent readout.
N-104	Incandescent readout (remote). Typically a projection readout module.
N-105	Nixie readout. (Can be cabled to remote Nixie.)
N-106	Nixie readout with preset control switch. (Can be cabled to remote Nixie.)
N-107	Incandescent readout with inputs for external preset control.
N-108	Incandescent readout (remote) with inputs for external preset control.
N-111	No readout, but with 1-2-4-2 code.

TYPICAL SPECIFICATIONS

The N-102 Transistorized Decade (with internal incandescent readout) employs four binary stages operating in a 1-2-4-2 code. Visual readout consists of the numerals 0 through 9 displayed vertically and illuminated by incandescent lamps. Total power consumption is approximately one watt. Outputs include (N/10), (N/10)′, and a 9-step staircase, which may be adapted for a visual display by means of an emitter follower and DC voltmeter.

ELECTRICAL SPECIFICATIONS

INPUT

Minimum Trigger Input: (0-100 kcs): 7 volts positive pulse or step at 0.5 μsec. rise time; (100 kcs to 250 kcs): 7 volts positive pulse or step at 0.2 μsec. rise time.

Maximum Operating Frequency: 250 kcs.

Input Impedance: 470 μμfd. capacitance, max.

DC Reset Input is provided (normally supplied by T-129 DC Reset Generator).

OUTPUT (No Load)

Amplitude: 8 volts, peak to peak.

Output Levels: (N/10) and (N/10)′: −11 volts DC and −3 volts DC, nom. Staircase: −11 volts DC to −3 volts DC in 9 steps.

Rise Time: (N/10): 0.5 μsec.; (N/10)′: 0.5 μsec.

Type: (N/10), (N/10)′, and 9-step staircase.

Load: Typical, two N-Series decades or two T-Series flip-flops. (Load information available on request.)

PHYSICAL SPECIFICATIONS

Dimensions: 1-5/16″ wide x 3″ deep x 3-7/8″ seated height (including handle). Dimensions are exclusive of external addenda found in external preset and Nixie models.

Mounting: Plugs into standard 9-pin miniature socket. (Some other models require a special 13-pin miniature socket, which is furnished with each such unit.)

Pin Connections: Arranged for in-line wiring of power and grounds.

Operating Temperature Range: −54°C to +71°C.

NOTE: 0 to 5 megacycle models available soon.

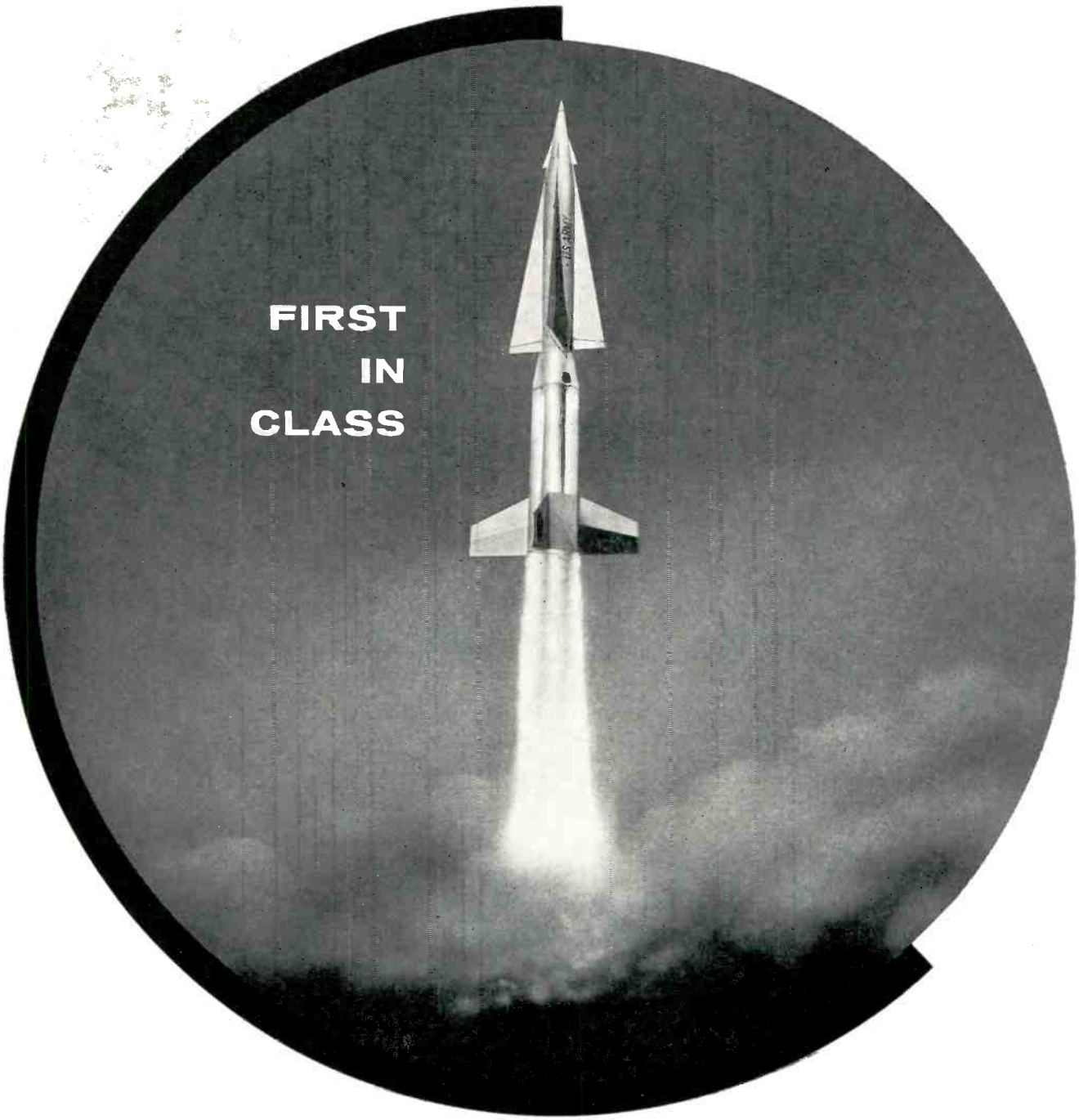
Additional information on N-Series Transistorized Decades and other EECO products available on request.

ENGINEERED ELECTRONICS Company

ENGINEERED ELECTRONICS COMPANY

(a subsidiary of Electronic Engineering Company of California)

506 East First Street • Santa Ana, California

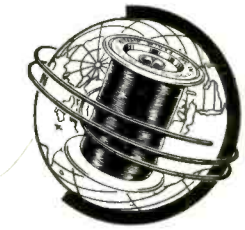


NIKE HERCULES

With deadly accuracy the U.S. Army's new Nike Hercules ground-to-air guided missile streaks out to meet an approaching enemy air force. Its nuclear warhead can wipe out an entire formation.

Western Electric selected Teflon* insulated wire for use in building the alert guidance and control systems of this faster, higher climbing Nike.

As leading specialists in high temperature insulated wires and cables, the men and women at Hitemp are proud of this choice, and the role Teflon wiring plays in giving America a strong new perimeter of defense.



HITEMP WIRES, INC.

1200 SHAMES DRIVE, WESTBURY, NEW YORK

*Du Pont's trade name for Tetrafluoroethylene

As We Go To Press . . . (Continued)

Field Defense System For Missile Batteries

First production units of a new, advanced field air defense system designed to pinpoint data on the approach of enemy planes for Army missile batteries are now being delivered to the Army.

Designated the AN/MSQ-18 by the Army Signal Corps, the truck-mounted units were delivered to Fort Bliss, Tex., by the Ground Systems Group, Hughes Aircraft Co.

The system is housed in five 2½-ton Army trucks, an Operations Central truck and four Coder-Decoder group trucks. The Central may be manned by a single operator. Through him the commander may assign specific airborne targets to various missile batteries.

The commander is able to make a rapid evaluation of the overall tactical situation on the basis of information furnished by radars currently used in the missile battalions. This permits autonomous use of the central. When the AN/MSQ-18 is employed as part of "Missile Monitor," information is provided by the new three-dimensional radar, Frescanar, which simultaneously computes range, azimuth and altitude, and from other sources.

Dial Phone System Links RCA Plants

A telephone network tying 12,000 telephones in four widely separated Radio Corporation of America plants into one common dialing system has been turned over for RCA's use by the Long Lines Department of the American Telephone and Telegraph Company.

It is the first dialing tie-line network of its type set up to service one company. It permits RCA operators in one city to dial RCA employes in other cities and also to dial outside-the-plant numbers in those cities.

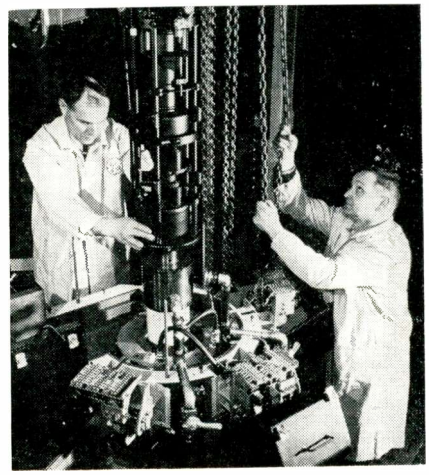
Operators in four RCA installations in New York City, Camden, N. J., Harrison, N. J., and Lancaster, Penna., can dial any telephone in any of those plants and also can dial local telephones, outside the plants, by dialing through the switchboard in the distant city.

New Multi-Beam Radar For Air Defense Cmd.

The first in a series of new high power, multi-beam radar systems, the AN/FPS-7, has been delivered to the Air Defense Command by General Electric's Heavy Military Electronics Dept.

The FPS-7 provides much faster target data on approaching aircraft than is possible with the conventional system. This data is relayed to the computers at the same time, eliminating the present interdependency of one radar on another and speeding up the calculation of intercept data.

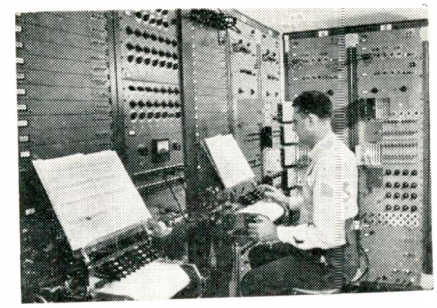
The FPS-7 features a unique "varifocal" antenna design. It operates on a multi-beam principle whereby several narrow beams are fed to the antenna, as compared with the standard single broad beam method.



GE technicians install multi-million watt klystron in the FPS-7 super power radar

Power for the FPS-7 system is generated by a new 5-ft. high klystron tube developed jointly by the Rome ADC and GE. Its frequency limits can be held much closer than the frequency limits of

MUSIC SYNTHESIZER



RCA's electronic music synthesizer has been installed at Columbia Univ. for research in electronic music by Columbia and Princeton under a grant from Rockefeller Fndn.

"Polarization Switch" Boosts Radar Range

A "polarization switch" that filters out radar images of storms and heavy clouds and permits all-weather jet interceptor pilots to see their targets more clearly has been developed by Westinghouse.

The development will increase radar range between five and ten times the present maximum in storms because it eliminates much of the "clutter" on the radar scope reflected from storms and clouds. Thus, the radar signal bouncing back from the target aircraft shows up proportionately better.

The pilot will be able to flip a switch that will change the type of signal his radar will transmit. One type of signal will be good for clear weather and give maximum range. The other, just developed into practical use, will greatly increase range in "soupy" weather because reflection characteristics from this type of transmission tend to show only the target plane and not the great masses of rain clouds.

The new device is shaped like a roadside directional arrow and can be mounted inside the radar antenna in the nose of all-weather interceptors. It will add almost no weight or size to the electronic system.

E. E. Starting Salaries Up 6% Over Last Year

Starting salaries for last month's electrical engineering graduates at Lehigh University are up 6% over 1958.

Electrical engineers will receive an average starting salary of $515 a month, or $30 more than the 1958 graduates received. The $515 figure trails only the $525 average of the engineering physicists.

The average starting salary for the 1959 Lehigh seniors is $474, as compared to $455 a year ago. This represents a 4% increase.

The number of interviews conducted for electrical engineers was nearly double over last year. This year the 40 electrical engineers received 618 interviews with recruiters from 137 companies as compared to the 317 interviews by 120 companies for the 44 graduates in 1958.

CHECK YOUR PULSE, SIR?

"SCOTCH" BRAND High Resolution Tapes deliver a sharper pulse—with fewer dropouts!

In instrumentation, as in life, it's often the pulse-count that counts. So what if your recording impulses are as square as a bar-graph? If your tape only records camel-backed humps, where are you? Probably about due for a change—to "SCOTCH" BRAND High Resolution Tapes.

Your equipment is somewhat like the proverbial sweater—no matter how advanced, you can only get out of it what you put in. And that calls for "SCOTCH" BRAND High Resolution Tapes—made to deliver improved resolution as pulse density climbs and effective frequencies soar upward to stratospheric heights.

Like so many other advances in tape technology, this superior resolution is a product of 3M research. For one thing, "SCOTCH" BRAND high potency oxides give coatings a higher magnetic retentivity —about a third more than standard. And since the shorter wave lengths of high frequencies are recorded by the surface of the coating, a coating of these potent oxides can be thinner and yet provide equal flux line strength. Results? A flexible tape for intimate tape-to-head contact, a cleaner, sharper recorded pulse.

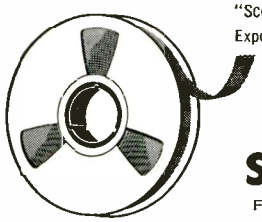
"SCOTCH" BRAND High Resolution Tapes offer these potent coatings on your choice of two tough polyester backings—158 for standard play, 159 for extra-play. And both are designed to line up your square-waves as densely as a close-order drill, so sharp and clean you'll never miss a bit.

In taping high frequencies, the tested uniformity and dropout-free performance of "SCOTCH" BRAND Magnetic Tapes give the added bonus of reliability. The greater the density of information, the more critical the need for defect-free tapes, and here's where experienced "SCOTCH" BRAND Tape technology really tells.

Whatever your application—data acquisition, reduction or control programming—"SCOTCH" BRAND Instrumentation Tapes supply the reliability you need today and continue to anticipate tomorrow's needs with newer, more sensitive tapes.

In addition to "SCOTCH" BRAND High Resolution Tapes 158 and 159, check the others for your application. "SCOTCH" BRAND High Output Tape 128 offers top output in low frequencies, even in ambient temperature extremes. "SCOTCH" BRAND Sandwich Tapes 188 and 189 end rub-off, build-up, reduce head wear to an absolute minimum, show little wear after 50,000 passes. "SCOTCH" BRAND Instrumentation Tapes 108 and 109 remain the leaders for top performance at low cost.

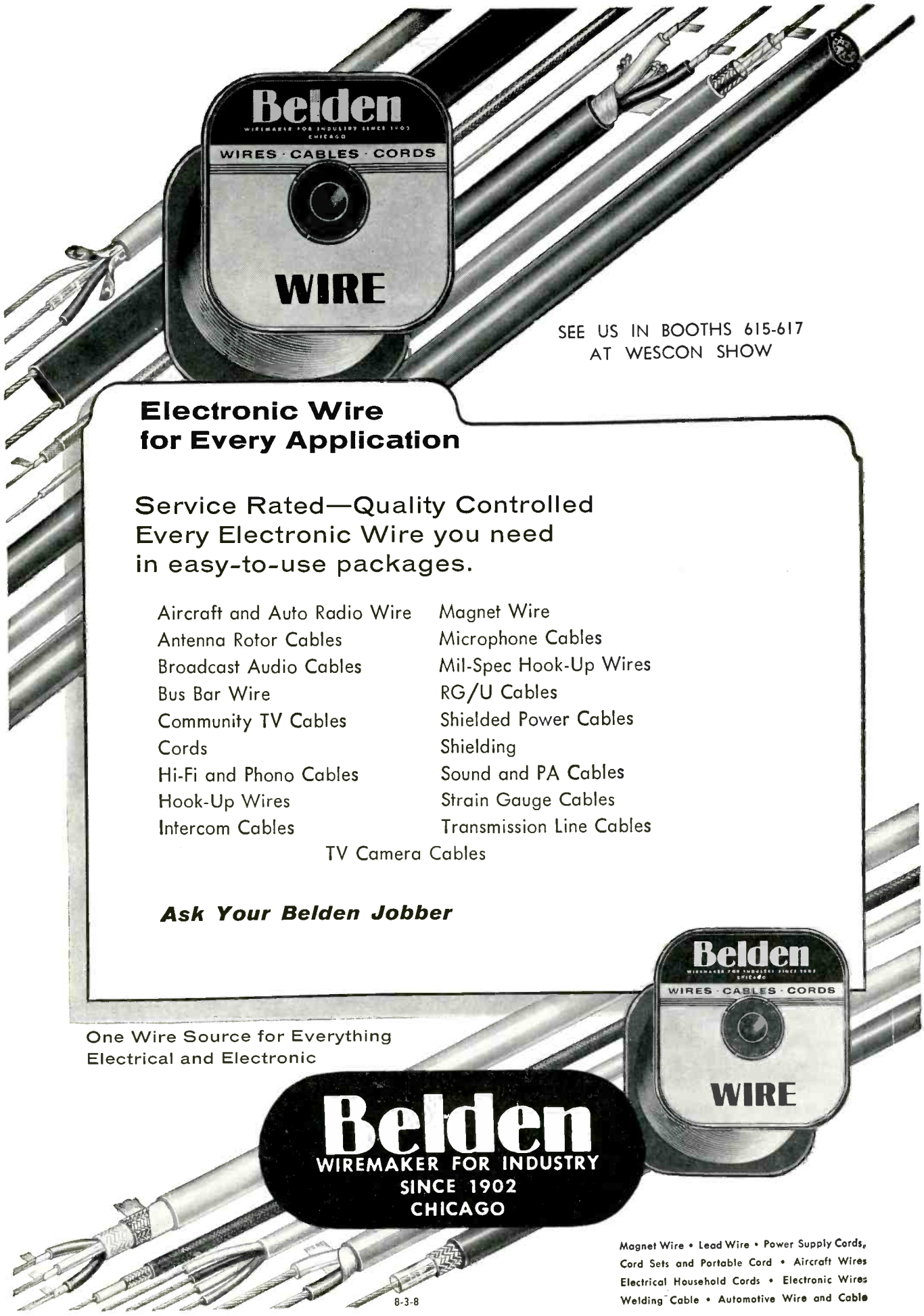
Where there's no margin for error, there's no tape like "SCOTCH" BRAND Magnetic Tape for instrumentation. For details, write Magnetic Products Div., Dept. MBR-89, 3M Company, St. Paul 6, Minn. or mail the inquiry card.



REG U.S. PAT. OFF.
SCOTCH BRAND MAGNETIC TAPE
FOR INSTRUMENTATION

MINNESOTA MINING AND MANUFACTURING COMPANY
... WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY



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Electronic Wire for Every Application

Service Rated—Quality Controlled
Every Electronic Wire you need
in easy-to-use packages.

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- Intercom Cables
- Magnet Wire
- Microphone Cables
- Mil-Spec Hook-Up Wires
- RG/U Cables
- Shielded Power Cables
- Shielding
- Sound and PA Cables
- Strain Gauge Cables
- Transmission Line Cables
- TV Camera Cables

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One Wire Source for Everything
Electrical and Electronic

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902
CHICAGO

Magnet Wire • Lead Wire • Power Supply Cords,
Cord Sets and Portable Cord • Aircraft Wires
Electrical Household Cords • Electronic Wires
Welding Cable • Automotive Wire and Cable

8-3-8

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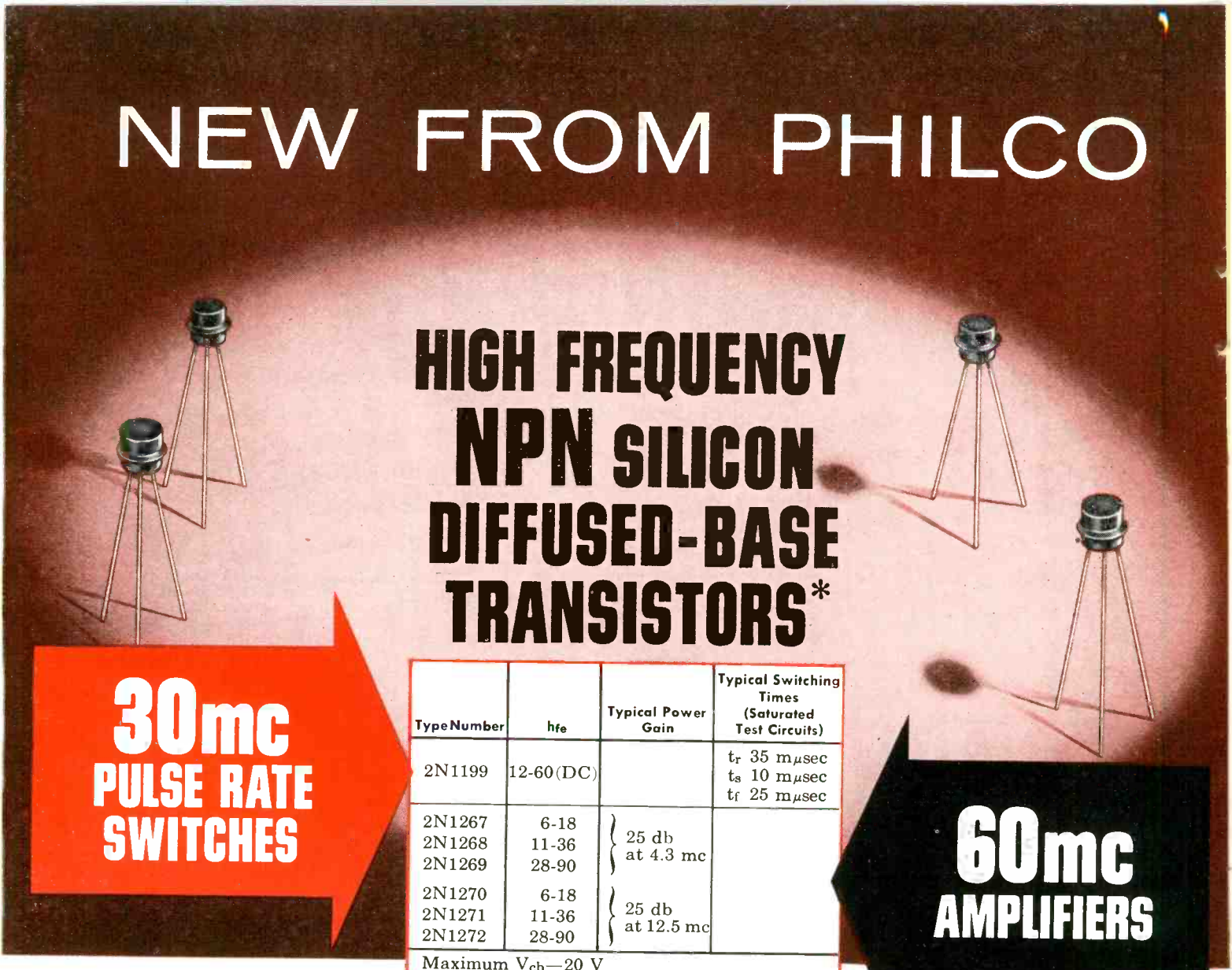
NEW FROM PHILCO



HIGH FREQUENCY NPN SILICON DIFFUSED-BASE TRANSISTORS*

30mc PULSE RATE SWITCHES

60mc AMPLIFIERS

Type Number	h_{fe}	Typical Power Gain	Typical Switching Times (Saturated Test Circuits)
2N1199	12-60 (DC)		t_r 35 mμsec t_s 10 mμsec t_f 25 mμsec
2N1267	6-18	25 db at 4.3 mc	
2N1268	11-36		
2N1269	28-90		
2N1270	6-18	25 db at 12.5 mc	
2N1271	11-36		
2N1272	28-90		

Maximum V_{cb}—20 V
Maximum temperature—150° C
Maximum dissipation—100 MW

2N1199

This high speed switch has exceptionally low saturation voltage (typically 0.125 V), permitting *practical* design of 5 mc pulse circuits, using conventional saturated switching configurations. 30 mc pulse rates are obtainable in *practical* circuits using non-saturating techniques.

2N1267-68-69

The high gain characteristics of these units make possible the design of high efficiency IF amplifier circuits for communications equipment. These devices have unusually low collector capacitance . . . typically 1.5 μμf . . . and are available with restricted beta ranges to simplify design problems.

2N1270-71-72

The excellent high frequency response of these transistors makes practical the design of high performance communications systems at frequencies up to 60 mc. They have the same low collector capacitance and are available with restricted beta ranges.

Immediately available for prototype design from your Philco Industrial Semiconductor Distributor.

Write Dept. EI-859, Lansdale Tube Company, Division of Philco Corporation, Lansdale, Pa.

**SADT . . . Trademark Philco Corp. for Surface Alloy Diffused-base Transistor.*

PHILCO®

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.

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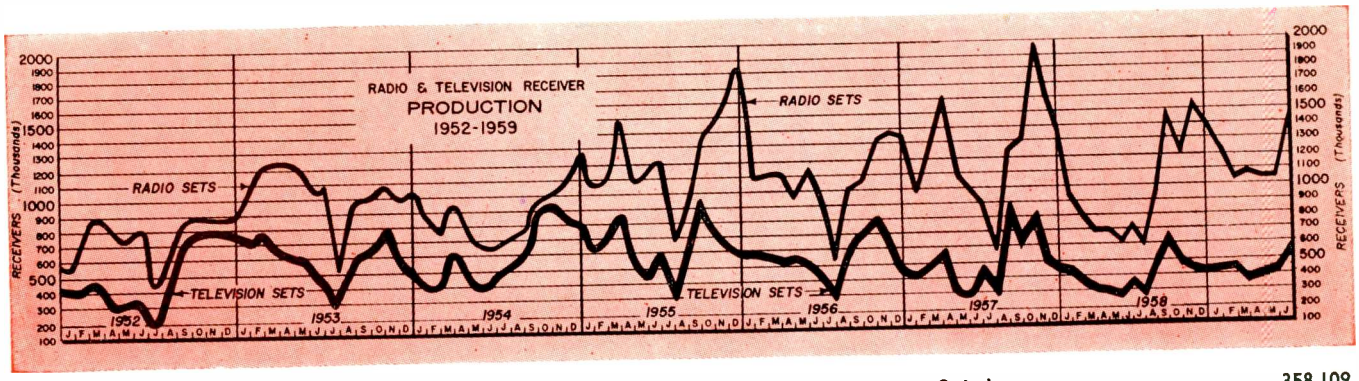
ELECTRONIC INDUSTRIES TOTALS



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in June 1959.

Amplifiers, a-f	35,560
Amplifiers	540,877
Amplifiers, servo	88,163
Analyzers, spectrum	50,276
Antennas	859,844
Batteries, dry	3,424,101
Batteries, water activated	976,958
Bridge, impedance	36,423
Cable assemblies	57,063
Cable, electronic	60,177
Cable, telephone	105,387
Capacitors	249,889
Computers	156,632
Computers, analog	60,785
Computers, digital	46,314
Connectors	234,953
Data loggers	83,869
Discriminators	30,785
Equipment, communications	139,835
Equipment, monitoring	53,920
Filters, h-f	30,000
Filters, radio interference	100,242
Fuses	315,000
Generators, digital timing	48,450
Gyros	239,865
Handsets	31,116
Inverters	343,384
Measuring systems, electronic	977,941
Meters, frequency	182,228
Microphones	305,210
Modulators	39,398
Multimeters	46,634
Networks, pulse forming	63,690
Oscillators	39,278
Oscilloscopes	93,277
Oscillographs	432,050
Potentiometers	27,554
Power supplies	198,621
Radomes	37,511
Radar sets	19,223,978
Radiac sets	582,164
Radio sets	735,705
Radiosonde	934,815
Reactors	73,709
Readers, tape	77,996
Receivers, radio	1,047,415
Receiver/transmitters	381,000
Recorders/reproducers	438,229
Reflectors, parabolic	31,365
Regulators, audio level	38,267
Relay assemblies	356,820
Relays, solenoid	25,980
Resistors	640,904
Semiconductors	59,000
Servo motors	445,649
Signal generators	372,252
Solenoids	54,376
Standards, frequency	50,000
Stroboscopes	44,200
Switchboard equipment	318,951
Switches	480,322
Switches, pressure	358,109
Switches, rotary	90,346
Switches, thermostat	57,800
Switches, toggle	76,319
Systems, data display	79,188
Systems, microwave	10,107
Systems, radar	26,603
Systems, telemetry	81,760
Systems, TV	33,215
Tape, magnetic	32,728
Terminals, telephone	570,285
Test sets, radar	304,873
Thermostats	292,538
Transformers	246,605
Transistors	77,784
Transmitters	323,730
Tubes, electron	6,822,730
Tubes, klystron	59,060
Tubes, magnetron	1,229,351
Tubes, thyratron	58,650
Tuners r-f	120,214

AVERAGE MONTHLY EARNINGS OF COLLEGE MEN EMPLOYED 5 YEARS AGO (Class of 1953) and 10 YEARS AGO (Class of 1948)

	Under $500	$500 to $600	$601 to $700	$701 to $800	$801 to $900	$901 to $1000	Over $1000	Number Companies Reporting	Average Salary*
ENGINEERING									
Class of 1953	—	26	46	13	—	—	—	85	$641
Class of 1948	—	3	17	25	24	5	1	75	778
ACCOUNTING									
Class of 1953	7	25	13	3	—	—	—	48	577
Class of 1948	—	6	12	11	6	5	3	43	783
SALES									
Class of 1953	5	13	19	6	2	—	—	45	637
Class of 1948	—	3	4	12	10	3	7	39	866
GENERAL BUSINESS									
Class of 1953	7	35	14	5	1	—	—	62	583
Class of 1948	—	7	15	7	11	7	6	53	788

*The overage salaries shown above are averages by companies.

—13th Annual Report by Frank S. Endicott, Northwestern University.

ELECTRONIC INDUSTRY IN THE 11 WESTERN STATES

Metropolitan Areas	Number Electronic Firms	Square Feet Plant Facilities	Employment	Sales (000) Omitted	Payroll (000) Omitted	Technical Employment
San Diego	28	300,000	3,500	45,000	16,500	n.a.
Phoenix-Tucson	15	245,000	4,000	52,000	22,500	n.a.
Portland-Seattle	30	298,000	4,500	50,000	22,000	n.a.
Los Angeles-Orange	450	14,550,000	82,000	1,125,000	457,000	n.a.
San Francisco-Peninsula	129	6,356,000	27,000	380,000	145,000	8,600
Denver and other areas Colorado	14	165,000	2,100	27,000	9,450	n.a.
Balance 11 Western States	69	500,000	11,000	110,000	53,000	n.a.
Total 11 Western States	735	22,414,000	134,100	1,789,000[1]	725,450	n.a.
Total U. S. A.	4100	n.a.	700,000	7,800,000[1]	n.a.	127,000

11 Western States as percentage U.S. Electronics Industry: 17.8% of electronic firms; 19% of employment; 23% of sales.
(1)Does not include broodcast and service revenue.

—Western Electronic Manufacturers Association

Electronic Industries' News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

SPERRY GYROSCOPE CO., Great Neck, N. Y., has received contracts totaling $47 million for development and production of high-powered air search radar systems. Contract was awarded by the U. S. Air Force.

GENERAL PRECISION LABORATORY INC., Pleasantville, N. Y., has just won a $1,844,000 Air Force contract award. The new contract covers additional procurement of components for the AN/APN-81 Doppler Navigation System.

NOTHELFER WINDING LABORATORIES, manufacturers of customs transformers, have moved their plant and offices to Ewingville Rd., Trenton, N. J.

FILTORS, INC., Port Washington, N. Y., has completed their new production reliability center for their line of relays. The new test center is adjacent to their main building.

ACF INDUSTRIES, INC., Avion Div., Paramus, N. J., has just received a U. S. Army contract of $600,000 to produce radar beacons for the SD-1 surveillance drone.

WESTINGHOUSE ELECTRIC CORP. has announced the development of an airborne device, called a polarization switch, that will filter out radar images of storms and heavy clouds. This will permit all-weather jet interceptor pilots to see their targets more clearly under poor conditions.

RAYTHEON CO. has announced completion of plans to construct a transistor plant which will eventually employ more than 2000 persons in Lewiston, Maine. The new plant will contain 140,000 square feet of production space. Construction will start early this fall and will be completed by mid-1960.

PHILCO CORP. has broken ground for its new multi-million dollar Transac computer center which will be located near Willow Grove, Pa. The new plant will contain over 200,000 square feet of floor space.

ALLEN B. DU MONT LABORATORIES, INC., has received a contract from the U. S. Air Force for the manufacture of 3200 radar indicator cathode-ray tubes.

INTERNATIONAL TELEPHONE & TELEGRAPH CORP. has been awarded a $2.3 million contract to supply integrated power systems for the Air Force's B-58. The contract was awarded by Convair, a division of General Dynamics, manufacturer of the delta-winged Hustler.

THE INDIANA STEEL PRODUCTS CO. and **GENERAL CERAMICS CORP.** have announced an agreement on basic terms for a merger. A special meeting of the stockholders will be held in late August for a vote on the merger.

ACOUSTICA ASSOCIATES, INC., has opened a new plant in Plainview, L. I. The modern new building contains 50,000 square feet of floor space and was specially designed for them.

HAVEG INDUSTRIES is consolidating all of its wire and cable facilities in their wholly owned subsidiary, American Super-Temperature Wires, Inc. This includes all of Haveg's Wilmington, Delaware, wire and cable manufacturing, development and production facilities.

MID-WEST

ROHN MFG. CO., Peoria, Ill., recently acquired additional manufacturing facilities of approximately 20,000 square feet. This additional space is in a building next to the main plant at Bellevue near Peoria.

CHICAGO TELEPHONE SUPPLY CORP., Elkhart, Ind., has announced the formation of a new subsidiary, CTS, Inc., and also the opening of a new 10,000 square feet plant in Berne, Ind. This is CTS' 5th plant, bringing their total plant area to 436,000 sq. ft.

POTTER & BRUMFIELD, INC., presently a subsidiary of American Machine & Foundry Co., has become an AMF division. The company's name will be changed to Potter & Brumfield Div. of AMF Co.

VICTOREEN INSTRUMENT CO., now has a new atomic radiation monitoring and alarm system for U. S. Navy submarines under test on a nuclear submarine prototype reactor. It is designed to monitor general gamma ray radiation levels in and around the reactor engine.

P. R. MALLORY & CO., INC., has formed a new division, Mallory Electronics Div., to develop manufacture and sell electronic assemblies for military, missile, industrial and commercial applications.

DOW CORNING CORP. has announced a new price reduction for Silastic® LS-53, the fuel and solvent resistant silicone rubber. The new price will be $16.00 per lb.

COLLINS RADIO CO. has received a new contract for approximately $5 million. The contract calls for an extension of the Strategic Air Command's global communications network.

MOTOROLA INC. has opened a new 78,000 square feet Administration Office and Engineering Laboratory at their Military Electronics Center, 1450 N. Cicero Ave.

WEST

TEXAS INSTRUMENTS INCORPORATED has set up an Avionics Flight Test Center in newly-acquired facilities at Addison Airport in extreme North Dallas.

BJ ELECTRONICS, BORG-WARNER CORP. has received a substantial supplemental contract to the initial $500,000 contract for GMD-1 transportable ground tracking and data-recording equipment. The additional contract was issued by the U. S. Army Signal Corps.

MAGNETIC AMPLIFIERS, INC., has obtained larger quarters for its West Coast Div. The new plant contains 12,000 sq. ft. as compared with their former 5,000 ft. Plant is located in El Segundo, Calif.

SLIP RING CO. OF AMERICA has recently acquired a $180,000, 6½ acre industrial site at 13000 So. Avalon Blvd., Los Angeles. They will soon start construction on a 100,000 sq. ft. manufacturing plant at this site.

MAGNETIC RESEARCH CORP., Hawthorne, Calif., has received a contract from Bendix Products Div., Mishawaka, Ind., for the production of 28 v. 60 cps ground power supplies for use on the Navy's operational surface-to-air Talos Missile.

HERMETIC-PACIFIC CORP., Rosemead, Calif., has just completed expansion of their plant facilities. They are subsidiaries of Hermetic Seal Corp. of Newark, N. J.

ENGINEERED ELECTRONICS CO. are starting construction of 23,000 square feet production plant in Santa Ana, Calif.

LOCKHEED AIRCRAFT CORP. has announced selection of a site adjoining the city of Newport Beach, Calif. to build administrative and scientific headquarters for the recently established Lockheed Electronics and Avionics Div. (LEAD). An agreement to purchase the 200-acre tract is subject to approval of satisfactory zoning and other conditions.

SYLVANIA ELECTRIC PRODUCTS, INC. has announced plans for a 40,000 square feet Special Tube Operations laboratory in Mountain View, Calif.

COMPUTER EQUIPMENT CORP., Los Angeles, Calif., has announced the receipt of a contract for the development of an advanced space/time velocity data recording system. The prime contract was issued by the Air Research & Development Command of the U. S. Air Force.

CAL-TRONICS CORP., has received a $500,000 contract from Hughes Aircraft Company's Semiconductor Div. to produce a group of Automatic Production Diode Testers.

AEROJET-GENERAL CORP. has been named a member of an 8-company team, led by Airborne Instruments Lab. to design and develop advanced airborne electronic equipment. AIL recently received a $38.9 million contract from the Air Force.

CONVAIR, Div. of General Dynamics Corp., has received a $2 million contract for design and manufacture of a radar for a navigation-bombing system from Autonetics, a Div. of North American Aviation, Inc. The equipment will be used in the Navy's A3J carrier-based attack bomber.

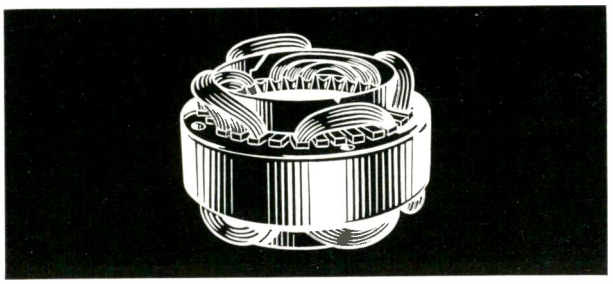
HALLAMORE ELECTRONICS CORP., a div. of the Siegler Corp., has been awarded a half million dollar contract for airborne computers and associated test equipment for the Vega outer space rocket. Contract was awarded by the Jet Propulsion Laboratory of the California Institute of Technology.

ROBERTSHAW-FULTON CONTROLS CO. has been awarded follow-on contracts totaling $963,338 for stability augmentation amplifiers and spares by Convair Div. of General Dynamics Corp.

THE DEUTSCH CO. will open their new air-conditioned electrical connector plant in Banning, Calif. on September 4th. The 35,000 square feet plant will be used for completely integrated production and engineering facility of their electrical connectors.

THOMPSON RAMO WOOLDRIDGE INC. has announced a $2 million expansion of its Tapco Group West Coast operation. The aircraft and missile components plant will be located in Orange County, Calif.

RAYTHEON CO. has announced plans to establish a wholly-integrated electronic warfare center in Santa Barbara, Calif., to be known as the Santa Barbara Subdivision, the center will tie together in a single geographic location—engineering, production and marketing of the division's widespread interests in the countermeasures, counter-countermeasures and infrared fields now at various places.



LectALite
MAGNET WIRE

...unsurpassed for hermetic and other rigorous applications

Developed originally for hermetic applications and accepted for such use because of its excellent resistance to Freon refrigerants, LectALite magnet wire is proving to be of great interest in other electrical products. As LectALite is 20° to 25°C higher in heat-aging characteristics than Formvar and has excellent resistance to cut-through under heat, it offers superior performance in many other types of windings.

LectALite magnet wire is insulated with a smooth, uniform film of Lecton, an aqueous dispersion of an acrylic polymer. Applied by a dip and bake process, Lecton enamel gives a uniform rich mahogany color to the finished wire.

Outstanding properties of LectALite are: exceptional resistance to Freon 12 and Freon 22, dielectric strength, film adherence, thermoplastic flow, high temperature rating, heat shock, heat aging, and moisture resistance. LectALite's physical, electrical, and chemical properties equal or exceed those of Formvar.

LectALite is a member of the full Auto-Lite line of outstanding magnet wire—BondALite • DacALite • IsALite • LectALite • NyALite • SodALite

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AUTO-LITE GENERAL PRODUCTS GROUP (EI)
Wire and Cable Division
Toledo 1, Ohio

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Plants at Port Huron, Michigan, and Hazleton, Pennsylvania

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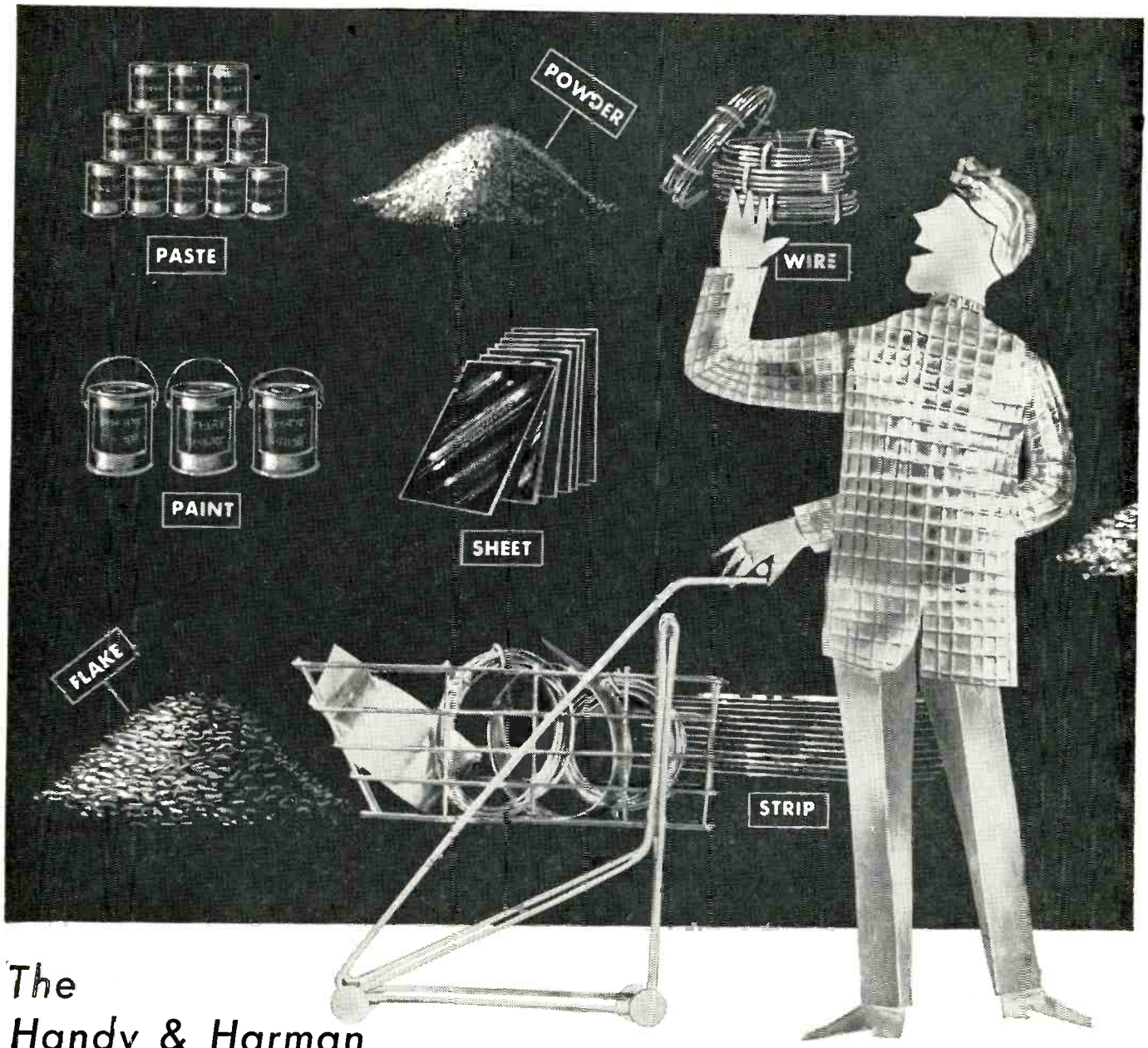

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Silver, in many forms and alloys, is a necessity in the electronics and electrical industries. To meet this need on a high quality level, Handy & Harman manufactures powder, flake, paint, paste, sheet, strip, wire, etc., for printed circuits, wiring, resistors, condensers, thermistors, contacts, printed terminal strips on glass, ceramics, plastic laminates, etc.

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DELCO RADIO

NEW POWER TRANSISTORS

MILITARY–COMMERCIAL

	2N1168	2N392	2N1011	2N1159	2N1160
V_{cb} max.	50	60	80	80	80 volts
I_c max.	5	5	5	5	7 amp.
I_{co} (V_{ec} 2 volts) Typical 25 °C.	65	65	65	65	65 μ a.
HFE (3 amp.)	—	60-150	30-75	30-75	—
HFE (5 amp.)	—	—	—	—	20-50
AC Power Gain (I_c = 0.6 amp.)	37 DB	—	—	—	—
V_{ceo} (I_c = 1 amp.)	40 typical	50 typical	60 min.	60 min.	60 volts min.
Thermal Gradient max.	1.5	1.5	1.2	1.2	1.2° c/w

Delco Radio rounds out its power transistor line with this new 5-ampere germanium PNP series. Types 2N1168 and 2N392 are specially designed for low-distortion linear applications, while 2N1159 and 2N1160 are outstanding in reliable switching mode operations.

Type 2N1011 is designed to meet MIL-T-19500/67 (Sig. C). It joins 2N665, MIL-T-19500/68 (Sig. C); 2N297A, MIL-T-19500/36 (Sig. C) and JAN2N174, MIL-T-19500/-13A to provide a selection for military uses.

Write today for engineering data on Delco Radio's line of High Power Transistors.

See you at the WESCON Show, Booth No. 114

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KOKOMO, INDIANA

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726 Santa Monica Boulevard
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Electronic Industries International

ITALY

New U. S.—Italian Firm

Northrop Corp. and Societa Edison of Milan, an Italian electric power company, have formed a new Italian communications engineering company to be known as Edison-Page S.p.A.

Northrop, through its wholly-owned subsidiary, Page Communications Engineers, Inc., has acquired 49% of the stock of the new company. Societa Edison owns 51%. The new firm will begin operations immediately on the engineering and development of Page communications networks and related electronic activities for Europe and Africa.

DENMARK

Danes Buy 10 MEV Accelerator from U. S.

High Voltage Engineering Corp., Burlington, Mass., has sold a 10-million-electron-volt, tandem Van de Graaf accelerator to the Universitet Institut for Teoretisk Fysik, Copenhagen, Denmark.

The institute is directed by Prof. Niels Bohr, internationally famed nuclear physicist. Support for research equipment was received by the university from foundations in Denmark and the U. S. The equipment will be used for fundamental investigation of atomic nuclei under the direction of Dr. T. Huus. A specific study will be the nuclear energy levels in heavier nuclei.

This is the third accelerator of this design to be ordered from High Voltage Engineering by European research centers. They have been ordered by Physikalisches Institut der Eidgenossischen Technischen Hochschule, Zurich, and another European university.

INDIA

Radio Officials Study U. S. Operations

Four key officials of the All India Radio system are now in the U. S. for four months of observation of the American telecommunications industry. They are here under the International Educational Exchange Program of the U. S. Dept of State.

The visitors are: Mr. Dinesh Chandra Bhattacharji, Director, Engineering Staff Training School; Mr. Dinkar Vishwanath Phatak, Deputy Planning Officer, Planning and Development Unit; Mr. Umesh Chandra Sinha, Assistant Engineer; and Mr. Ananthakrishna Venkateswaran, Deputy Planning Officer, planning and Development Unit.

The group will observe training methods for U. S. radio and TV personel, the latest trends and techniques, the installation of equipment, the manufacture and use of sound recording devices, and the design practices used in studios and auditoriums.

MIDDLE EAST

Communications Link for U. A. R.

A tropospheric scatter link is to be established between the Egyptian and Syrian regions of the United Arab Republic, reports the Bureau of Foreign Commerce, U. S. Dept. of Commerce. Probable sites will be at Saroukhia in Syria, and Port Said in Egypt. The sites are about 280 miles apart.

Additional VHF links of about 19 miles between Saroukhia and Damascus in Syria, and 31 miles between Port Said and a site in Egypt are being considered.

PUERTO RICO

Electronic Plants Listed

The 70 U. S. branch plants manufacturing electronic-electrical products in Puerto Rico are listed in a new directory of nearly 600 factories issued by the Office of Puerto Rico's Economic Development Administration, Dept. PR, 666 Fifth Ave., New York.

The plants, which ship $400 million worth of production annually to the Continental U. S., are listed by name and address, product made, the date of start of operations, and the name of the executive in charge.

NATO Communications

Headquarters Land Forces Southeastern Europe is linked to NATO's Southern Europe hdqts and to SHAPE in Paris with this transmitter-receiver station near Izmir, Turkey.

WESTERN EUROPE

NATO Nations to Make Hawk

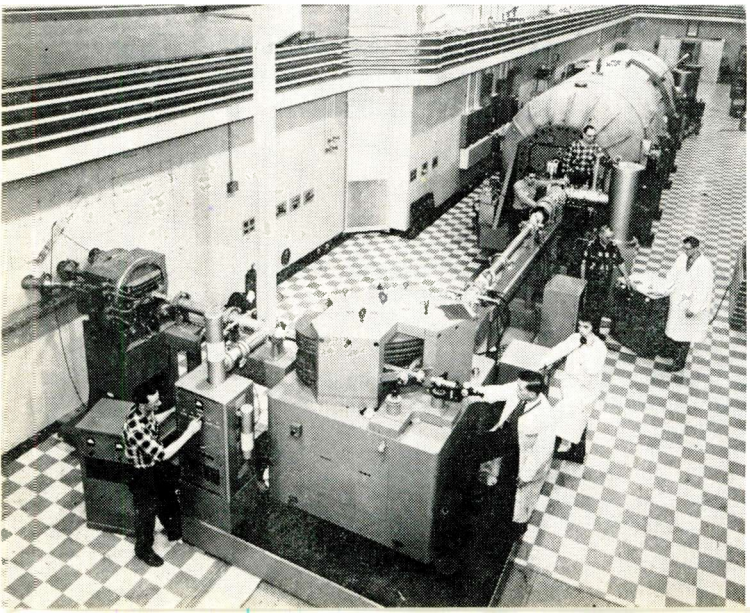
Five Western European allies—France, Italy, Germany, Belgium, and Holland—have signed an agreement with the U. S. to mass-produce within their own countries the Army-Raytheon Hawk missile, a key defensive armament soon to become operational with American troops.

The NATO nations will use their own monies, manpower, and other production facilities. They expect to produce more than $400 million of Hawks. The five will pool their funds to finance the program and have formed a managing company, the Societe Europeane de Teleguidage. The U. S. will furnish some parts and technical assistance to help the program get underway.

Tracerlab Studies European Instrumentation Market

S. S. Auchincloss, President of Tracerlab Keleket, a U. S. nucleonic instrumentation firm, Waltham, Mass., says that the company's engineers have been investigating the capabilities and facilities of various European manufacturers, and that final arrange-

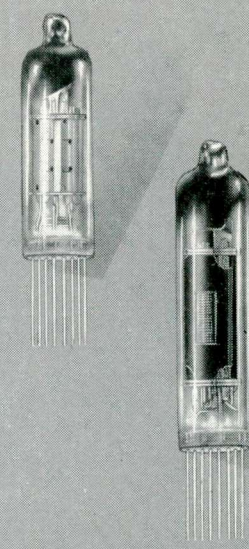
(*Continued on page* 30)



Tandem Van de Graaff particle accelerator, a 10-million-electron volt research tool built by High Voltage Engineering Corp., Mass., will be used in basic nuclear research by the Danes.

Now you can specify these popular submins for extra-severe duty — in new Raytheon Reliability-Plus types

CK6021WA
CK6111WA
CK6112WA
Twin Triodes
CK5639WA
Video & Power Amplifier
CK5902WA
Beam Power Pentode



Only Raytheon produces these improved-reliability button base subminiature tubes — electrically identical to and directly interchangeable with prototypes, and controlled throughout production to meet the following tests above and beyond military specifications:

IMPROVED MECHANICAL STABILITY
15G sweep frequency vibration test to 2000 c.p.s.
10G sweep frequency fatigue test to 2000 c.p.s.
75G, 10 millisecond shock test — in addition to usual 1 millisecond test.

IMPROVED PULSE OPERATION
Triode-connected pulse life test (CK6021WA, CK6111WA)

IMPROVED ELECTRICAL STABILITY
2 hour and 20 hour life tests to guarantee stability of characteristics.

IMPROVED HIGH TEMPERATURE LIFE
Life-test end points now 1000 hours instead of 500 hours.

MAXIMUM RATING LIFE

CONTROLLED WARM-UP TIME

REDUCED HEATER-CATHODE LEAKAGE AT HIGH HEATER VOLTAGES (CK6021WA, CK6111WA, CK6112WA)

EACH TUBE MUST MEET RIGID QUALITY CONTROL STANDARDS

- 0.4% AQL for major characteristics — compared with prototypes' 0.65%.
- High sensitivity thyratron short test.
- X-ray inspection — an original Raytheon safeguard.

RAYTHEON®

INDUSTRIAL TUBE DIVISION

55 CHAPEL STREET, NEWTON 58, MASSACHUSETTS

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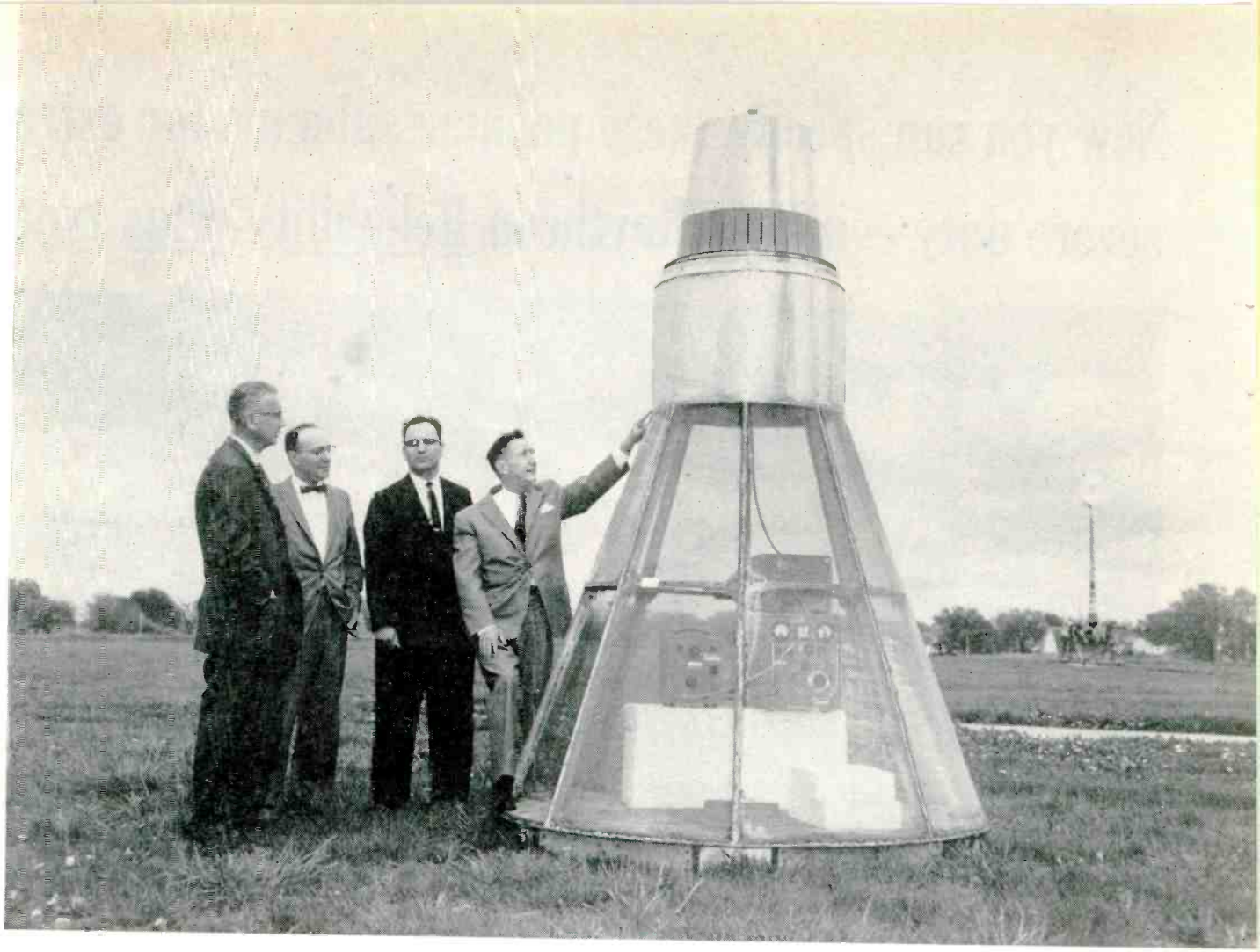
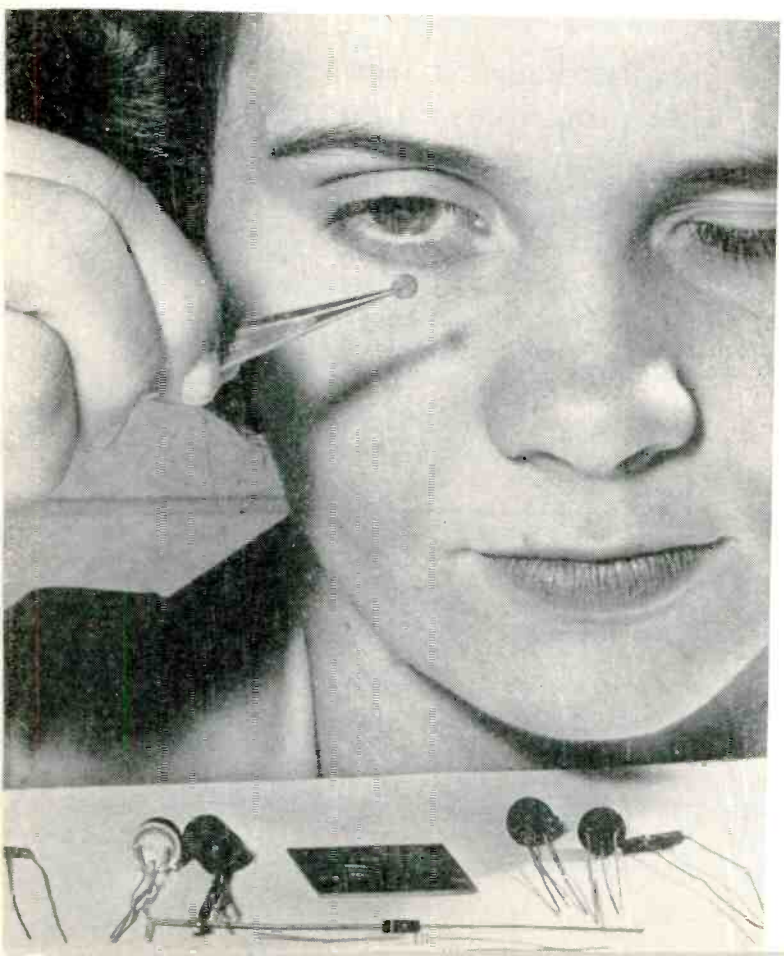


PROJECT MERCURY TEST

Arthur A. Collins, pres. of Collins Radio, and other Collins officials examine a full scale antenna test mockup of a Project Mercury capusle being used to check out the communications system which Collins is supplying for the "man-in-space" attempt. Design work has been completed, the antennas are now being tested.

"MOLECULAR ELECTRONICS"

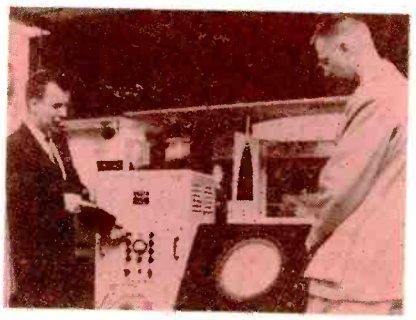
Minute slice of silicon shown, used as a light sensing device for telemetry, duplicates all the functions of a miniaturized, transistorized oscillator comprised of parts shown in foreground.

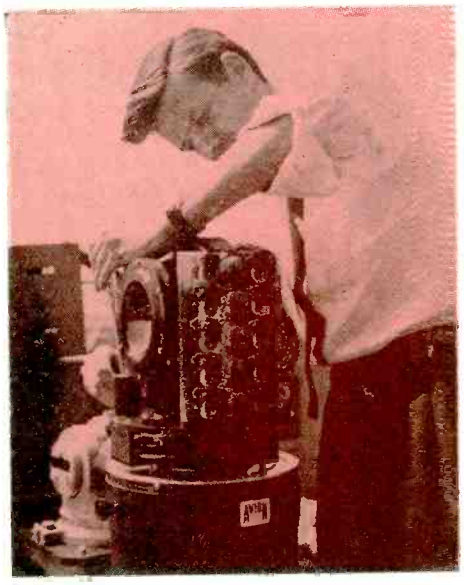


Snapshots . . . of the Electronic Industries

RADAR JAMMING

Realistic simulation of radar jamming signals was demonstrated on Sylvania's Anti-Counter measures Trainer (ACTER) at PGMIL show in Wash., D. C.





IR DETECTOR

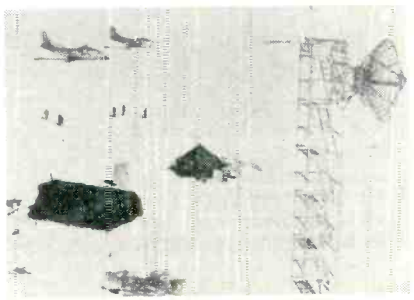
At the recent PGMIL show Avion Div. of ACF Industries exhibited this CODES (Commutating Detection System) infra-red receiver designed for detecting space satellites.

INTERROGATION

Russian-speaking Americans, to serve as guides at U.S. exhibit in Moscow, meet the IBM RAMAC which will answer questions—in Russian—about America.

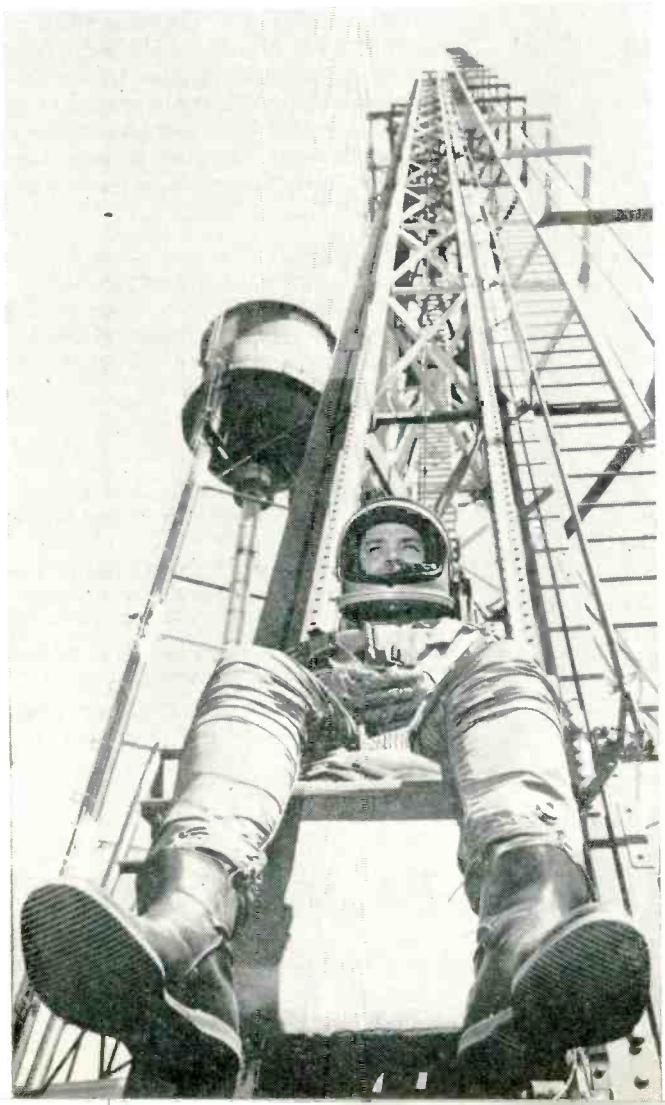
RADIO PATH TESTING

On the Greenland ice cap portable aluminum towers, with parabolic discs, check out proposed new communications system. Up-right Scaffolds made the towers.



SPACE BOUND

Space pilot readies himself for a 19-G ride on the test tower at U. S. Naval Material Center, Phila. Test ride will check the new Mark IV "space suit" developed for the Navy by B. F. Goodrich.

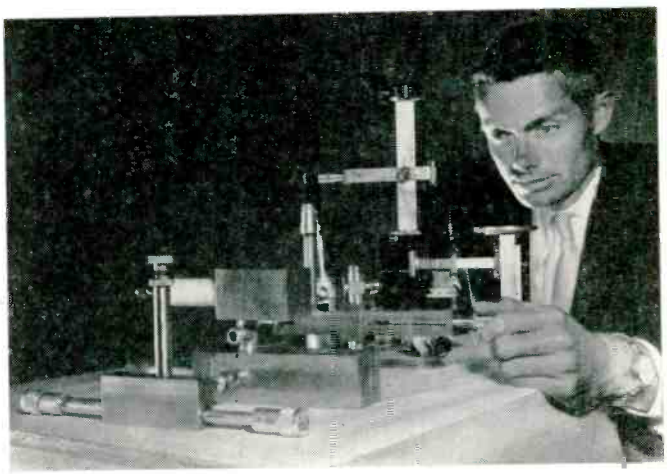


SAFETY VAN

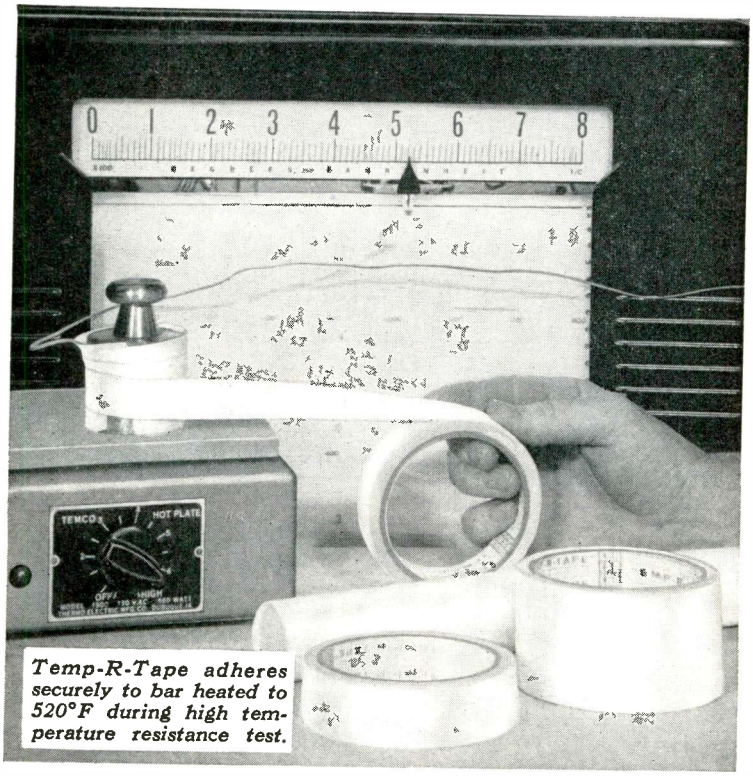
At Patrick AFB, Cape Canaveral this TV van developed by Hallamore Electronics flashes a picture of missile launching to the Range Safety Officer to check missile's attitude.

LONG RANGER

C. W. Curtis of Hughes Aircraft demonstrates new "parametric amplifier" that doubles the effective range of air traffic radars.



Now 4 CHR High Temperature TEFLON® Tapes



Temp-R-Tape adheres securely to bar heated to 520°F during high temperature resistance test.

Pressure-Sensitive TEFLON Tapes

easy to apply in both electrical and mechanical applications

The electrical uses of Temp-R-Tape include slot lining, interlayer and interphase insulation, harness bundling, wrapping for microwave components, transformer coils, capacitors and high voltage cables, etc.

As a low friction, non-stick facing, Temp-R-Tape applications range from facings for film guides in sensitive electronic instruments to the facing for heat sealing bars, forming dies, chutes, guide rails, etc.

Chemical resistant facing applications include masking tape in high temperature dipping operations.

All four of these pressure-sensitive Teflon tapes are available from stock in rolls and in sheet form. In addition to Teflon tapes, CHR also makes a fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape GV) and silicone rubber coated fiberglass tape with thermal curing, pressure-sensitive silicone adhesive (Temp-R-Tape SGV).

FREE SAMPLES and folder — write, phone or use inquiry service.

— −100°F to 500°F applications

— Class H and Class C insulation

— Non-stick and low friction facing

— Chemical resistant facing

TEMP-R-TAPE T is a .006″ pressure-sensitive Teflon tape with −100°F to 400°F (−70°C to 200°C) temperature range. It has high dielectric strength, low power factor, negligible moisture absorption, high elongation, is non-corrosive and non-contaminating. Meets Class H Temperature requirements.

TEMP-R-TAPE TH is a .013″ pressure-sensitive Teflon tape with −100°F to 400°F temperature range. It is similar to Temp-R-Tape T except that it is made of .010″ Teflon film to which .003″ silicone polymer adhesive has been added. Often used where a single, thicker dielectric barrier is desired or where a more rigid, abrasion resistant wrap is required.

TEMP-R-TAPE C is a .002″ pressure-sensitive, thermal curing Teflon tape with −100°F to 500°F temperature range. It is made with a cast Teflon film which provides dielectric strength (2750 v/m) higher than any other type of Teflon film. When cured in place, it will operate at temperatures up to 500°F and will withstand much higher temperatures for short periods. Meets Class H and Class C temperature requirements.

TEMP-R-TAPE TGV is a thermal curing, pressure-sensitive Teflon impregnated fiberglass tape with −100°F to 500°F temperature range. Although it is used extensively for mechanical and electrical applications, its dielectric strength is lower than other Temp-R-Tapes.

CHR products include:

COHRlastic Aircraft Products — *Airframe and engine seals, firewall seals, coated fabrics and ducts*

COHRlastic Silicone Rubber Products — *Silicone rubber moldings and extrusions, silicone rubber sheets, silicone sponge rubber*

Temp-R-Tapes — *Pressure sensitive, thermal curing Teflon and silicone tapes*

Allied Products — *COHRlastic silicone cements and conductive gasketing*

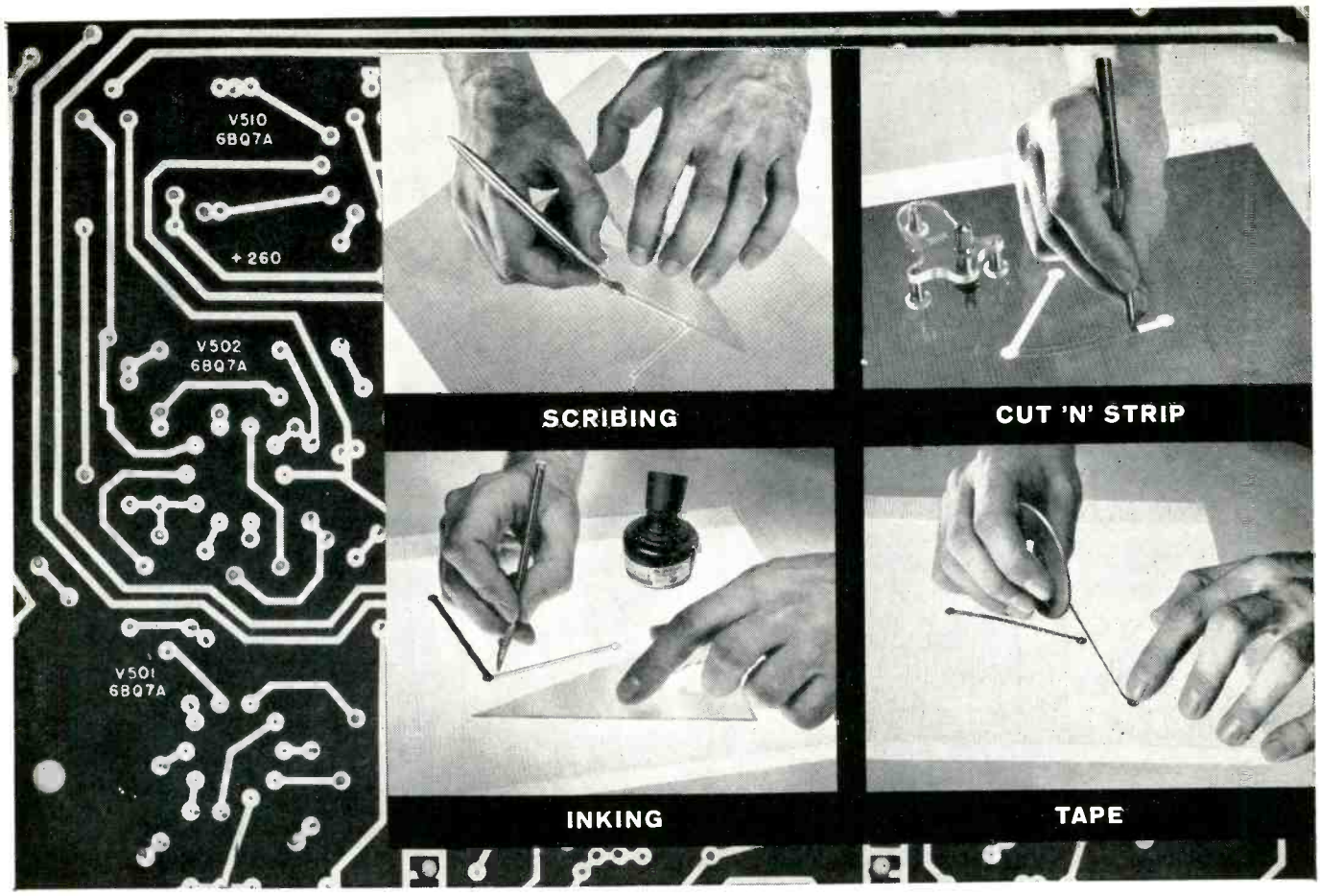
CHR

Leader In Fabrication of Silicone Rubber

CONNECTICUT HARD RUBBER COMPANY

Main Office: New Haven 9, Connecticut

Circle 15 on Inquiry Card



Printed Circuits:

for the newest techniques...and basic methods, too...

STABILENE® Film by K&E gives accurate dependable results

However you make your masters, you can expect better, more uniform results if you start with STABILENE Films. These strong, clear, completely stable films are available in a *complete range* of surfaces, for traditional preparation methods or the most advanced technique now used.

The Scribing Method—newest and most accurate – is fast and simple, too. The circuit is penciled on the STABILENE surface, then scribed in outline with double lines. Pads are scribed in, and the master copy is ready for transfer to a sensitized Peel-Coat STABILENE, where the lines and pads are simply stripped out.

The scribing method – an exclusive K&E development – is 2 to 3 times faster than taping. All but the most complicated circuits can be prepared one-to-one – eliminating reductions. Scribe points retain proper sizes, produce accurate lines of *constant* thickness.

Cut 'N' Strip is another time-saving new K&E technique. If you work one-to-one, it's just *one step* from master to board – there's no intermediate photography. A rough pencil layout is made on the back of STABILENE Film, using an accurate grid underlay. Then, the sheet is turned face-up, pads are laid out with a modified K&E Drop Bow Compass with blade, and circuit lines are cut with a circuit-path cutting tool. The surface can now be easily peeled off with a knife or tweezers.

One big advantage of Cut 'N' Strip: you can make a positive or a negative from the same basic drawing, depending on which surface you strip off. Corrections are easily made, using K&E opaquing fluid. With it, you can touch up or replace lines, then re-cut and re-peel. STABILENE Film is actinically opaque, cuts clean, yields sharp, accurate lines.

Stabilene Films For Taping or Inking Methods provide accurate, permanent dimensions. All have outstanding size-holding stability, plus the exclusive K&E "Engineered Surface," which accepts drawn lines clearly and uniformly—without feathering or blurring. STABILENE makes accurate taping easier, too—*it lays down absolutely flat.*

Only K&E offers a complete range of films for printed circuit preparation . . . plus a full line of scribers and special Cut 'N' Strip tools. All the basic techniques are described in detail in a new K&E brochure "Preparing Printed Circuits on STABILENE Film". For your copy, simply clip the coupon below and mail it today.

KEUFFEL & ESSER CO. Dept. EI-8, Hoboken, N. J.

Send me your new brochure "Preparing Printed Circuits on Stabilene Film."
I am particularly interested in – ☐ Scribing ☐ Cut 'N' Strip ☐ Inking ☐ Taping

Name & Title: _____

Company & Address: _____

_____ 1633

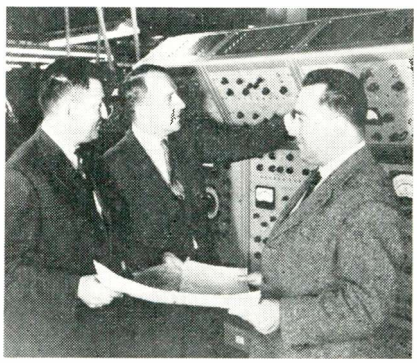
ELECTRONIC INDUSTRIES
International

(*Continued from page 24*)

ments with several of them are now being formulated.

"A large share of future power requirements will be filled by nuclear power as Europe seeks to obtain price stability and security not currently offered by coal and Mid-East oil," says Mr. Auchincloss, "and the large increase in power reactors will cause a corresponding increased demand for nucleonic instrumentation."

Test Equipment for France



George Mettler (center), president of MB Electronics, Inc., checks vibration test equipment ordered by Sud Aviation Societe Nationale de Constructions Aeronautiques Group Technique de Cannes on the French Riviera. M. Agliany (left), engineer Sud Aviation, and J. Cartier of MB's EuropeanTechnical Service Office in Paris look on.

NATO Early Warning Radar

Marconi's Wireless Telegraph Co., Eng., and Compagnie Generale de Telegraphie Sans Fil, France, have a $20,000,000 contract to provide and install equipment in the NATO early warning chain. The contract also calls for training national personnel and assistance in technical maintenance after handover of the stations in working order.

The two companies are planning to award substantial sub-contracts to Italian industry.

UNITED KINGDOM

U. S.—U. K. Joint Atomic Venture

An agreement has been signed between North American Aviation, Inc., through its Atomics International Div., Canoga Park, Calif., and the English Electric Co., Ltd., London, England, providing for collaboration between the two companies in the field of organic liquid cooled reactor systems.

Atomics International have done extensive research and development for some years on this reactor, which shows promise as a potential low-cost system for smaller nuclear power stations and for nuclear marine propulsion.

MAIN PLANT — ELKHART, INDIANA • Manufacturers of variable resistors, precision wire fixed resistors, tube savers, switches and other special components for radio, television, commercial and military electronic equipment.

CANADIAN SUBSIDIARY — C. C. Meredith & Company, Ltd., Streetsville, Ontario, Canada • Manufacturers of variable resistors and associated switches, industrial rectifiers (selenium, silicon, tube, regulated—mechanical and static control, non-regulated), emergency/normal motor generator sets diesel driven generators, 400 cycle motor generators, control panels, switchboards, and photo-electric street lighting controls

EXPANDS

WEST COAST SUBSIDIARY — Chicago Telephone of California, Inc., 105 Pasadena Avenue, South Pasadena, California • Manufacturers of variable resistors and associated switches, custom moldings, transformers, foot switches, ignition coils and solenoid coils.

MIDWEST SUBSIDIARY — CTS, Inc., Berne, Indiana • Manufacturers of wirewound variable resistors, buzz and balance rheostats and special electronic components.

SOUTHEASTERN SUBSIDIARY — CTS of Asheville, Inc., Mill Gap Road, Skyland, North Carolina • Manufacturers of variable resistors and associated switches.

BURTON BROWNE ADVERTISING

YESTERDAY

Since 1896, CTS has had a reputation for product excellence . . . becoming the world's largest variable resistor manufacturer. Most radio & TV sets throughout the world have dependable CTS controls.

TODAY

Now...in 5 plants...with over 1600 highly skilled technical personnel . . . in 436,000 sq. ft. plant area . . . CTS expands and diversifies . . . adding many other products . . . manufactured to these same high reliability standards.

FOR YOUR TOMORROW

CTS research and development with its established reputation will continue to anticipate your needs.

NEW NATION-WIDE SALES ORGANIZATION

It's easy to get the CTS product you desire. There's a CTS plant, office or representative near you.

Founded CTS 1896

CHICAGO TELEPHONE SUPPLY Corporation

ELKHART ★ INDIANA

PACIFIC AREA

LOS ANGELES BRANCH OFFICE
Chicago Telephone of California, Inc.
105 Pasadena Avenue
So. Pasadena, California

LOS ANGELES OFFICE
International Resistance Co.
1136 N. La Brea Blvd.
Hollywood, California

SAN FRANCISCO,
Logan & Stone Company
1485 Bayshore Boulevard

PORTLAND 9, OREGON
Richard Legg Company
1633 N.W. 21st Avenue

EASTERN AREA

NEW JERSEY BRANCH OFFICE
Chicago Telephone Supply Corp.
5 Haddon Avenue
Haddonfield, New Jersey

NORTH CAROLINA BRANCH OFFICE
CTS of Asheville, Inc.
Mills Gap Road
Skyland, No. Carolina

NEW YORK CITY OFFICE
International Resistance Co.
165 Broadway—Room 2024
New York City 6, New York

PHILADELPHIA OFFICE
International Resistance Co.
401 North Broad Street
Philadelphia 8, Pennsylvania

SYRACUSE OFFICE
International Resistance Co.
112 Montgomery Street
Syracuse, New York

LEXINGTON 73, MASSACHUSETTS
Richard Purinton, Inc.
11 Muzzey Street

PITTSBURGH 34, PENNSYLVANIA
Tanner & Covert
300 Mt. Lebanon Blvd.

CLEVELAND 7, OHIO
Baehr, Greenleaf & Assoc.
14700 Detroit Avenue

NORTH MIAMI BEACH 62, FLORIDA
Benz Sales Company
P.O. Box 178

MOUNTAIN AREA

DENVER 9, COLORADO
Electronic Components Sales, Inc.
645 So. Broadway

SCOTTSDALE, ARIZONA
Carl Hower
369 N. Craftsman's Court

MIDWESTERN AREA

CHICAGO OFFICE
International Resistance Co.
5243 W. Diversey Avenue
Chicago 39, Illinois

MINNEAPOLIS 16, MINNESOTA
Robert W. Marshall
6106 Excelsior Boulevard

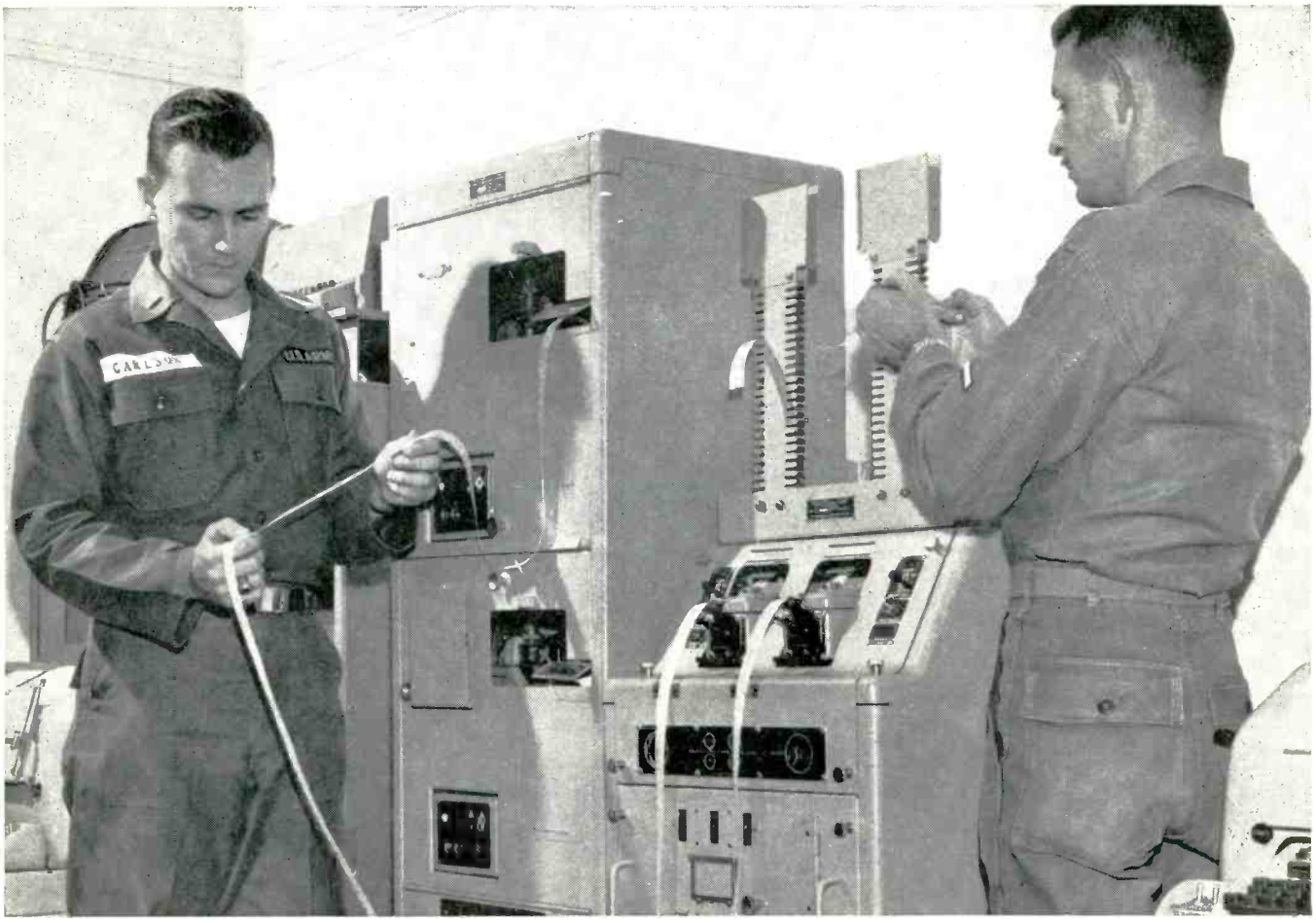
INDIANAPOLIS 20, INDIANA
Macnabb, Schroeder & Loomis
820 East 64th Street, P.O. Box 5971

KANSAS CITY, MISSOURI
E. B. Schwerin
4210 Main Street

DALLAS 35, TEXAS
John A. Green Company
7118 Envoy Court

TOP LEVEL TALK

relayed on teleprinted tape



At U.S. Army field communications centers, Kleinschmidt torn tape relay units send, receive, retransmit messages to widely-dispersed commands

"Getting the word" from top command to outlying units in the field can create a communications traffic jam. This compact relay unit solves the problem. It quickly, accurately, automatically numbers and *prints* each message as it simultaneously *relays* another message to one or 100 receivers in the communications network! Developed in cooperation with the U. S. Army Signal Corps, the unit's applications include telemetering, integrated data processing, torn tape communication. In recognition of Kleinschmidt's high standards of performance, equipment produced for the U. S. Army is manufactured under the Reduced Inspection Quality Assurance Plan.

KLEINSCHMIDT

DIVISION OF SMITH-CORONA MARCHANT INC., DEERFIELD, ILLINOIS

Pioneer in teleprinted communications systems and equipment since 1911

Circle 19 on Inquiry Card

Circle 20 on Inquiry Card

Silicon Very High Voltage Cartridge Rectifiers

¼ ACTUAL SIZE

EIA Type	Length Inches	Absolute Max. Rtgs. H/W Res. Load at 75°C Ambient: Peak Inverse Voltage Volts	Absolute Max. Rtgs. H/W Res. Load at 75°C Ambient: Max. Rectified DC Output Current MA	Electrical Characteristics at 25°C Ambient: Forward DC Volt Drop at Rated DC Current Volts	Electrical Characteristics at 25°C Ambient: Reverse DC Current at Rated PIV MA
1N1139	4 3/16	3600	65	27.0	.025
1N1140	2½	3600	65	18.0	.025
1N1141	4 3/16	4800	60	36.0	.025
1N1142	2½	4800	50	24.0	.025
1N1143	4 3/16	6000	50	45.0	.025
1N1143A	4 3/16	6000	65	30.0	.025
1N1144	6 1/16	7200	50	54.0	.025
1N1145	4 3/16	7200	60	36.0	.025
1N1146	6 1/16	8000	45	60.0	.025
1N1147	6 1/16	12000	45	60.0	.025
1N1148	6 1/16	14000	50	52.0	.025
1N1149	6 1/16	16000	45	60.0	.025

Storage and Operating Temperature Range—55°C to 150°C

Physical Characteristics

HERMETICALLY SEALED—Glass-to-metal fused and metal-to-metal welded seals.

TERMINALS—Tinned copper leads .020 inches diameter. Lead length 1¼ inch minimum.

MARKING—Wide color band indicates cathode end. (Wide band indicates positive bias on Varicaps.) Type number designated by color bands reading from cathode.

ALL DIMENSIONS SHOWN IN INCHES—Patented under one or more of the following United States Patents: No. 2815474, No. 2827403. Other patents pending.

PSI®

*A. F. APPROVED

1N645 • 1N646 • 1N647 • 1N648 • 1N649

ALL TYPES AVAILABLE

Unusual Opportunities in Semiconductor Electronics ... in the New PSI Facility

With the opening of the first unit of the newest and most modern semiconductor manufacturing facility in the world, Pacific Semiconductors, Inc., announces exceptional technical staff opportunities in expanding programs for advanced semiconductor devices.

ELECTRICAL ENGINEERS ... APPLICATION ENGINEERS ... diode, rectifier, transistor and test equipment development.

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PHYSICAL SCIENTISTS ... research programs in crystal growth and perfection studies ... solid state diffusion techniques ... the study of surface phenomena.

SALES ENGINEERS ... attractive openings East and West Coast and Mid-Continent areas.

PSI now occupies the first unit of its new facility near Los Angeles International Airport.

All of these positions offer opportunity for growth and individual recognition in a dynamic, rapidly expanding company. For specific information in your particular field, write to Technical Staff Placement, Pacific Semiconductors, Inc., 10451 West Jefferson Blvd., Culver City, Calif.

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SALES OFFICES

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Boston—471 Washington St., Wellesley 81 • CEdar 5-0171
Philadelphia—320 Huntingdon Pike, Rockledge • PIlgrim 2-8089
Madeira Beach, Fla.—P.O. Box 8215 • Phone 7-6126
Ottawa—227 Laurier Ave. West • CE 2-8504

DISTRIBUTORS: BALTIMORE—Wholesale Radio Parts Company • BOSTON—Cramer Electronics, Inc. • BUFFALO—Genesee Radio & Parts Co. • MELBOURNE and ST. PETERSBURG—Electronic Supply • NEW YORK—Peerless Radio Distributors and Terminal Radio Corporation • PHILADELPHIA—Almo Radio Company • ROCHESTER—Rochester Radio Supply Company • SYRACUSE—Syracuse Radio Supply Company • TORONTO—Electro Sonic Supply Company, Ltd. • WASHINGTON, D.C.—Electronic Industrial Sales.

ILLINOIS—6957 W. North Avenue, Oak Park, Illinois • VIllage 8-9750 • TWX: OKP 1547

Dallas—954 Magellan Circle • RIverside 7-1258
DISTRIBUTORS: CHICAGO—Allied Radio • CLEVELAND—Pioneer Electronic Supply Co. • DALLAS—Wholesale Electronic Supply • DAYTON—Srepco, Inc. • DETROIT—Ferguson Electronic Supply Co. • HOUSTON—Sterling Radio Products, Inc. • MINNEAPOLIS—Lew Bonn Co.

CALIFORNIA—8271 Melrose Ave., Los Angeles 46, Calif. • OLive 3-7850

Palo Alto—701 Welch Road, Suite 305 • DAvenport 1-2240
DISTRIBUTORS: ALAMOGORDO—Radio Specialties Company • DENVER—Denver Electronic Supply Co. • LOS ANGELES—Electronic Supply Corporation and Kierulff Electronics, Inc. • OAKLAND—Elmar Electronic Supply, Inc. • PHOENIX—Radio Specialties Corporation • SALT LAKE CITY—Standard Supply Company • SEATTLE—C & H Supply Company.

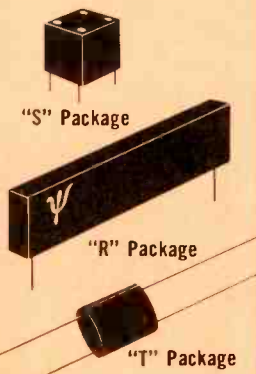
LITHO IN U.S.A.

Standard Encapsulations

A variety of assemblies can be furnished for matched pairs and quads, ring modulators, full wave and bridge rectifiers and many other applications.

Numerous lead arrangements are possible in these three basic configurations. Up to four diodes or rectifiers can be encapsulated in the "S" or "T" packages. Up to 12 units can be contained in the "R" package. The number of units contained determines its maximum length.

Leads .020" diameter,
1" minimum length.
Spaced on .1" grid centers.



⅔ ACTUAL SIZE

DIMENSIONS

	"R" Package	"S" Package	"T" Package
Length	.375" to 1.75"	.45"	.50"
Width	.25"	.39"	—
Height	.50"	.40"	—
Diameter	—	—	.375"

Silicon
High Conductance Diodes

ACTUAL SIZE

PSI or EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Maximum Forward Voltage DC @ 25°C (volts)		Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts)		Maximum Average Rectified Current (mA)	
		@ 100 mA	@ 200 mA	@ 25°C	@ 150°C	@ 25°C	@ 150°C
1N482	40	1.1		.250 @ − 30v	30	125	50
1N482A	40	1.0		.025 @ − 30v	15	200	70
1N482B	40	1.0		.025 @ − 30v	5	200	70
PS603	40		1.0	.250 @ − 30v	30	200	100
PS604	40		1.0	.025 @ − 30v	15	200	100
PS605	40		1.0	.025 @ − 30v	5	200	100
1N483	80	1.1		.250 @ − 60v	30	125	50
1N483A	80	1.0		.025 @ − 60v	15	200	70
1N483B	80	1.0		.025 @ − 60v	5	200	70
PS609	80		1.0	.250 @ − 60v	30	200	100
PS610	80		1.0	.025 @ − 60v	15	200	100
PS611	80		1.0	.025 @ − 60v	5	200	100
1N484	150	1.1		.250 @ −125v	30	125	50
1N484A	150	1.0		.025 @ −125v	15	200	70
1N484B	150	1.0		.025 @ −125v	5	200	70
PS615	150		1.0	.250 @ −125v	30	200	100
PS616	150		1.0	.025 @ −125v	15	200	100
PS617	150		1.0	.025 @ −125v	5	200	100
1N485	200	1.1		.250 @ −175v	30	125	50
1N485A	200	1.0		.025 @ −175v	15	200	70
1N485B	200	1.0		.025 @ −175v	5	200	70
PS621	200		1.0	.250 @ −175v	30	200	100
PS622	200		1.0	.025 @ −175v	15	200	100
PS623	200		1.0	.025 @ −175v	5	200	100
1N486	250	1.1		.250 @ −225v	50	125	50
1N486A	250	1.0		.050 @ −225v	25	200	70
1N486B	250	1.0		.050 @ −225v	10	200	70
PS627	250		1.0	.250 @ −225v	50	200	100
PS628	250		1.0	.050 @ −225v	25	200	100
PS629	250		1.0	.050 @ −225v	10	200	100
1N487	330	1.1		.250 @ −300v	50	125	50
1N487A	330	1.0		.100 @ −300v	25	200	70
PS632	330		1.0	.250 @ −300v	50	200	100
PS633	330		1.0	.100 @ −300v	25	200	100
1N488	420	1.1		.250 @ −380v	50	125	50
1N488A	420	1.0		.100 @ −380v	25	200	70
PS636	420		1.0	.250 @ −380v	50	200	100
PS637	420		1.0	.100 @ −380v	25	200	100

OTHER ABSOLUTE MAXIMUM RATINGS:
Maximum Power Dissipation 0.5 Watts @ 25°C. Maximum Power Dissipation 0.25 Watts @ 150°C. Maximum 1 Second Surge Current 1.5 Amperes @ 25°C. Storage and Operating Temperature Range −80° to 200°C.

Silicon
General Purpose Diodes

ACTUAL SIZE

EIA TYPE NUMBER	Minimum Saturation Voltage @ 100 μa @ 25°C (volts)	Minimum Forward Current @ +1.0 VDC @ 25°C (mA)	Maximum Inverse Current at Maximum DC Operating Voltage (μa @ volts)		Maximum Average Rectified Current (mA)	
			@ 25°C	@ 150°C	@ 25°C	@ 150°C
1N456 1N456A	30 30	40 100	.025 @ 25 .025 @ 25	5 @ 25 5 @ 25	90 200	70
*1N457 1N457A	70 70	20 100	.025 @ 60 .025 @ 60	5 @ 60 5 @ 60	75 200	70
*1N458 1N458A	150 150	7 100	.025 @ 125 .025 @ 125	5 @ 125 5 @ 125	55 200	70
*1N459 1N459A	200 200	3 100	.025 @ 175 .025 @ 175	5 @ 175 5 @ 175	40 200	70
1N461 1N461A	30 30	15 100	.5 @ 25 .5 @ 25	30 @ 25 30 @ 25	60 200	70
1N462 1N462A	70 70	5 100	.5 @ 60 .5 @ 60	30 @ 60 30 @ 60	50 200	70
1N463 1N463A	200 200	1 100	.5 @ 175 .5 @ 175	30 @ 175 30 @ 175	30 200	70
1N464 1N464A	150 150	3 100	.5 @ 125 .5 @ 125	30 @ 125 30 @ 125	40 200	70

*JAN Types

OTHER ABSOLUTE MAXIMUM RATINGS:
Power Dissipation 0.5 Watts @ 25°C. Power Dissipation 0.25 Watts @ 150°C. 1 Second Surge Current 1.5 Amperes 25°C. Storage and Operating Temperature Range −80°C to 200°C.

Varicap®
Voltage-Variable Capacitor

ACTUAL SIZE

Varicap Type	Capacitance @ 4VDC μμf	Capacitance Approx. Range μμf*	Quality Factor (Q) @ 50 mc. Minimum @ 4VDC	Quality Factor (Q) @ 50 mc. Typical @ 4VDC	Quality Factor (Q) @ 50 mc. Typical @ MWV	Maximum Working Voltage (MWV) Volts D.C.
MODULATION, AFC AND OTHER APPLICATIONS						
V-7	7	3.0-18	13	18	43	25
V-10	10	4.3-26	13	18	43	25
V-12	12	5.2-31	13	18	43	25
V-15	15	6.5-39	13	18	43	25
V-20	20	10-50	7.0	18.7	40.2	20
V-27	27	14-70	7.0	15.7	33.8	20
V-33	33	17-85	7.0	14.6	31.4	20
V-39	39	20-100	7.0	15.1	32.4	20
V-47	47	24-120	7.0	15.4	32.4	20
V-56	56	32-145	7.0	13.5	24.8	15
V-68	68	39-175	9.0	14.0	25.8	15
V-82	82	47-210	9.0	13.0	23.9	15
V-100	100	57-260	8.0	11.0	20.2	15
HIGH VOLTAGE TYPES—TUNING AND OTHER APPLICATIONS						
V-7E	7	1.5-18.0	3.0	4.5	22.5	100
V-10E	10	2.2-26.0	3.5	5.5	27.5	100
V-12E	12	2.7-31.0	4.0	6.5	32.5	100
V-15E	15	3.3-39.0	4.5	7.5	37.5	100
V-20E	20	5.0-50.0	7.0	18.7	78.5	70
V-27E	27	7.0-70.0	7.0	15.7	63.5	65
V-33E	33	9.0-85.0	7.0	14.6	56.5	60
V-39E	39	11.0-100.0	7.0	15.1	55.8	55
V-47E	47	14.0-120.0	7.0	15.4	53.8	50
V-56E	56	20.0-145.0	7.0	13.5	41.8	40

*C range specified from 0.1 volts to maximum working voltage.

"VARICAP" is the registered trade-mark of silicon voltage-variable capacitors manufactured by Pacific Semiconductors, Inc.

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.

Silicon Subminiature Rectifiers

ACTUAL SIZE

MEDIUM POWER TYPES

EIA TYPE NUMBER *	MAXIMUM RATINGS Peak Inv. Voltage (v)	Maximum Avg. Rectified Current (mA)[1] @ 25°C	@ 150°C	ELECTRICAL CHARACTERISTICS Minimum Saturation Voltage @ 100°C	Maximum Reverse Current @ PIV (μA) @ 25°C	@ 100°C	Max. Forward Voltage Drop @ 100 mA DC @ 25°C[2]
1N645	225	400	150	275	0.2	15	1.0
1N646	300	400	150	360	0.2	15	1.0
1N647	400	400	150	480	0.2	20	1.0
1N648	500	400	150	600	0.2	20	1.0
1N649	600	400	150	720	0.2	25	1.0

400 MILLIAMPERE PSI TYPES

400 mA @ 25°C—150 mA @ 150°C

PSI TYPE NUMBER	MAXIMUM RATINGS @ 100°C Peak Recurr. Inverse Voltage (volts)	Maximum RMS Input Voltage[1] (volts) @ 150°C	Maximum Average Rectified Current[1] (mA)	ELECTRICAL CHARACTERISTICS DC Forward Voltage @ Specified Current @ 25°C (volts @ mA) @ 25°C	Maximum Average Inverse Current[1] @ 100°C (μA) @ 150°C
TYPE					
PS 405	50	35	150	1.5 @ 500	500
PS 410	100	70	150	1.5 @ 500	500
PS 415	150	105	150	1.5 @ 500	500
PS 420	200	140	150	1.5 @ 500	500
PS 425	250	175	150	1.5 @ 500	500
PS 430	300	210	150	1.5 @ 500	500
PS 435	350	245	150	1.5 @ 500	500
PS 440	400	280	150	1.5 @ 500	500
PS 450	500	350	125	1.5 @ 500	500
PS 460	600	420	125	1.5 @ 500	500

250 MILLIAMPERE PSI TYPES

250 mA @ 25°C—140 mA @ 100°C

PS 005	50	35	140	1 @ 100	100
PS 010	100	70	140	1 @ 100	100
PS 015	150	105	140	1 @ 100	100
PS 020	200	140	140	1 @ 100	100
PS 025	250	175	140	1 @ 100	100
PS 030	300	210	140	1 @ 100	100
PS 035	350	245	140	1 @ 100	100
PS 040	400	280	140	1 @ 100	100
PS 050	500	350	140	1 @ 100	100
PS 060	600	420	140	1 @ 100	100

1. Resistive or inductive load.
2. Averaged over one cycle for half wave resistive or choke input circuit with rectifier operating at full rated current and maximum RMS input.

Storage and Operating Temperature Range—65°C to 200°C.

500 MA TYPES IN MINIATURE PACKAGE ALSO AVAILABLE.

New Types! Silicon HighVoltage Rectifiers

⅔ ACTUAL SIZE

EIA TYPE NUMBER	Peak Inverse Voltage (volts)	Average Rectified Current (mA) @ 25°C	@ 100°C	MAX RMS Input Voltage (volts)	MAX DC Fwd Voltage Drop @ 100 mA DC 25°C	Dimensions (inches) L.	Dia.
1N1730	1000	200	100	700	5	.5	.375
1N1731	1500	200	100	1050	5	.5	.375
1N1732	2000	200	100	1400	9	1.0	.375
1N1733	3000	150	75	2100	12	1.0	.375
1N1734	5000	100	50	3500	18	1.0	.5
1N2382	4000	150	75	2800	18	1.0	.5
1N2383	6000	100	50	4200	27	1.5	.5
1N2384	8000	70	35	5600	27	1.5	.5
1N2385	10000	70	35	7000	39	2.0	.5

Maximum DC Reverse Current @ Rated PIV 10μA @ 25°C, 100μA @ 100°C.
Maximum Surge Current (8msec.) 2.5 Amps.
Continuous DC Voltage same as PIV.
Operating temperature range —55°C to 150°C.

Very High Frequency Silicon Power Transistors

N-P-N Triple-diffused silicon mesa

VHF POWER AMPLIFIER TYPES

PT-518 TYPICAL 70 MC POWER GAIN 10 db WITH 75 mw POWER OUTPUT; 4 db WITH 250 mw POWER OUTPUT. V_{CB} = 75V, I_C = 30 mA.

PT-519 TYPICAL 70 MC POWER GAIN 10 db WITH 250 mw POWER OUTPUT; 4 db WITH 500 mw POWER OUTPUT. V_{CB} = 75V, I_C = 30 mA.

PT-520 TYPICAL 70 MC POWER GAIN 10 db WITH 500 mw POWER OUTPUT; 4 db WITH 750 mw POWER OUTPUT. V_{CB} = 75V, I_C = 30 mA.

See Footnotes 1 and 2.

ABSOLUTE MAXIMUM RATINGS (25° ± 3°C except as noted)

Collector-Base Voltage	V_{cb}	160 Vac Peak
	V_{CB}	120 Vdc
Collector Current	I_C	75 mAdc
Emitter-Base Voltage	V_{EB}	4 Vdc
Junction Temperature	T_J	150°C
Collector Dissipation	P_C	2.8 W @ 25°C case temp.
		2.25 W @ 50°C case temp.
		1.1 W @ 100°C case temp.

OTHER ELECTRICAL CHARACTERISTICS (25° ± 3°C except as noted)

Symbol	Characteristics	Test Conditions	Min.	Typical	Max.	Unit
I_{EBO} I_{CBO} I_{CBO}	Emitter Cutoff Current Collector Cutoff Current Collector Cutoff Current	V_{EB} = 2V, I_C = 0 V_{CB} = 10V, I_E = 0 V_{CB} = 100V, I_E = 0			100 1.5 1.0	μA μA mA
h_{fe}	HF Current Gain	V_{CB} = 50V, I_C = 30mA, f = 70mc.	1.0	1.5		
h_{fe}	LF Current Gain	V_{CB} = 50V, I_C = 30mA, f = 1kc		13		
r_b'	HF Base Resistance	V_{CB} = 12V, I_E = −10mA, f = 150mc.			100	ohm
C_{ob}	Output Capacitance[3]	V_{CB} = 50V, I_E = 0 f = 140kc.			7.5	μμf
r_e+r_e'	Emitter Resistance	I_E = −10mA, I_C = 0 f = 1kc		7		ohm
r_c'	Collector Series Resistance	I_E = −20mA, I_C = 10mA, f = 1kc		15		ohm

Footnotes:
1. Case temperature 50°C maximum.
2. Neutralized common emitter power gain with input and output conjugate matching.
3. Includes approximately 1.5μμf header capacitance.

VHF POWER OSCILLATOR TYPES

PT-515 OSCILLATOR POWER OUTPUT 250 mw MIN. @ 70 mc. V_{CB} = 80V, I_C = 30 mA.

PT-516 OSCILLATOR POWER OUTPUT 500 mw MIN. @ 70 mc. V_{CB} = 90V, I_C = 30 mA.

PT-517 OSCILLATOR POWER OUTPUT 750 mw MIN. @ 70 mc. V_{CB} = 100V, I_C = 30 mA.

See Footnotes 1 and 2.

ABSOLUTE MAXIMUM RATINGS (25° ± 3°C except as noted)

Collector-Base Voltage	V_{cb}	160 Vac Peak
	V_{CB}	120 Vdc
Collector Current	I_C	75 mAdc
Emitter-Base Voltage	V_{EB}	3 Vdc
Junction Temperature	T_J	150°C
Collector Dissipation	P_C	2.8 W @ 25°C case temp.
		2.25 W @ 50°C case temp.
		1.1 W @ 100°C case temp.

OTHER ELECTRICAL CHARACTERISTICS (25° ± 3°C except as noted)

Symbol	Characteristics	Test Conditions	Typical	Max.	Unit
I_{EBO} I_{CBO} I_{CBO}	Emitter Cutoff Current Collector Cutoff Current Collector Cutoff Current	V_{EB} = 1V, I_C = 0 V_{CB} = 10V, I_E = 0 V_{CB} = 100V, I_E = 0		100 1.5 1.0	μA μA mA
h_{fe}	LF Current Gain	V_{CB} = 50V, I_C = 30mA f = 1kc	6		
r_b'	HF Base Resistance	V_{CB} = 12V, I_E = −10mA f = 150mc.	60		ohm
C_{ob}	Output Capacitance[3]	V_{CB} = 50V, I_E = 0 f = 140kc.	4.0		μμf
r_e+r_e'	Emitter Resistance	I_E = −10mA, I_C = 0 f = 1kc	7		ohm
r_c'	Collector Series Resistance	I_E = −20mA, I_C = 10mA f = 1kc	15		ohm

Footnotes:
1. Case temperature 50°C maximum.
2. Power output in parallel line oscillator.
3. Includes approximately 1.5 μμf header capacitance.

Note: The above transistors will soon be designated by EIA Type numbers. Watch for announcement.

NEW!

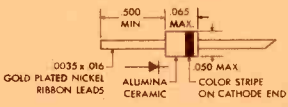
Latest product advances in Micro-Miniaturization... immediately available from PSI

PSI *micro*diode

ACTUAL SIZE

TYPE No.	Min. Sat. Voltage @ 100 μa (v)	Min. Fwd. Current @ +1.0 V (mA)	Maximum Reverse Current (μA)		Reverse Recovery Characteristics	
			25°C	100°C	Reverse Res (ohms)	Max. Recov Time (μs)
PD-1	50	5	1(10v)	25(10v)	100K	1.0
PD-021	50	20	.5(10v)	25(10v)	100K	0.3
PD-031	100	5	.5(10v)	25(10v)	100K	0.3
PD-034	100	20	.5(10v)	25(10v)	100K	0.3
PD-041	200	10	.025(10v) 1(10v)	5(10v)	200K	0.3
PD-042	200	10	.5(10v) 5(10v)	25(10v)	200K	0.3

DIMENSIONAL SPECIFICATIONS



A major advance in micro-miniaturization featuring high standards of reliability. Volume and weight of these new PSI types are approximately 1/20 of present subminiature diodes.

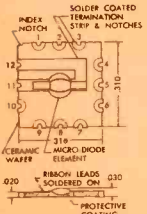
These six types of silicon diffusion computer Microdiodes, except for power ratings, are the electrical equivalent of PSI subminiature computer diodes.

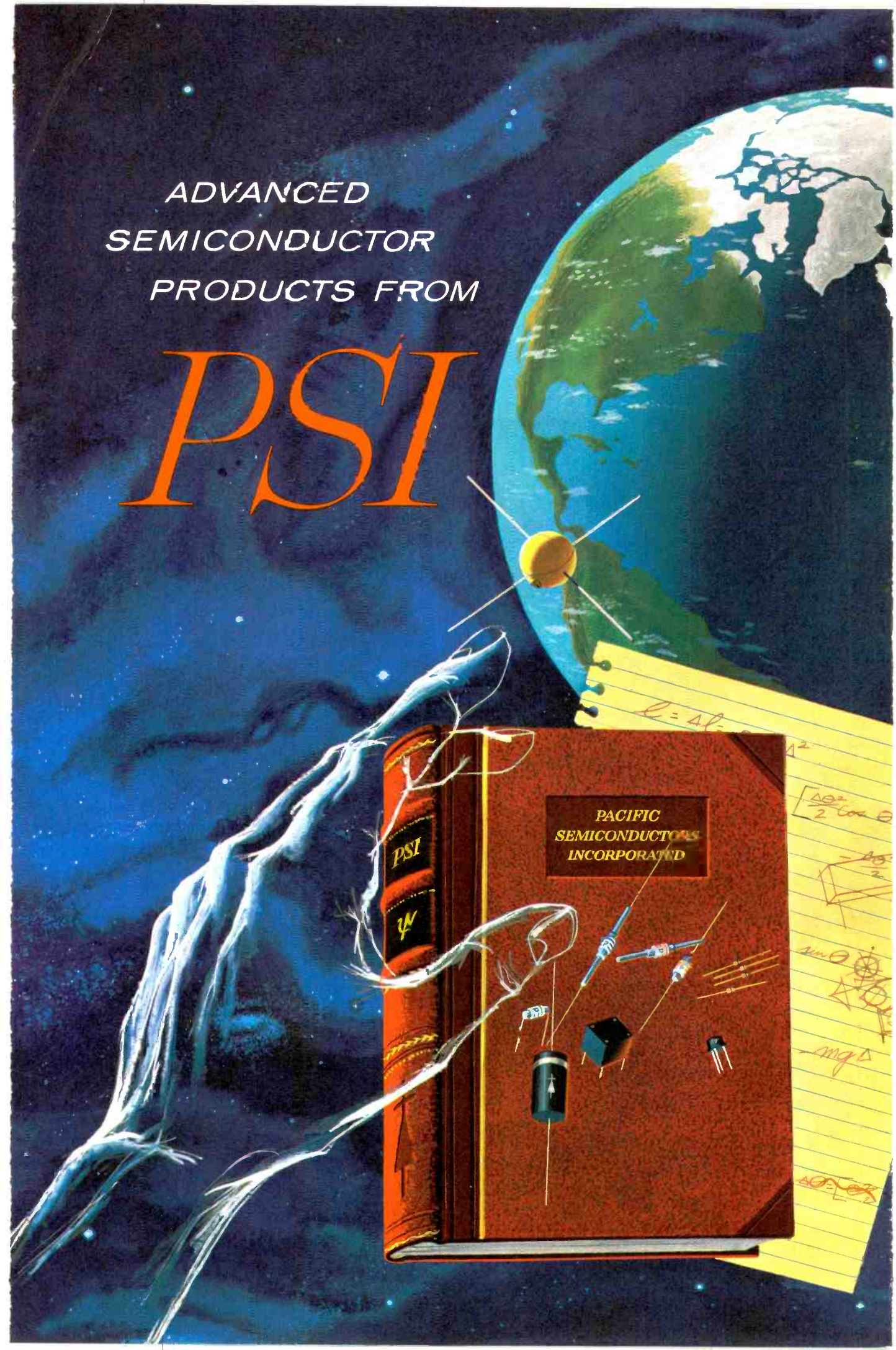
All types immediately available.

PSI *micro*module

ACTUAL SIZE

The new PSI Micromodule is available now, in all of the above Microdiode types. Phone, wire, or write your nearest PSI Sales Office for detailed specifications, curves, reliability data, prices and delivery schedules.

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PSI Hi-Q Varicap®

ACTUAL SIZE

VARICAP TYPE	Capacitance* @ 4VDC 50MC ($\mu\mu$f)	Quality Factor Min. (Q) @ 4VDC 50MC	Max. Working Voltage (VDC)	Minimum Saturation Voltage @ 100 μADC (VDC)	Maximum Inverse Current @ 50VDC (μADC)
PC-112-10	10	50	80	90	1.0
PC-113-22	22	50	80	90	1.0
PC-114-47	47	50	80	90	1.0
CAPACITANCE CHANGE: From 2VDC to 80VDC, 4.0 to 1 Min.					
VARICAP TYPE	**Capacitance* @ 4VDC 50MC ($\mu\mu$f)**	**Quality Factor Min. (Q) @ 4VDC 50MC**	**Max. Working Voltage (VDC)**	**Minimum Saturation Voltage @ 100 μADC (VDC)**	**Maximum Inverse Current @ 75VDC (μADC)**
PC-115-10	10	100	100	110	1.0
PC-116-22	22	100	100	110	1.0
PC-117-47	47	100	100	110	1.0
CAPACITANCE CHANGE: From 2VDC to 100VDC, 5.2 to 1 Min.					

*All capacitance values are ±20% All values at 25°C

"VARICAP" is the registered trade-mark of silicon voltage-variable capacitors manufactured by Pacific Semiconductors, Inc.

An entirely new approach to the design of electronic tuning, automatic frequency control, harmonic generation and numerous other circuits is made possible by the introduction of these new silicon voltage-variable capacitors. The Q specifications of 50 and 100 at 4VDC at 50 mc. for the first time combine wide tuning range and high Q.

All High Q Varicap types are available on good delivery schedules.

Fast Recovery Silicon Diffusion Computer Diodes

ACTUAL SIZE

Type Number	Minimum Saturation Voltage * @ 100 μa (volts)	Minimum Forward Current @ + 1.0 volt (mA)	Maximum Reverse Current (μa) 25°C	Maximum Reverse Current (μa) 100°C	Reverse Recovery Characteristics: Reverse Resistance (ohms)	Reverse Recovery Characteristics: Maximum Recovery Time (μs)
MILITARY TYPES						
1N643†	200	10	.025 (10v) 1 (100v)	5 (10v) 15 (100v)	200K	0.3
1N662‡	100	10	1 (10v) 20 (50v)	20 (10v) 100 (50v)	100K	0.5
1N663*	100	100	5 (75v)	50 (75v)	200K	0.5
†Mil-E-1/1171 (SigC) ‡Mil-E-1/1139 (SigC) *Mil-E-1/1140 (SigC)						
1N789	30	10	1 (20v)	30 (20v)	200K	0.5
1N790	30	10	5 (20v)	30 (20v)	200K	0.25
1N791	30	50	5 (20v)	30 (20v)	200K	0.5
1N792	30	100	5 (20v)	30 (20v)	100K	0.5
1N793	60	10	1 (50v)	30 (50v)	200K	0.5
1N794	60	10	5 (50v)	30 (50v)	200K	0.25
1N795	60	50	5 (50v)	30 (50v)	200K	0.5
1N796	60	100	5 (50v)	30 (50v)	100K	0.5
1N797	120	10	1 (100v)	30 (100v)	200K	0.5
1N798	120	10	5 (100v)	30 (100v)	200K	0.25
1N799	120	50	5 (100v)	30 (100v)	200K	0.5
1N800	120	100	5 (100v)	30 (100v)	100K	0.5
1N801	150	10	1 (125v)	30 (125v)	200K	0.5
1N802	150	50	5 (125v)	50 (125v)	200K	0.5
1N803	200	10	5 (175v)	50 (175v)	200K	0.5
1N804	200	50	10 (175v)	50 (175v)	200K	0.5
1N659	60	6	5 (50v)	25 (50v)	400K	0.3
1N660	120	6	5 (100v)	50 (100v)	400K	0.3
1N661	240	6	10 (200v)	100 (200v)	400K	0.3
1N625	30	4 @ 1.5v	1 (20v)	30 (20v)	400K	1 μsec
1N626	50	4 @ 1.5v	1 (35v)	30 (35v)	400K	1 μsec
1N627	100	4 @ 1.5v	1 (75v)	30 (75v)	400K	1 μsec
1N628	150	4 @ 1.5v	1 (125v)	30 (125v)	400K	1 μsec
1N629	200	4 @ 1.5v	1 (175v)	30 (175v)	400K	1 μsec

*Maximum DC working inverse voltage is 85% of minimum saturation voltage.

OTHER SPECIFICATIONS:
Peak Pulse Current, 1 μsec, 1% duty cycle: 3.0 Amps.
Storage and Operating Temperature Range: −65°C to 200° C.

Please Note: All specifications and information contained herein are current as of:

August 1, 1959

Zener Diodes 500 mW Power Dissipation

ACTUAL SIZE

LOW VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 5 mA @ 25°C: E_z Min. (v)	E_z Max. (v)	Maximum Dynamic Resistance (ohms) 1	Maximum Inverse Current: I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6465	1N465	2.0	3.2	60	75	100	1
PS6466	1N466	3.0	3.9	55	50	100	1
PS6467	1N467	3.7	4.5	45	5	100	1
PS6468	1N468	4.3	5.4	35	5	100	1.5
PS6469	1N469	5.2	6.4	20	5	100	1.5
PS6470	1N470	6.2	8.0	10	5	50	3.5

1. Measured at 10mA DC Zener current with 1mA RMS signal superposed.

MEDIUM VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 200 μA @ 25°C: E_z Min. (v)	E_z Max. (v)	Maximum Inverse Current: I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6313	1N1313	7.5	10	.5	5	6.8
PS6314	1N1314	9	12	.5	5	8.2
PS6315	1N1315	11	14.5	.5	5	10.0
PS6316	1N1316	13.5	18	.5	5	12.0
PS6317	1N1317	17	21	.5	5	15.0
PS6318	1N1318	20	27	.1	10	18.0

HIGH VOLTAGE GROUP

PSI Type Number	Elect. Equiv.	Zener Voltage @ 200 μA @ 25°C: E_z Min. (v)	E_z Max. (v)	Maximum Inverse Current: I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)
PS6319	1N1319	25	32	.1	10	22
PS6320	1N1320	30	39	.1	10	27
PS6321	1N1321	37	45	.1	10	33
PS6322	1N1322	43	54	.1	10	39
PS6323	1N1323	52	64	.1	10	47
PS6324	1N1324	62	80	1.0	50	56
PS6325	1N1325	75	100	1.0	50	68
PS6326	1N1326	90	120	1.0	50	82
PS6327	1N1327	110	145	1.0	50	100

MAXIMUM Power Dissipation 500 mW @ 25°C.
Operating Range −65°C to 200°C.

Now Also Available . . .

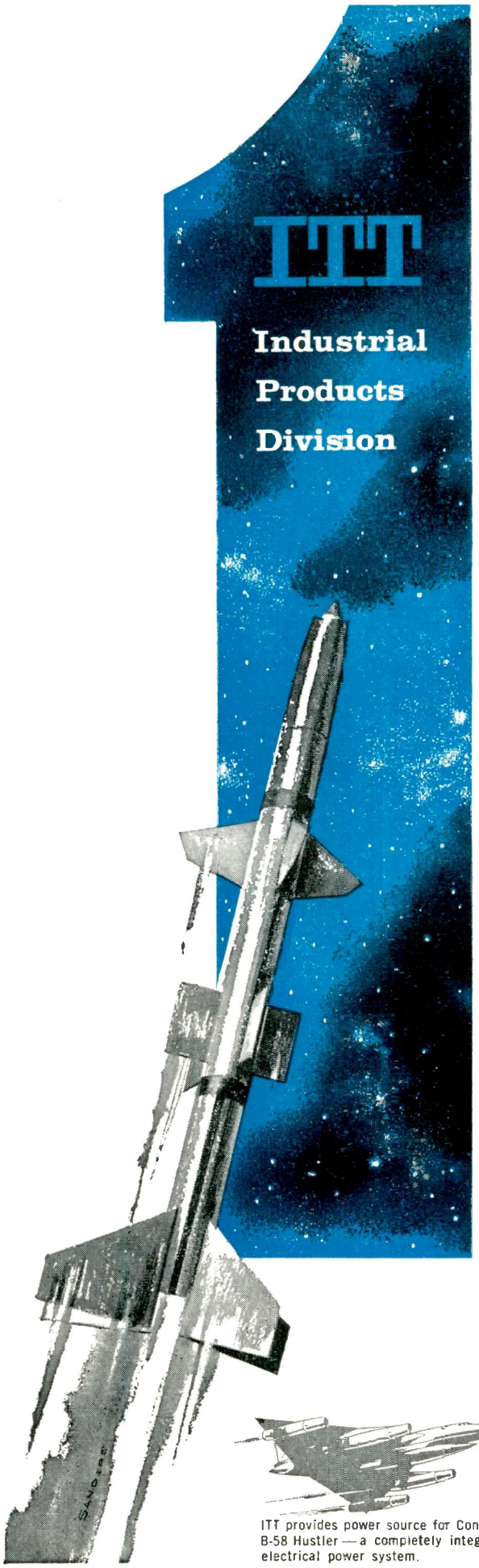
EIA TYPES	Zener (Breakdown) Voltage @ 5 mA: Ez Min. (v)	Ez Max. (v)	Maximum Inverse Current: I_b @ 25°C (μA)	I_b @ 100°C (μA)	At Inverse Voltage (v)	Maximum Dynamic Resistance (ohms) 1
1N702	2.0	3.2	75	100	−1	60
1N703	3.0	3.9	50	100	−1	55
1N704	3.7	4.5	5	100	−1	45
1N705	4.3	5.4	5	100	−1.5	35
1N706	5.2	6.4	5	100	−1.5	20
1N707	6.2	8.0	5	50	−3.5	10

1. Measured at 10 mA DC Zener current with 1 mA RMS signal superposed.

All of the above types can be supplied in ±5% Tolerance. Add "A" suffix to indicate units with ± 5% Tolerance of center Zener Voltage Value.

. . . Just released
Zener 1N 708 thru 1N 725
Zener 1N 746 thru 1N 759

PSI



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The Industrial Products Division of ITT offers a complete facility for custom airborne, ground, and ground-support power equipment and systems. Backed by the research, development, manufacturing, and technical experience of the worldwide International Telephone and Telegraph Corporation, we can package power equipment with built-in reliability to your exact requirements. Our complete engineering staff and environmental testing facilities enable us to supply reliable, high-quality units and systems, both quickly and at reasonable cost –

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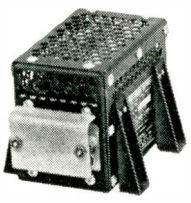

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Static power unit for this nation's most advanced jet bomber.

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INTERNATIONAL TELEPHONE & TELEGRAPH CORPORATION
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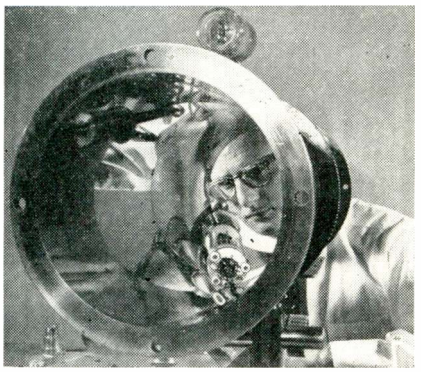
Hughes Builds Maser Clock for Satellite

The National Aeronautics and Space Administration has awarded a $200,000 contract to Hughes Aircraft Company to build an atomic clock with an accuracy of about one second in a thousand years. The clock, said to be the most accurate instrument in the history of man, will be designed around an ammonia maser.

The clock will be placed in an orbiting satellite to check the Einsteinian theory that time is influenced by both gravity and motion. Dr. Harold Lyons, inventor of the first atomic clock, heads the project.

The maser clock uses the vibrations of ammonia molecules vibrating at about 24 billion times a second to drive a frequency divider which synchronizes a low frequency clock, in this case a quartz crystal. The ammonia molecules are formed into a jet which travels down an evacuated tube, and enters a metal



Dr. Harold Lyons, Hughes scientist, examines tubular heart of "ammonia maser" clock. Clock will measure the geometric shape of the earth.

cavity where they emit the radio waves. Hughes is using a chemical method of maintaining the vacuum in the tube instead of the usual mechanical and oil diffusion pumps.

Other features of the Hughes design are a frequency divider and servo circuit of the phase-locked type, a highly stable, double-resonant cavity, temperature stabilization, a precision cavity tuning method, a unique source for generating the ammonia beam and a parametric diode frequency multiplying circuit. The phase-locked servo can only be used with a maser and is the most accurate type of divider known. The double cavity system reduces reaction of the maser output system on the molecules and eases the temperature control problem, while the cavity tuning method likewise provides a reduction of possible interactions.

This month's news from Raytheon . . .

RAYTHEON ANNOUNCES NINE NEW SUBMINIATURE TRANSISTORS

Raytheon Distributors offer you broadest line of Submins

WHATEVER YOUR REQUIREMENTS — Raytheon offers 22 types of subminiature transistors for use in computers, general purpose audio, IF and RF for radio receivers and general purpose RF circuits. This broad Raytheon line now lets you select subminiature transistors to meet your exact requirements.

TOP PERFORMANCE AND RELIABILITY — Every Raytheon transistor features rigid processing control that insures reliability and stability of electrical characteristics. This rigid control lets you select any of these types with complete confidence in their performance.

FAST, EFFICIENT SERVICE — Raytheon Industrial Electronic Distributors offer these transistors and products to fill all your electronic needs from complete local stocks. You get faster, more efficient service and at no penalty in price.

SINGLE SOURCE, ONE STOP BUYING — Whatever your electronic needs, your local Raytheon Industrial Products Distributor offers you a complete line of industrial tubes including a new line of industrial control tubes, electronic hardware and now the broadest line of subminiature transistors available.

About Industrial Distributors

by John Hickey,
Raytheon Industrial Products Manager

Every industrial distributor must have you, the customer, in mind at all times. To do this he must offer at all times, the best of service—fast and efficient, complete knowledge of your electronic needs, full, one-stop coverage of all your electronic requirements, and the best in prices. Every Raytheon Industrial Distributor satisfies all these requirements. If you don't know your nearest Raytheon Industrial Electronics Distributor, write me direct and I'll be glad to give him your name or have him call you.

RAYTHEON

RAYTHEON

Raytheon Distributors Serving Key Markets Include:

Baltimore, Md.
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Detroit, Mich.
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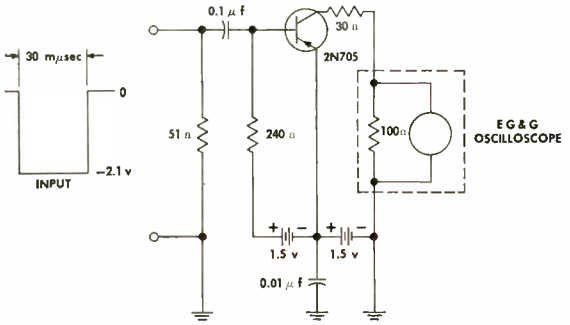
For high-reliability switching

APPLICATION NOTES

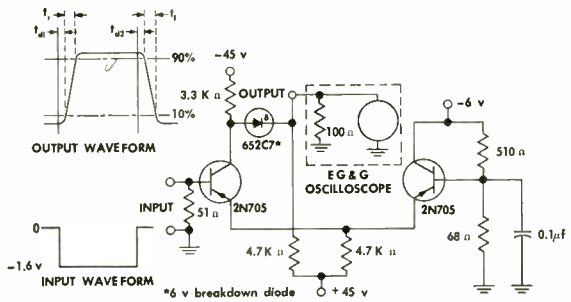
VOLTAGE SWITCHING CIRCUIT

t_d	t_r	t_s	t_f	$V_{BE(0)}$	$V_{BE(1)}$	$V_{BE(2)}$
5 mμsec	7 mμsec	7 mμsec	7.5 mμsec	1.5 v	−0.6 v	1.5 v



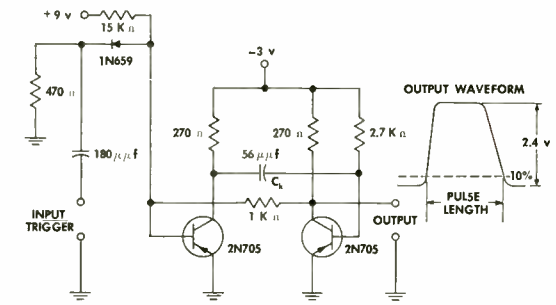
NON-SATURATING CURRENT MODE SWITCH

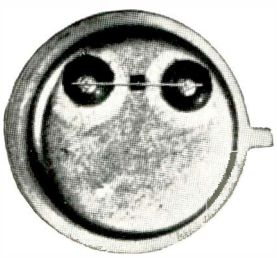
t_{d1}	t_r	t_{d2}	t_f
4 mμsec	3.6 mμsec	5.5 mμsec	10.4 m sec



MONOSTABLE MULTIVIBRATOR

t_r	t_f	Pulse length (depends on C_k)
20 mμsec	40 mμsec	120 mμsec





5 times actual size

Exact product uniformity and reproducibility is another benefit to you from TI's diffused-base production process. Maximum mechanical strength and high heat transfer characteristics are a direct result of mounting the wafer directly to the header.

Highest inherent reliability provided by diffused-base 'mesa' process

- Higher reliability because of lower operating junction temperature from the industry's highest dissipation germanium ultra-high speed switcher.
- Increased protection against surge voltages provided by diffused junction (rugged emitter-base junction) permits greater design freedom.
- Maximum resistance to shock and vibration is designed into all TI diffused-base products by fusing the semiconductor wafer directly to the header.

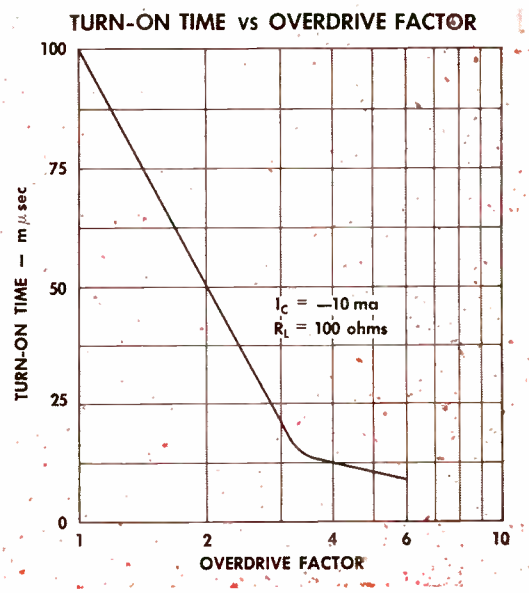
Actual Size

Now utilize the combination of *maximum* reliability and ultra-high speed switching furnished by TI 2N705's. Reliability is determined largely by device operating junction temperature. 2N705 *300-mw dissipation at 25°C case temperature and operation to 100°C junction temperature gives you three times greater power handling capacity* plus typical total switching times of 25 mμsec!

TRUE SWITCHING SPEED

A transistor's true switching speed in any circuit is dependent on the amount of over-drive designed in the circuit: Overdrive $= \frac{I_b h_{FE}}{I_{CS}}$

Below is the speed-up of 2N705's as a function of overdrive characteristics.

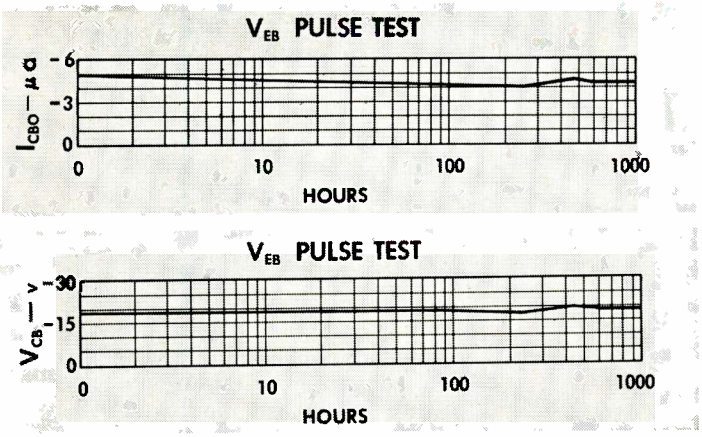


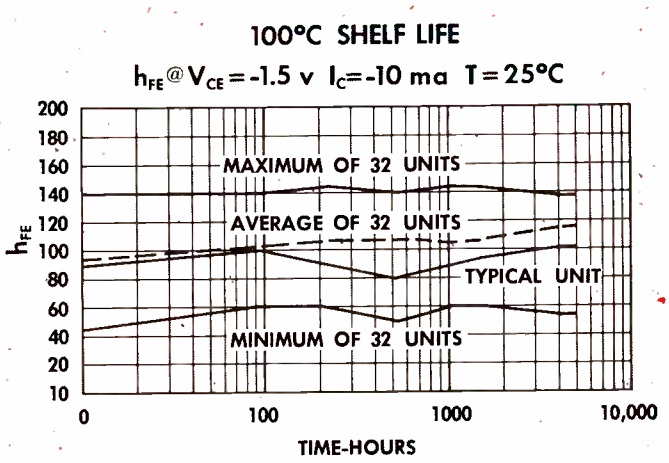
FROM THE WORLD'S LARGEST SEMICONDUCTOR PLANT

TEXAS

Circle 24 on Inquiry Card

...TI 'mesa' transistors!





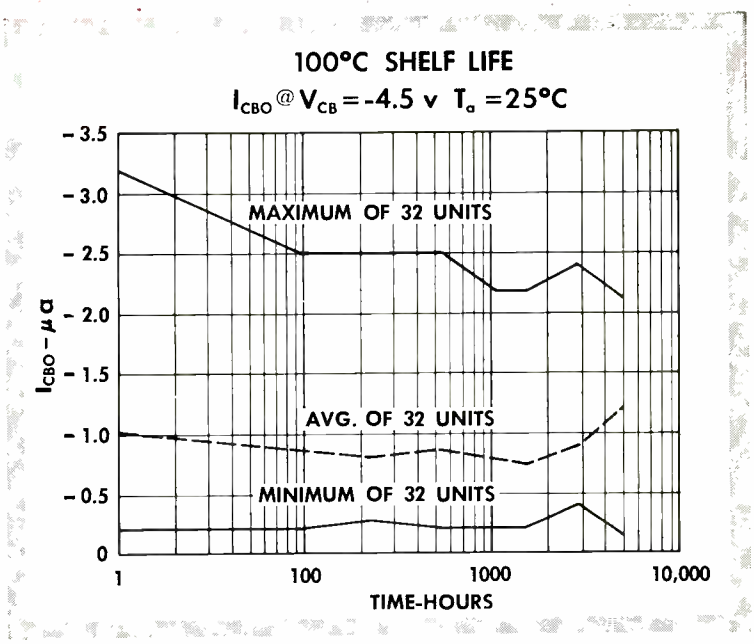
RELIABILITY INSURED BY RUGGED DESIGN, TEST

5000-hours life test data! Check the curves on the right for yourself and see how TI's 2N705 h_{FE} and I_{CBO} proved-performance characteristics apply to your high speed switching requirements. Also, for absolute assurance of conformance to specifications, all units are stabilized at 100°C for 100 hours and then 100% production tested!

Rugged Emitter-Base Junction

For an added design safety factor, consider the voltage surge tests shown above from which the graphic data on this page was obtained. In a circuit utilizing 2N705's a voltage pulse was applied to the emitter base diode in sufficient magnitude that it resulted in breakdown of the emitter base diode, causing flow of a 1, 5 and 10 ma current in each of three separated device groups. This test was continued for 1000 hours and all test data indicated that device characteristics I_{CBO}, h_{FE}, V_{EB}, and V_{CB} were *unaffected by this 1000 hour pulse test.*

Like all other TI semiconductors, the new 2N705 series is guaranteed for one full year.



absolute maximum ratings at 25°C case temperature
(unless otherwise specified)

	2N705	2N710
Collector-Base Voltage	−15 v	−15 v
Emitter-Base Voltage	− 3.5 v	− 2.0 v
Collector-Emitter Voltage	−15 v	−15 v
Storage Temperature Range	−65 to +100°C	
Emitter Current	−50 ma	−50 ma
Collector Current	−50 ma	−50 ma
Collector Junction Temperature	+100°C	+100°C
Total Device Dissipation	300 mw*	300 mw*

* Derate at 4 mw/°C. This is equivalent to a maximum power rating of 300 mw at a case temperature of 25°C. The power rating in free air at 25°C is 150 mw.

Evaluate the data on these pages for your requirements and call your nearby TI sales office for complete price and delivery information . . . or contact your authorized TI distributor for off-the-shelf overnight delivery!

INSTRUMENTS
INCORPORATED
SEMICONDUCTOR-COMPONENTS DIVISION
13500 N. CENTRAL EXPRESSWAY
POST OFFICE BOX 312 · DALLAS, TEXAS

Write on your company letterhead describing your application for specific details on TI products.

Heat From Components Fires Vacuum Tubes

By confining the heat generated by electronic components and using it to operate vacuum tubes General Electric engineers have come up with a new miniatured construction that can reduce circuits to pencil eraser size.

The miniature circuits are called TIMMs, short for "thermionic integrated micro-modules."

Enginering samples will be developed in a relatively short time and production in quantity may be possible after another year, depending on the requirements of particular applications which could take advantage of the unique capabilities of these new electronic building blocks.

TIMMs differ chiefly from other micro-modular concepts in that (1) tiny heaterless electron tubes are used instead of transistors, and (2) auxiliary cooling is reduced or eliminated and the heat losses generated within the equipment serve a useful purpose of increasing the over-all efficiency of operation and contribute to the extended life and reliability of the equipment.

Resistors built into the ceramic modules consist of a resistive film on the inside of evacuated and sealed ceramic insulators. The laboratory report indicates resistances of 5,000 ohms per square are possible, and resistors made in this fashon of from one to 500,000 ohms have operated stably at 700°c. The preliminary data presented showed changes of less than 3 per cent in resistance in an operating temperature of 550 degrees centigrade, and similar stability in operation within a nuclear pile.

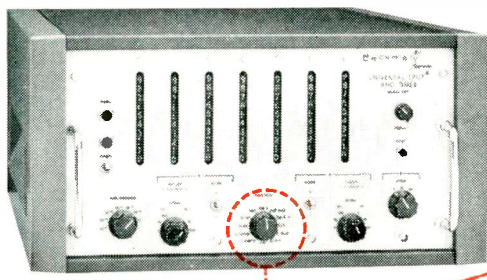
Built-in micro-miniature capacitors, with synthetic mica as the dielectric, have in operation shown a change of less than 5% over a temperature variation ranging from zero to 700°C.

The heaterless electron tubes built into the stacks have a self-biasing characteristic — no grid current flows until the grid is at least two volts positive with repect to the cathode — thus eliminating the necessity for an external bias battery or a cathode bias resistor and capacitor.

A typical circuit module one-third inch in diameter and 2.6 inches in length—no bigger than a stubby pencil—can contain 10 diodes, 14 triodes, 14 resistors and 6 capacitors. This represents a circuit density of 250,000 components per ft.^{3}

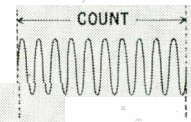
10 Mc COUNTER

does everything without plug-ins

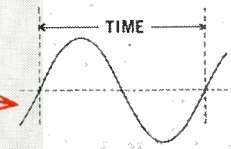


FUNCTION

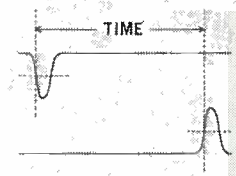
TEST
PER B
PER Bx10
E/UT
TIM B-A
SCAN
E/B
E/UTx10
E/Bx10
COUNT-E
OFF
E/B-A



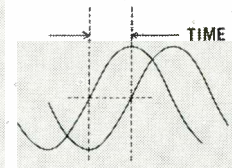
Frequency counting to 10Mc **with 0.1v sensitivity**



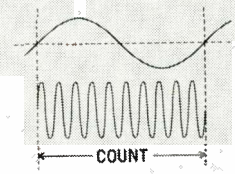
Period measurements in 0. 1μsec units



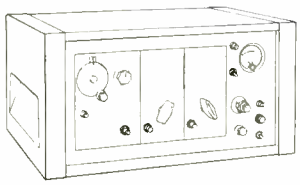
2-channel time interval measurements



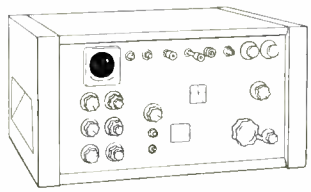
Phase difference measurements



Frequency ratio measurements



Add this heterodyne unit (Model 7570 Series) to measure frequencies up to 1000Mc.



Or add this computing transfer oscillator (Model 7580) to get a counter display of frequencies up to 15,000Mc.

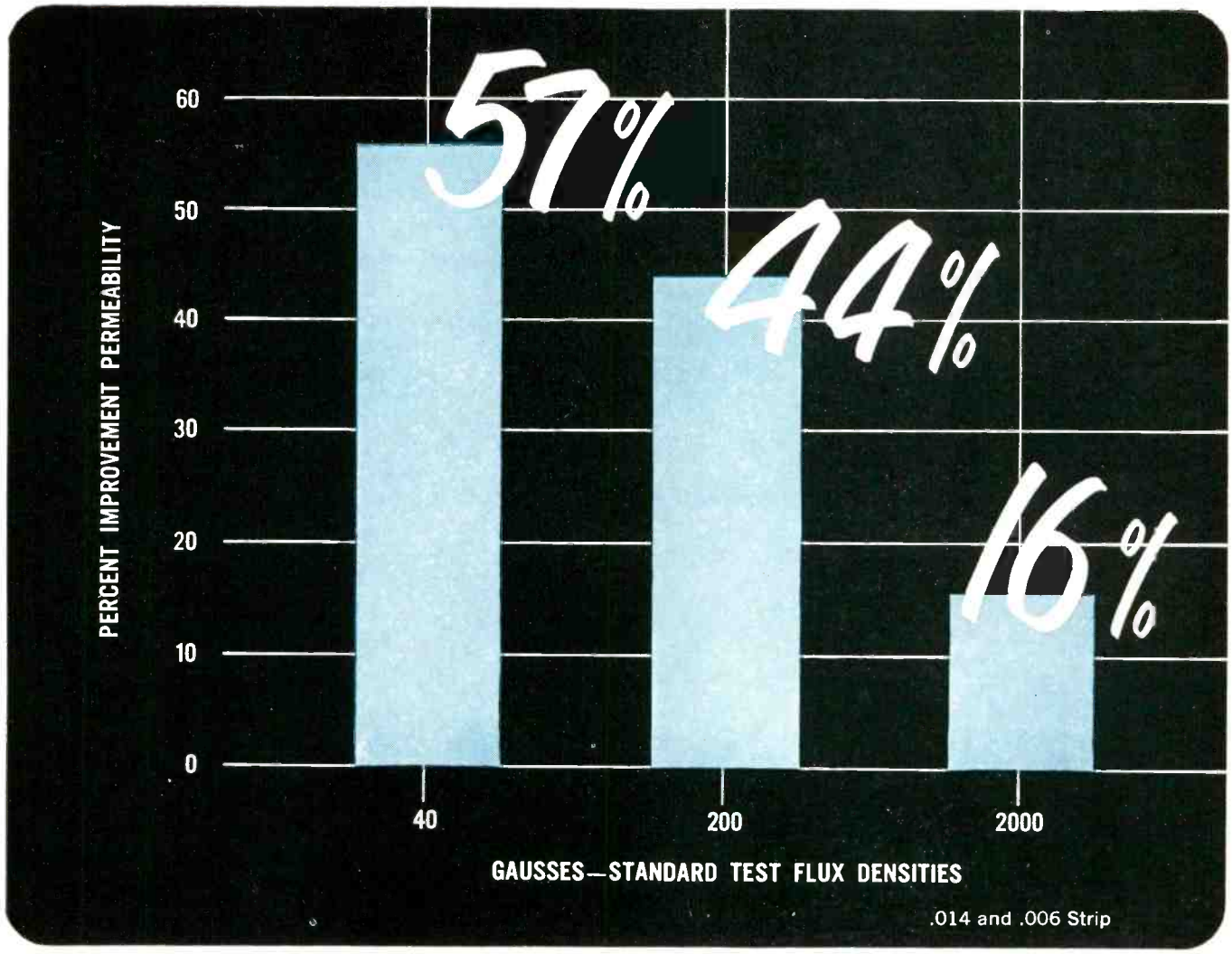
Complete specifications on Models 7370, 7570 and 7580 will be sent on request.

Beckman

Berkeley Division
2200 Wright Avenue, Richmond 3, California
a division of Beckman Instruments, Inc.

T21

Experience**—the added alloy in **A-L Electrical Steels



Greater permeability for Allegheny Ludlum's AL-4750...and it's *guaranteed*

promises more consistency, higher predictability for magnetic cores

AL-4750 nickel-iron strip now has higher *guaranteed* permeability values than ever before. For example, at 40 induction gausses AL-4750 now has 57% higher permeability than in the past, using the standard flux density test.

This greater permeability means better consistency and predictability for magnetic core users . . . and allows careful, high performance design.

This improvement in AL-4750 is the result of Allegheny Ludlum's continuing research on electrical alloys and nickel-bearing steels. Moly Permalloy has been similarly improved in permeability. A-L constantly researches silicon steels, including A-L's well-known grain-oriented silicon, Silectron, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available at Allegheny Ludlum. And A-L's technical know-how guarantees you close gage tolerance, uniformity of gage throughout the coil and minimum spread of gage across the coil-width.

If you have a problem on electrical steels, laminations or magnetic material, call A-L for prompt technical assistance. Write for blue sheet EM-16 for complete data on AL-4750. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa. Address Dept.* EI-20.

WSW 7491

ALLEGHENY LUDLUM

STEELMAKERS TO THE ELECTRICAL INDUSTRY

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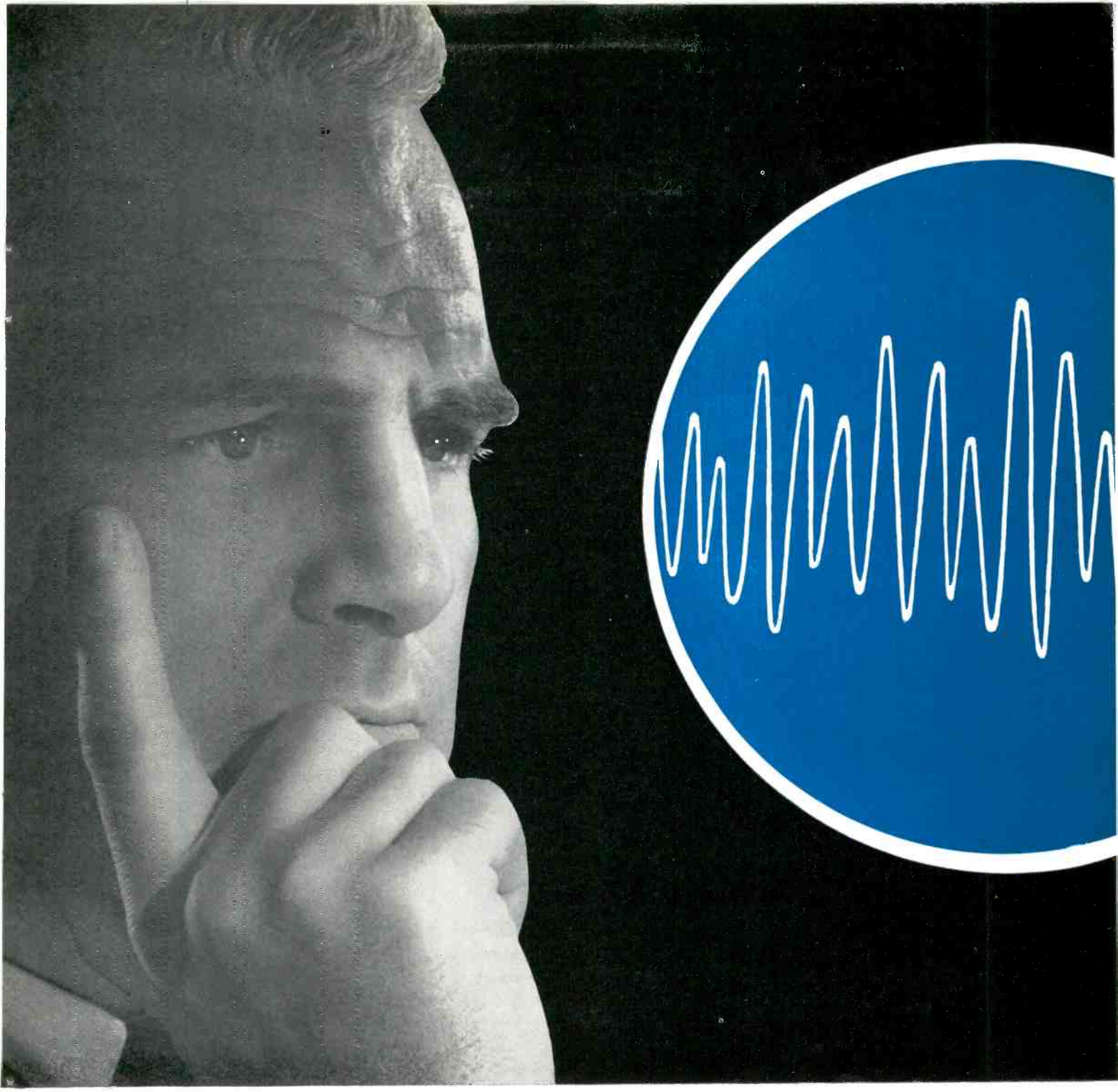

WHAT YOU SHOULD KNOW ABOUT ULTRASONIC EQUIPMENT

The "miracle" of ultrasonic energy is based on definite scientific and engineering principles that govern its application to your needs. The efficiency of your ultrasonic equipment depends on its **Quality.** Whether you use ultrasonic equipment for more thorough cleaning of electronic components and intricate instruments—or whether you control the level of fuel by the highly accurate ultrasonic method—the vital factor is **Quality.** The result you get from the equipment you use is no better than its **Quality.**

Acoustica is the world's foremost producer of quality ultrasonic equipment. Acoustica research and Acoustica facilities are unequalled. Make the most of the great advantages that the ultrasonic method offers by always specifying **Acoustica!** Write for information concerning your ultrasonic needs in cleaners and liquid level switches. Acoustica Associates, Inc., Fairchild Court, Plainview, N.Y. • 10402 Aviation Blvd., Los Angeles, Calif.

See us at our Wescon booth

acoustica

THE GREATEST NAME IN ULTRASONICS

Circle 28 on Inquiry Card

Tele-Tips

THE "RAD" is being recommended as the national standard unit for reporting radiation dose. The rad represents 100 ergs of energy absorbed per gram of material. Unlike most other units of measurement—the roengen, for example—the rad measurement is independent of the kind of ionizing radiation, as well as of the type of material being irradiated.

TAPE CLUB organized in Dallas already has over 4,000 members in 60 countries. They correspond via tape recordings.

"ENGINEERS MAKE IT WORK" is the theme of a new series of ads by Engineers Joint Council appearing in "Editor & Publisher." The ads are designed to create desirable understanding of engineers and engineering by printed media, radio and TV, public officials, organizations and advertising agencies. The ads are carrying titles such as: "Let's Get Clear On What Engineers Do"; "Just Who's Firing Those Missiles" and "Say Engineer When You Mean Engineer!"

SALES ENGINEERS trying to defend their "swindle sheets" have new ammunition. It's now a matter of record—the cost of the average personal sales call is up more than 59% over the past ten years. In 1948 it was $14.02; by 1958 the cost had jumped to $22.33.

NEW WEATHER INFORMATION distribution system, based on the old "telephone party line" idea would be 20 times better than the existing weather services. As described to the recent meeting of the AIEE, the system would transmit data at rates of 1,000 wpm, with 1,000 stations sending and as many as 5,000 stations receiving. There will be no switching points. At the receiving station the end product will be a printed page copy with provision for feeding data directly into weather computing machines without the need for human intervention.

(*Continued on page* 54)

are you silicon wait-bait?

avoid unnecessary delays

GT DELIVERS SILICON TRANSISTORS IN 24 TO 48 HOURS!

No need to get hung up with delays or hooked by unkept promises! GENERAL TRANSISTOR delivers sample quantities of GT Silicon Transistors in 24 to 48 hours... production quantities in 2 to 4 weeks!

These are not mere claims, but firm promises on which you can base your design and production schedules.

Quality? Yes—plenty of weight here without waiting. General Transistor is today one of the largest suppliers of highly dependable devices, delivering **quality** in **quantity.**

For full information—**and fast delivery**—call your local General Transistor representative, or contact us directly. Write for Silicon Brochure S-100.

GENERAL TRANSISTOR CORPORATION

91-27 138th Place, Jamaica 35, New York
Phone: Hickory 1-1000

A Few of the GT Alloyed Junction Silicon Transistors Now Available

- HIGH SPEED SWITCHING
- MEDIUM SPEED SWITCHING
- HIGH VOLTAGE
- HIGH SPEED LINEAR AMPLIFIER
- MEDIUM SPEED LINEAR AMPLIFIER

	2N1219	2N1220	2N1221	2N1222	2N1223
V_{CBO}	30 v	30 v	30 v	30 v	40 v
V_{CEO}	25 v	25 v	25 v	25 v	40 v
V_{EBO}	20 v	20 v	10 v	10 v	10 v
I_{CO}	.1 μa max.	.1 μa max.	.1 μa max.	.1 μa max.	.1 μa max.
h_{FE}	18 min.	9 min.	—	—	—
f_{ab}(mc)	5 min.	2 min.	5 min.	2 min.	2 typ.
h_{fe}	—	—	18 min.	9 min.	6 min.

FOR IMMEDIATE DELIVERY FROM STOCK, CONTACT YOUR NEAREST AUTHORIZED GENERAL TRANSISTOR DISTRIBUTOR OR GENERAL TRANSISTOR DISTRIBUTING CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. FOR EXPORT: GENERAL TRANSISTOR INTERNATIONAL CORP., 91-27 138TH PLACE, JAMAICA 35, NEW YORK. PRECISION MAGNETIC RECORDING HEADS AVAILABLE FROM GENERAL TRANSISTOR WESTERN CORP., 6110 VENICE BLVD., LOS ANGELES, CALIF.

SEE US AT WESCON BOOTHS 3421 and 3423

Circle 30 on Inquiry Card

25 AMP 100 VOLT POWER TRANSISTORS

Motorola 2N1166 and 2N1167 PNP germanium transistors offer • more usable power output than any other transistor • low saturation resistance (0.012 ohms-typical) for lower dissipation • high current gain • welded hermetic seal • excellent Beta linearity.

These new high-power transistors can be used to reduce the size and weight of transmitters without sacrificing power output, to extend the life expectancy of DC-DC converters and for a wide number of other high current switching and audio applications. Both units are available from stock. For engineering quantities contact your authorized Motorola Semiconductor distributor.

ANOTHER MOTOROLA FIRST

MOTOROLA'S COMPLETE RANGE OF INDUSTRIAL POWER TRANSISTORS gives you power for every purpose. Three separately designed series, produced under individual specifications, enable you to select devices best suited for your specific application.

POWER TRANSISTOR	Type Number	Maximum Ratings BV_{CBO} volts	Maximum Ratings BV_{CES} volts	Typical Electrical Characteristics h_{FE} @ I_C amps	
25 AMP TO 100 VOLTS	2N1167*	100	75	25	25
	2N1166	100	75	25	25
	2N1165*	80	60	25	25
	2N1164	80	60	25	25
	2N1163*	50	35	25	25
	2N1162	50	35	25	25
	T_j = 90°C				
10 AMP TO 100 VOLTS	2N630*	100	75	18	10
	2N629*	80	60	18	10
	2N628*	60	45	18	10
	2N627*	40	30	18	10
	T_j = 90°C				
3 AMP TO 80 VOLTS	2N375	80	60	22	3
	2N618	80	60	35	3
	T_j = 95°C				

*Supplied in TO-3 package with solder terminals.

NOTE: all twelve of the above transistors have welded hermetic seals and are designed to meet or exceed mechanical and environmental requirements of MIL-T-19500A.

WESCON BOOTH 3615 - 3617

FOR COMPLETE TECHNICAL INFORMATION regarding Motorola power transistors contact your nearest Motorola Semiconductor regional office.

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from New York WI 8-6828

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ESTebrook 9-5200

HOLLYWOOD 28, CALIFORNIA
1741 Ivar Avenue
HOllywood 2 0821

IN FOREIGN COUNTRIES WRITE: MOTOROLA INTERNATIONAL, S.A.
4545 West Augusta Blvd.
Chicago, Illinois

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Circle 31 on Inquiry Card

Circle 32 on Inquiry Card →

His Majesty, the King!

AC-DC/DC Laboratory Standardizing Test Console. Accuracy — .05% of actual reading. Ranges — .5V. to 1111.5V. and 1 ma. (2 ma. on AC) to 11.115 amps. in decades of .1V. and 1 ma. Resolution — ±.01%. Frequency — DC to 25 kc. (minimum). General Description — The console combines an AC-DC thermal transfer standard and a DC calibrator with a .005% stable reference source, a high sensitivity galvanometer, and self contained power controls. Instrument certifications may be made directly in percentage error as well as in actual values.

Model LTC

Hand-drawn mirrored scales.
Temperature compensation.
Electrostatic & magnetic shielding.
Shock-mounted sapphire jewels.
Diamond pivoted, of course!

Model LTD

DC Calibrator. Accuracy — .05% of actual reading. Ranges — .1V. to 1111 V. and 1 ma. to 11.11 amps. in decades of .1V. and .1 ma. Resolution — ±.01%. Combines a .005% stable reference source with two "differential" indicating instruments. A rapid calibrator that certifies instruments directly in percentage error as well as in actual values.

Model RFVC

Radio Frequency "Self-Checking" Voltmeter Calibrator. Designed specifically for the accurate certification of VTVM's from DC to 10 megacycles. *Accuracy* — .3% of full scale. *Frequency Influence* — .2%. *Type* — AC/DC, true RMS responding, thermocouple instrument. *Ranges*—.01/.1/1/3 V. *Resolution* —100 and 150 divisions. 6.3" scale length. *Checks its own accuracy against an internal standard source.*

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Tele-Tips

(*Continued from page* 50)

LOS ANGELES TV station, out to prove that commercials can be fun, begins a weekly half-hour show consisting of nothing but commercials. There is no charge to advertisers whose commercials are used.

TEN YEARS from now one of every five American workers will be employed in offices.

TELEPHONE POLES and overhead wires are on the way out. The phone company now has special wire that can be buried directly in the ground. Developed by engineers of the Rural Electrification Administration the new wire has been installed in a 1,000 mi. stretch. Results have been quite favorable.

RADAR EQUIPMENT was used to make a survey of a 117-mi. pipeline route for Pacific Lighting Gas Supply Co., Los Angeles. The job was completed in three days, at a cost saving of about 15% over other methods.

THE METRIC SYSTEM has many supporters in top government posts, and odds are that it is only a matter of time before the U. S. officially switches from the present methods of measurement. One of the chief supporters of the move departed from Washington last month—Secy. of Commerce Lewis Strauss. A look at the various branches of science indicates the pressure being applied. Electrical measurements are already unanimously applying the MKS system, and the pharmaceutical industries made the decision just within the past few years to adopt the metric system. The move has been considered a number of times since the U. S. was established, and each time the problem comes up the switch-over becomes more difficult. The feeling is that either the move must be made very soon or discarded completely. Most of the sentiments are for making the switch now.

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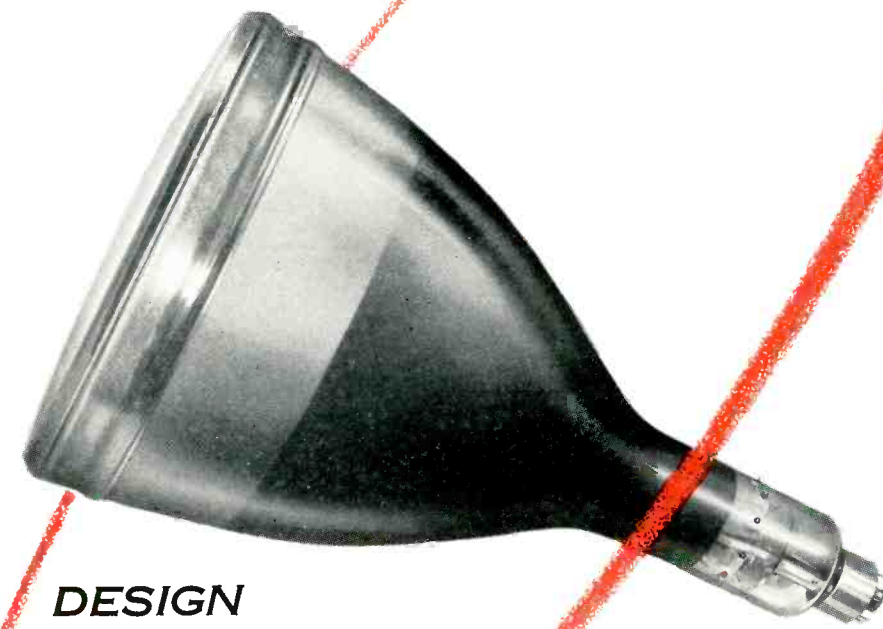

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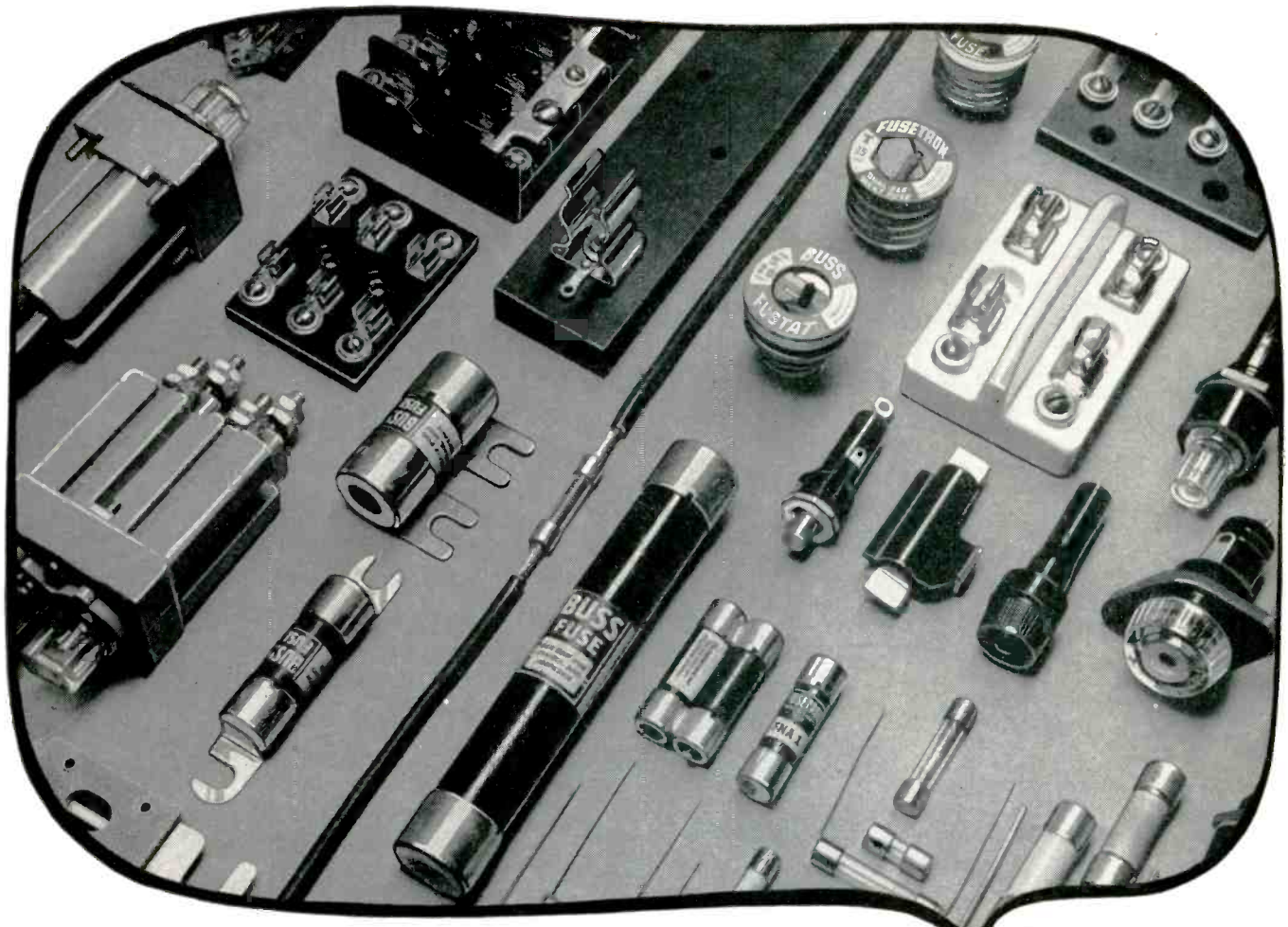

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BUSS fuses range in size from 1/500 amperes up — and there's a companion BUSS line of fuse clips, blocks and holders.

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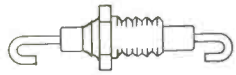
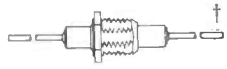
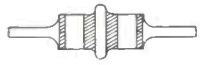
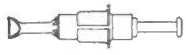
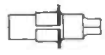
TYPE	ACTUAL SIZE ILLUSTRATION †	CAP. RANGE mmf	RATING VDCW	RATING VDCT	APPLICATIONS
Bushing type DA-717		10-4000	500	1000	High frequency filtering, bypass, etc. ± 5% tolerance in lower values
Bushing type DA-720		10-5000	500-1500	1000-3000	
Step type DA-728		10-1500	500	1000	Med. freq. use, bypass, TV tuners, etc. ± 10% tolerance below 200 mmf.
Step type DA-729		10-1500	500	1000	
Ring type DA-740*		10-1000	500	900-1300	Symmetrical design. Inserts from either end . . . ideal for automatic insertion
Ring type DA-741*		10-1000	500	900-1300	
Eyelet type DA-784		25-1000	500	1000	For high frequency filtering and bypass, where size is important
Eyelet type DA-785		25-1000	500	1000	
Eyelet type DA-787		25-1000	500	1000	
Resistor-Capacitor type 732		470 gmv. .3 to 1.0 meg. only	1000	**	Resistor-Capacitor in parallel. ** 1500 VAC test when immersed in Sil cone oil cooled with dry ice.

*patents pending

†Units marked † are ½ actual size

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Books

Solid State Magnetic and Dielectric Devices

Edited by Howard W. Katz. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 542 pages. Price $13.50.

The ferrite and titanates, the most significant new solid state materials, are currently being exploited for device application. However, since the device is developed from these materials and extends over many isolated fields, it has been difficult to find an inclusive treatment of the theory and application of them. The purpose of this book is to compensate for the absence of information in this area. The authors present a complete account of the solid state devices and components, with the exception of the transistor.

High Altitude and Satellite Rockets, a Symposium

Published 1959 by the Philosophical Library, Inc., 15 E. 40 St., New York 16. 136 pages. Price $15.00.

The proceedings of the first symposium on high altitude and satellite rockets to be held in Great Britain. Convened jointly by the Royal Aeronautical Society, the British Interplanatory Society, and the College of Aeronautics before the Russian and American satellites were launched; the symposium was held at Cranfield from the 18th to the 20th of July, 1957 and was attended by some 200 delegates from six countries.

The 12 papers in this proceedings, by British and American authors, are of interest to all those wishing to learn something of the problems of high altitude flight. A view of some of the design problems and propulsion problems of high altitude rockets, recovery after reentry, high temperature materials, instrumentation, telemetry and guidance and some of the human problems of flight beyond the atmospheres; one paper describes the British skylark upper atmosphere sounding rocket and another the American Vanguard satellite launching vehicle.

Analysis of Straight-Line Data

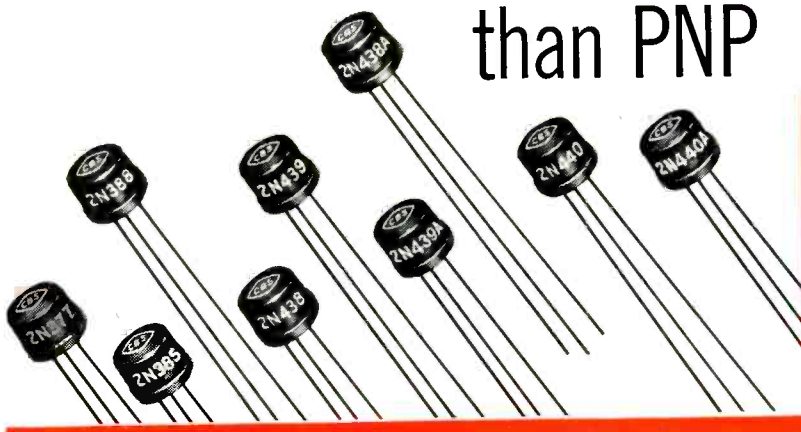
By Forman S. Acton. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 267 pages. Price $9.00.

This book thoroughly covers one important aspect of engineering statistics—the analysis of experimental data that can be described in terms of linear relationship. Emphasis is placed on matching the method of analysis to the type of information to

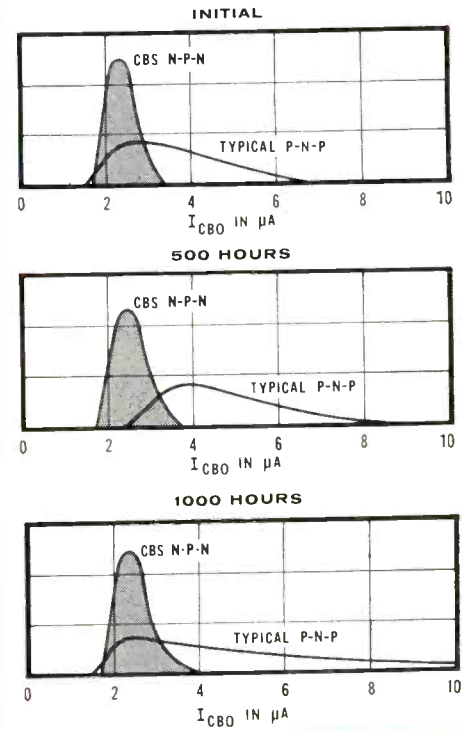
(*Continued on page 62*)

NPN switching transistors PROVE MORE RELIABLE than PNP

Some design engineers specify PNP switching transistors because they consider them inherently more reliable. Actually NPN transistors can give you superior reliability along with their well-known higher speed. Life tests covering hundreds of thousands of CBS NPN alloy-junction germanium switching transistors proved this during the past year. See graphs comparing these transistors with typical military-approved PNP transistors.



Comparative Life Tests
NPN vs. PNP Switching Transistors.



CBS NPN Switching Transistors

Type	Minimum BV_{CBO} (Volts)	Dissipation @ 25°C (Milliwatts)	Minimum h_{FE} @ I_C (Ma)		Typical $f_{\alpha b}$ (Megacycles)	Application
2N306	20	50	16*	1	1	Audio Driver
2N312	15	75	25	10	2	Switching
2N356	20	100	20	100	3	Core Driver
2N357	20	100	20	200	6	Core Driver
2N358	20	100	20	300	9	Core Driver
2N377	25	150	20	200	5	Core Driver
2N385	25	150	20	200	6	Core Driver
2N388	25	150	30	200	8	Core Driver
2N438	30	100	20	50	4	Logic Circuit
2N438A	30	150	20	50	4	Logic Circuit
2N439	30	100	30	50	8	Logic Circuit
2N439A	30	150	30	50	8	Logic Circuit
2N440	30	100	40	50	12	Logic Circuit
2N440A	30	150	40	50	12	Logic Circuit
2N444	15	100	10*	1	1	Switching
2N445	15	100	20*	1	3	Switching
2N446	15	100	30*	1	8	Switching
2N447	15	100	50*	1	10	Switching
2N556	25	100	15	10	1	Core Driver
2N558	15	100	20	10	3	Core Driver
2N634	20	150	15	200	8	Switching
2N635	20	150	25	200	12	Switching
2N636	20	150	35	200	17	Switching
2N1000	40	150	25	100	9	Core Driver
2N1012	40	150	40	100	5	Core Driver

*h_{fe} (a.c. gain)
Operating and storage temperature, T_j = −65 to +85°C

The superiority of CBS NPN transistors is achieved by special processing: For example, advanced surface chemistry techniques seal out moisture and contamination. Precise control of alloying produces high back voltages. Thorough bake-out stabilizes gain. The result is reliable NPN computer-type switching transistors featuring fast switching . . . high voltage . . . low cutoff current . . . and low saturation resistance . . . in a welded JETEC TO-9 package

A comprehensive line of these reliable CBS NPN high-speed switching transistors is available now in production quantities. Check the table. Order types you need . . . or write for Bulletin E-353 giving complete data . . . today.

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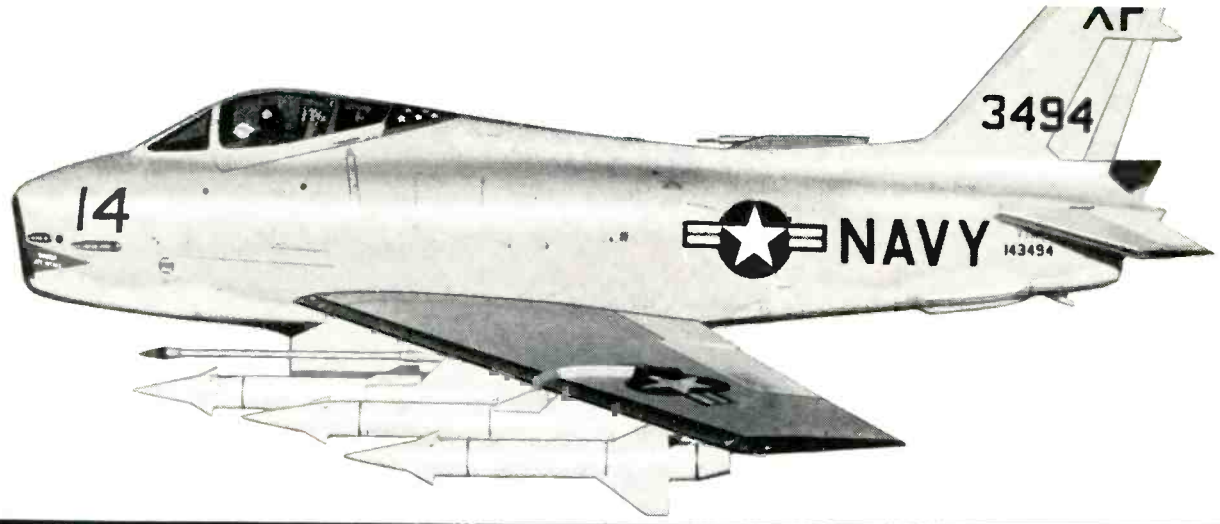

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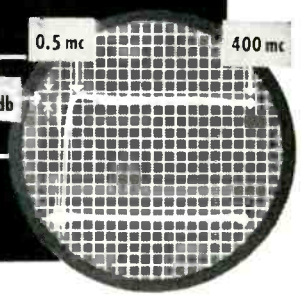
***FLAT OUTPUT!**
Flat to ±.5 db on widest sweep width!



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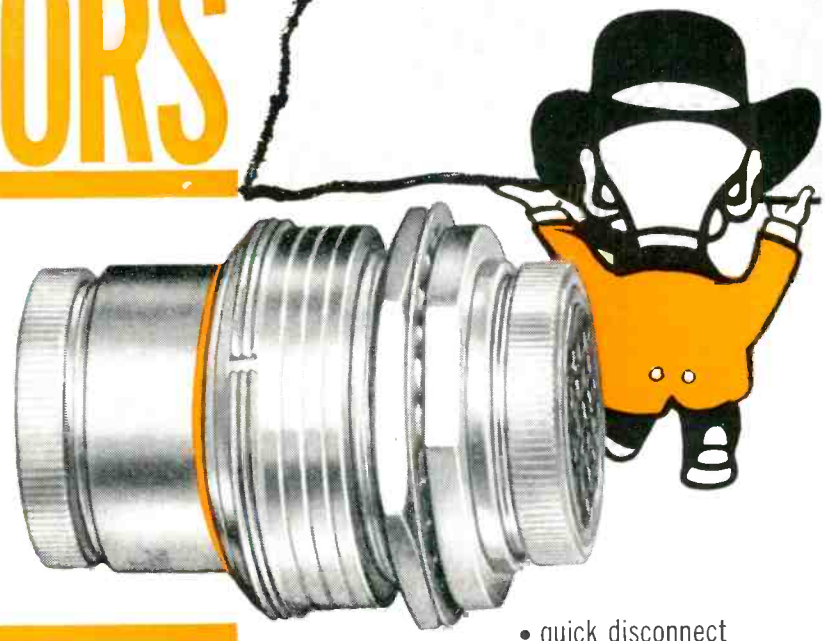

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- continuous dielectric separation without voids
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Books

(*Continued from page* 58)

be extracted and the influence of the assumed statistical model on the success of the analysis. To make the treatment practical, short-cut computational techniques (not usually found in statistical text) are stressed, and non-parametric and low-arithmetic techniques are brought together in a unified exposition.

Theory has been included whenever helpful to encourage analytical thinking, and the philosphy underlying a method also is frequently stressed to prevent the reader from getting lost in mere manipulative detail.

Analysis of Linear Systems

By David K. Cheng. Published 1959 by Addison-Wesley Publishing Co., Inc., Reading, Mass. 431 pages. Price $8.50.

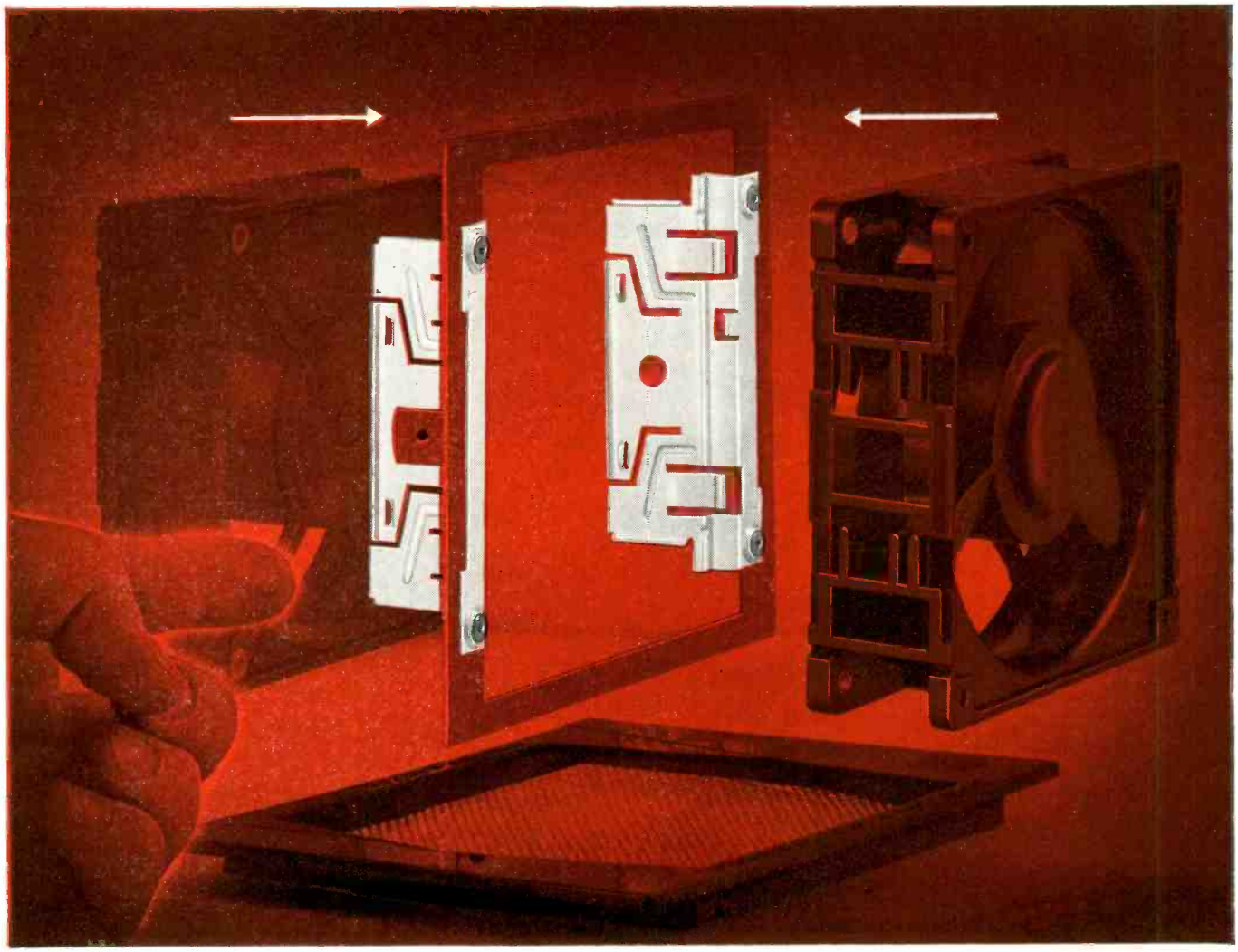
This book on analysis of linear systems is written at the undergraduate-graduate level. It is designed for students of electrical or mechanical engineering, physics, or applied mathematics; the author suggests in the preface how the book may be used in courses for these various groups. The aim of the book is to furnish a thorough exposition of the two essential steps involved in the analysis of a physical system: the setting up of a mathematical equation that describes the system in accordance with physical laws, and the solution of these equations subject to an appropriate initial or boundary conditions. One of the primary purposes of the book is to introduce the Laplace transformed method of solving linear differential and integro-differential equations. In so doing, the author discourages over-reliance on cables of transforms, feeling instead that a few fundamental transform pairs together with some important theorems should be remembered. Furthermore, although the complex Laplace inversion integral is derived from the Fourier integral, the book does not attempt to invaluate the inverse Laplace transformation by contour integration, nor does it include a chapter on the theory of function of a complex variable; the author feels that a superficial knowledge of this theory serves no useful purpose in a book of this kind.

Electronic Circuit Theory, Devices, Models and Circuits

By H. J. Zimmermann and S. J. Mason. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 564 pages. Price $10.75.

This volume deals primarily with

(*Continued on page* 64)



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Books

(Continued from page 62)

methods of analysis of electronic circuits. The model concept is stressed. Resistive models for electronic devices are synthesized. Special attention is given to piecewise-linear models suitable for large-signal operation. The authors devise models to approximate the characteristics of diodes, triodes, tentodes, transistors, and other controlled valves.

It contains extensive graphical and geometrical interpretations of analysis. The effect of circuit and signal on device operation is shown by means of locus plots. Basic circuit functions are classified as follows: rectification and detection, wave shaping and amplification, and waveform generation.

The Physics of Electricity and Magnetism

By William Taussig Scott. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 635 pages. Price $8.75.

This work provides a thorough explanation of the basic theory of electricity and magnetism, treated in a rigorous manner from the viewpoint of a physicist. The author uses a modern atomic approach to describe the phenomena such as metallic conduction and the production of chemical and thermo. The analysis of magnetic fields starts with the Lorentz force law, and Maxwell's equations are introduced as an integral part of the text, with a chapter at the end on their applications. Concepts are presented one at a time, and each is developed with examples before the next is introduced.

The fully descriptive yet mathematical treatment that is provided (using Vector notation and intermediate calculus) serves a smooth transition to more advanced work in physics.

Books Received

General Circuit Theory

By Gordon Newstead. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. 144 pages. Price $3.00.

Rapid Radio Repair

By G. Warren Heath. Published 1959 by Gernsback Library Inc., 154 W. 14th St., New York 11. 244 pages, paper bound. Price $2.90.

The Use of Q Equations to Solve Complex Electrical Networks

By H. T. Fristoe. Published 1959 by Oklahoma State Univ., Stillwater, Okla. 81 pages, paper bound. price $2.00.

Engineering Societies Directory, 1959

Published 1959 by Engineers Joint Council, 29 West 39th St., New York 18, N. Y. Price $3.50.

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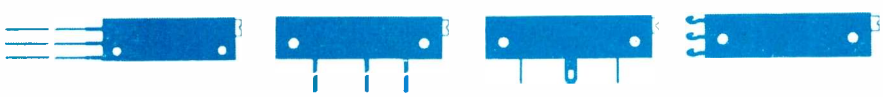

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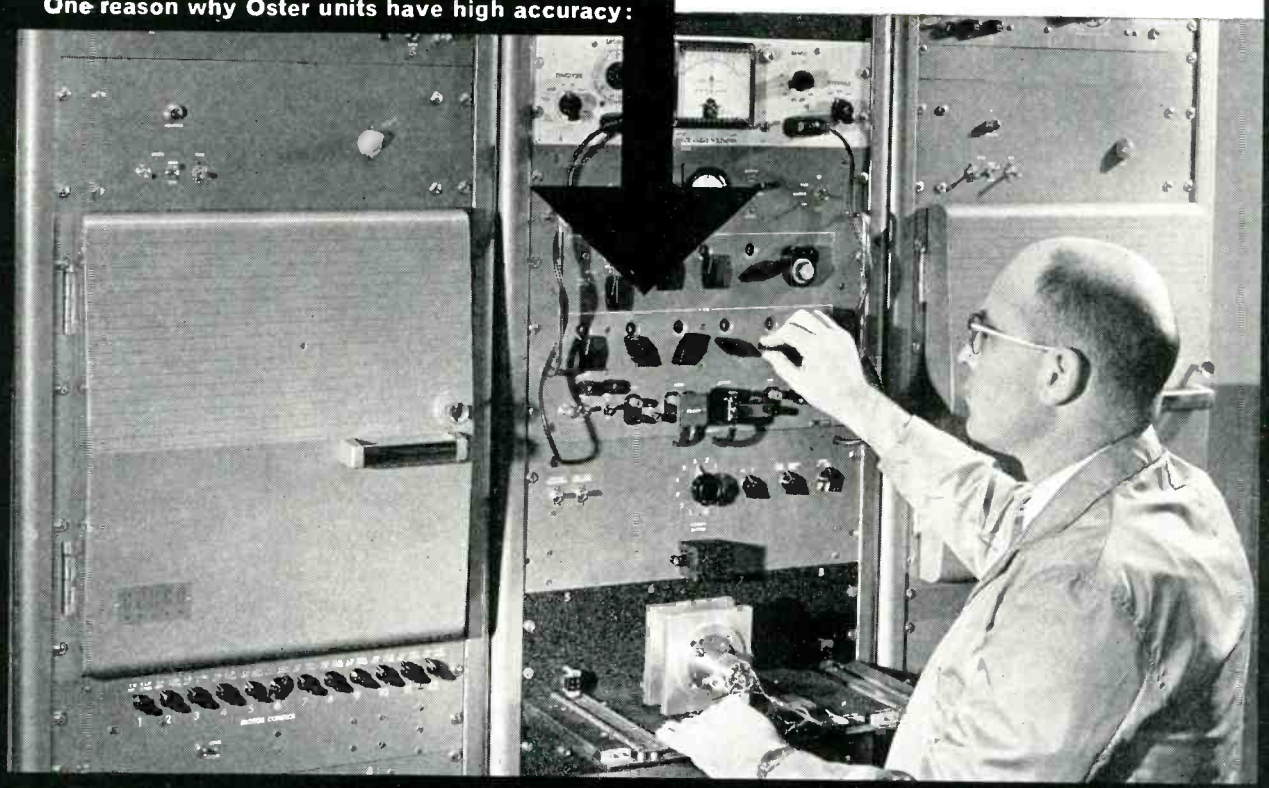

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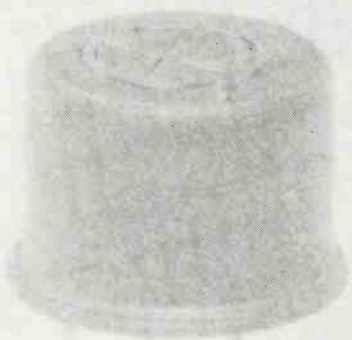

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2 WATTS dissipation at 25° C—the combination of power with high frequency that is available only in double diffused silicon transistors.

In Fairchild's recent succession of new transistor announcements, each has offered some exceptional combination of characteristics previously unattainable. The 2N699 combines high collector voltage rating with high-frequency performance, medium power capabilities and low saturation resistance. Its applications range from low-current high-frequency I-F circuits to high-current, low-frequency relay drivers. Other products nearing production at Fairchild promise even greater advances in the state of the art.

2N699 — ELECTRICAL CHARACTERISTICS (25° C)

Symbol	Characteristic	Min.	Typ.	Max.	Test Conditions	
h_{FE}	D.C. pulse current gain	40		120	I_C = 150ma	V_C = 10v
V_{BE} (sat)	Base saturation voltage		1.0	1.3	I_C = 150ma	I_B = 15ma
V_{CE} (sat)	Collector saturation voltage			5v	I_C = 150ma	I_B = 15ma
h_{fe}	Small signal current gain at f = 20 mc	2.5	5.0		I_C = 50ma	V_C = 10v
C_{ob}	Collector capacitance		14$\mu\mu$f	20$\mu\mu$f	I_E = 10ma	V_C = 10v
I_{CBO}	Collector cutoff current			2μa	V_C = 60v	T = 25°C
				200μa	V_C = 60v	T = 150°C

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Letters

to the Editor

"How to Specify Filters"

Editor, Electronic Industries:

As secretary of the Electronic Industries Association Committee on Electric Wave Filters, SJ-19, I have been directed by the members of the committee to submit the consensus of our criticism of an article entitled "How to Specify Filters," by Mr. Stanley Boyle, which appeared in your September 1958 issue.

This committee consists of representatives from the manufacturers of filters who supply the major portion of LC filters produced in the United States. The representatives themselves are the men who design these filters and, therefore, are in a unique position for properly advising users on how to specify filters.

A general fault of the article seems to be that the author tries to carry over a purely academic approach to the study of filters to industrial usage. An example of this is his statement that the pass band is determined by the 3db points. Obviously, in any specific application the pass band is determined by the individual requirements of the equipment. Experience shows that this requirement varies over a wide range, above and below 3db.

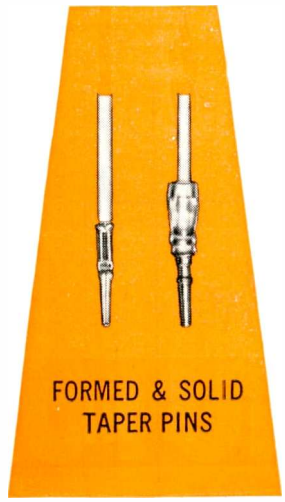
In the case of the band reject filter we are in complete disagreement. The pass band in this case occurs at those frequencies at which the attenuation is a minimum. Thus, there are two pass bands, one above the reject band and one below the reject band.

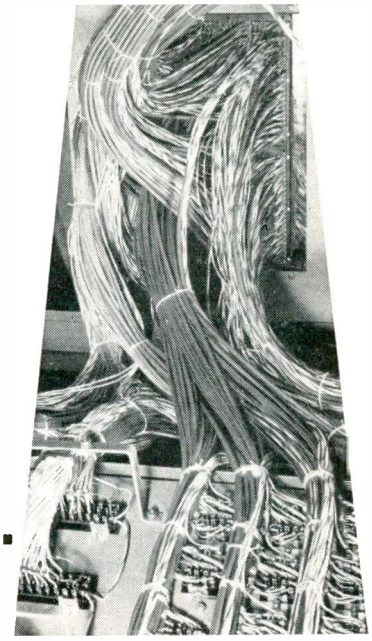
The part of the article relating to attenuation and insertion loss measurements received considerable adverse criticism. The definition of insertion loss as given by Shea in his "Transmission Networks and Wave Filters" on page 49 is "The insertion loss of a network in a circuit is the number of decibels by which the current on the load side of the network has been changed by its insertion."

As a general practice the insertion loss of any type filter is measured at a reference frequency within the flat portion of the response curve, the exact frequency depending upon the individual application. It is certainly arbitrary to select $F_c/2$ and $2F_o$ as the points for measuring insertion loss of low pass and high pass filters respectively, and the center frequency for bandpass and band reject filters.

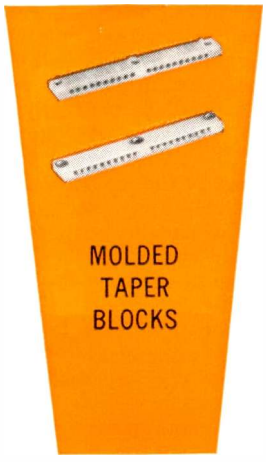
The correct circuit for measuring insertion loss is that shown in Fig. 2, not that of Fig. 1, and the correct

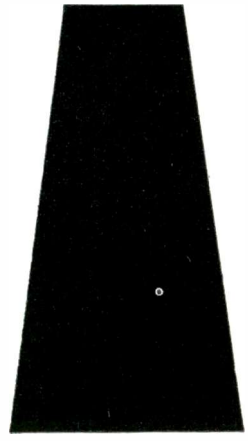
(*Continued on page 70*)

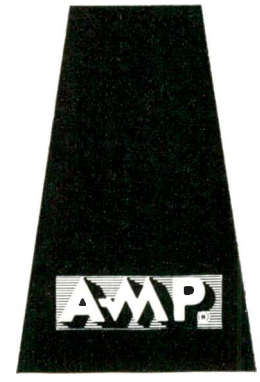




FOR A TIGHT FIT IN A TIGHT SPOT...







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Letters

to the Editor

(*Continued from page* 68)

expression for insertion loss is:

$$IL = 20 \log_{10} \frac{E_{out}}{E_{SG}} - 20 \log_{10} \frac{R_{out} + R_{in}}{R_{in}}$$

The attenuation reference level is usually taken at the same frequency at which the insertion loss is measured. The circuit for measuring attenuation is identical to that for measuring insertion loss, but the expression of attenuation is:

$$\text{attenuation} = 20 \log_{10} \frac{E_2}{E_2'}$$

where E_2 = voltage across the load at reference frequency.
E_2' = voltage across the load at frequency of measurement.

With respect to phase shift in a filter the author again is in error. The correct statement is that the phase shift in a filter approaches $\pm n\pi$ radians, or $\pm n\ 180°$ outside the pass band, where n equals the number of sections in the filter. The author would have us believe that all filters have a 180° phase shift, approximately.

With respect to the measurement of output impedance figure 4b would be correct only when the output impedance is purely resistive.

The statements relating to the size of a filter are deceptive. The size depends not only upon the frequency but also on the sharpness of the response required, the impedance, voltage level and other special requirements of the equipment manufacturer.

The statement limiting voltage levels to 1 volt maximum is misleading and erroneous. This may be true in special applications, but is definitely not true, generally.

I hope this letter will help to clarify some points that may have been confusing to some of your readers.

HOWARD A. GROSS,
Secretary, SQ-19

Ed.: Mr. Boyle's article, "How To Specify Filters," generated a great deal of interest throughout the industry, and brought a number of letters from our readers. These have been answered by Mr. Boyle on a personal basis. The letter above is being reprinted here because it reflects the thinking of an Electronic Industries Assoc. (EIA) group—the Committee on Electrical Wave Filters—SQ-19.

IBM Gives Computer Kit

A laboratory instrument used in the design of basic circuits for a large IBM computer has been presented to Electronics Institute, 2457 Woodward St., Detroit, by the International Business Machine Corp. The experimental kit will be used in training students in computer knowledge.

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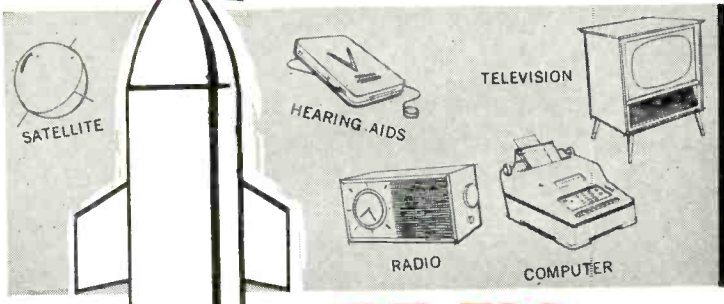

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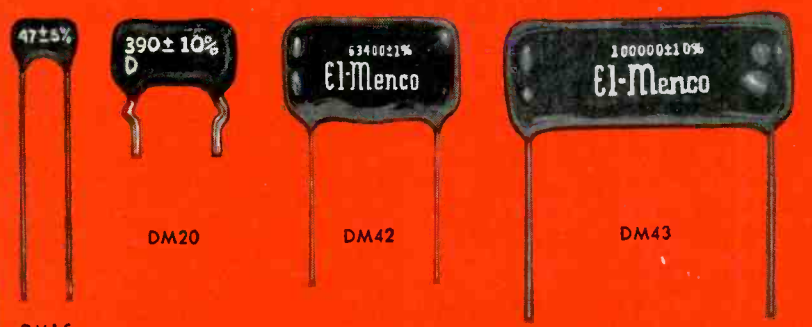

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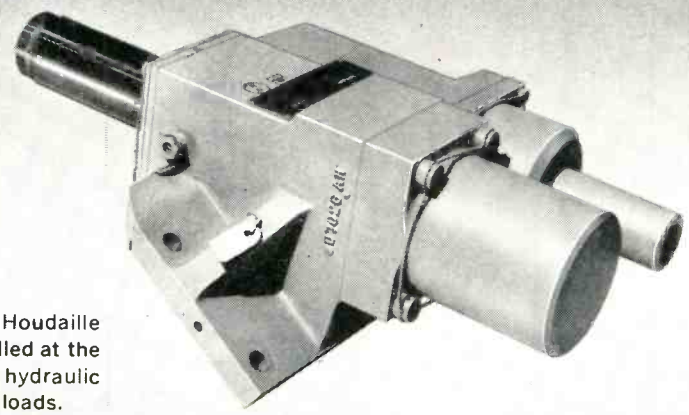

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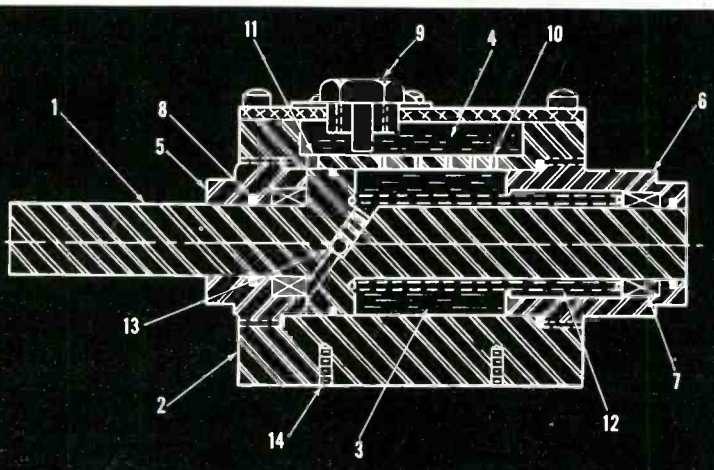

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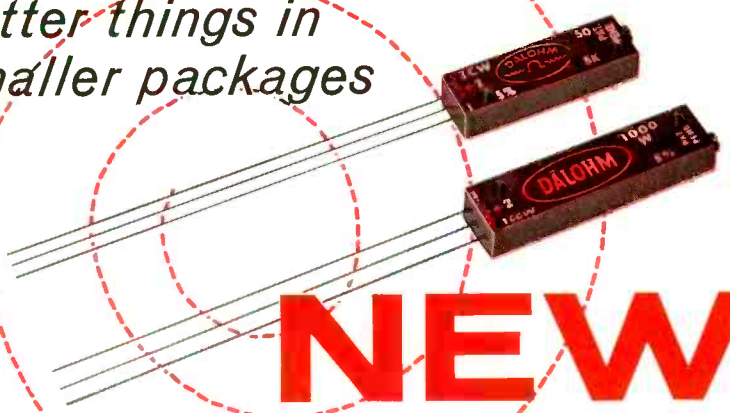

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Part I of this engineering reference series was published in the 1959 June Directory and All-Reference issue. This section dealt with rivets, eyelets, fasteners, quick operating release pins, straight pins, taper pins and roll pin. In Part II locknuts, specialty nuts, anchor nuts, clinch nuts, inserts, push nuts, and self threading nuts are treated.

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By H. MYRL STEARNS
Chairman of the Board, WESCON

A NEW virility is apparent in the electronics industry in the west—a resurgence that in the past five years has tagged electronics as the west's "fastest growing industry" and swept it into second place in dollar sales, exceeded only by agriculture.

The reasons for re-development of the electronics industry in the west where it had its beginning half a century ago are logical. Climatic conditions are the strong allure. The rich intellectual and sociological climates combine with ideal weather and favorable industrial conditions to form a nearly perfect package.

Since the electronics industry does not have to be located near sources of raw material, it enjoys a unique freedom of location-choice. The climate IS good out west and living conditions ARE pleasant, but these are only contributing attractions propelling the westward surge.

At the end of the war the state of the art had advanced so that electronics was a bright green pasture attracting small new companies and expansion of established large companies. By this time too, there was a large enough group of technical talent established in the west to attract others of like caliber. The built-in major scientific complex afforded by such universities as Stanford, University of California and California Institute of Technology, was a major inducement to individuals, groups of individuals and expanding eastern firms who joined the westward migration. Plus factors also included favorable industrial conditions such as low unit shipping costs for most electronic products and availability of a high quality labor supply. The sum of the total was a reiteration of "Go West Young Man" and in consequence the 1950 decade has been characterized by a steady westward shift of the center of gravity of the industry.

Throughout the 11 western states the "WELCOME" mat is out to attract the electronics industry which brings dollars to the communities in which it settles, raises standards of living, ups educational levels, and in whose research laboratories the Day after Tomorrow is taking shape.

The daring search for new boundaries to cross which always has typified the West is as true today as it was 100 years ago. The difference is the degree of sophistication. Throughout the electronics industry in the west, management is characterized by frontier, take-a-chance thinking supported by strong men in research, development and manufacturing. Willingness to take the calculated risk, to support pure research, is all part of the long range planning recognized by top management as essential to survival.

Responsibilities of management in any locale of course exceed the fundamentals of long range planning and attracting and holding top idea men. A balanced management team must be skilled and experienced in all phases of business organization as well; production, sales, research, finance, personnel. And to be balanced it cannot be dominated by people with strictly technical backgrounds as more than a few aspiring electronics companies have learned.

Challenges are the leavening agent in any business, the zest to the game. Electronics, of course, has its own special challenges. Obsolescence is the number one hazard, following on the heels of the necessity for rapid technological advancement. Companies whose management have vision and courage to underwrite a large enough research stake, both on a short and a long term basis, are striking "paydirt" in the laboratories.

It is basic to the electronics industry to realize that unless you are in the consumer production area the emphasis must be on rapid technological advancement. Out-ahead technology generated by military requirements cannot be ignored and companies who have the biggest impact in the industry are the ones who initiate projects which they in turn sell to the military.

In such a fast moving industry, the engineering

department must be carefully integrated with development and production. Actually, it is impossible to have a production run on anything and one of the biggest mistakes an electronics company can make is after spending a great deal of money developing something to insist on exploiting it in an attempt to make it pay.

The average life of a microwave tube, for example, formerly was about five years but this period is shortening before our eyes. A typical example is the klystron tube developed for railroad radar used for distributing railway cars in marshalling yards. On the market only two years, this tube now is obsoleted by our own newly developed tube. Tnis type of operation does and should happen frequently.

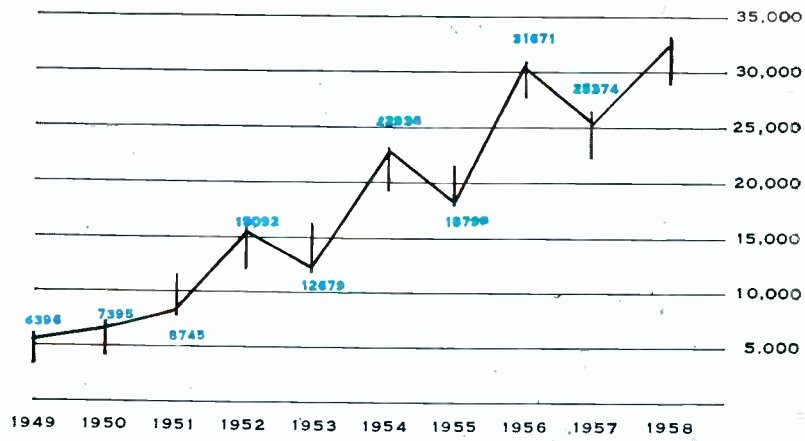
The unprecedented western growth of the electronics industry is sharply pointed up by a breakdown of statistics. The total industry has emerged from 49th place in 1939 to become the nation's fifth ranking manufacturing group in 1959, exceeded only by automotive, steel, aircraft and chemicals. In the west, electronics is second only to agriculture. The industry curve, climbing sharply from $500 million at factory level in 1947 to $8.0 billion in 1958 (including research and development contracts) is expected to pass the $14.0 billion mark by 1965. Based on past performance, the West will share significantly in this astronomical total. Total sales for the 11 western states reached in 1958 $1,789,000,000 or 23% of the total. Experts predict a 14% per year growth for the next few years. Leaders, however, should do twice that much or they are dead and it takes three years for them to find this out.

A look down the runway shows many sectors on the threshold of dynamic growth and ideas germinating in the labs today which may revolutionize entire concepts tomorrow. Just emerging is the scarcely explored field of integrated molecular circuity with its staggering implications. Continuing to grow are areas of military and industrial equipment, transmitting and special purpose tubes, semiconductors and specialized components for missiles and other advanced weapon systems, data processing equipment, air navigations and communications. There is no time scale on the field of communications which actually has just been touched. To come, is TV around the world, individual communications systems for the military, strides in airlines communications systems, unmanned aircraft . . . the list is long, yet really just begun.

Opportunities for pioneering and discovery were never greater than today. Electronics is the gold strike of the 1950's—today's Eureka in the West.

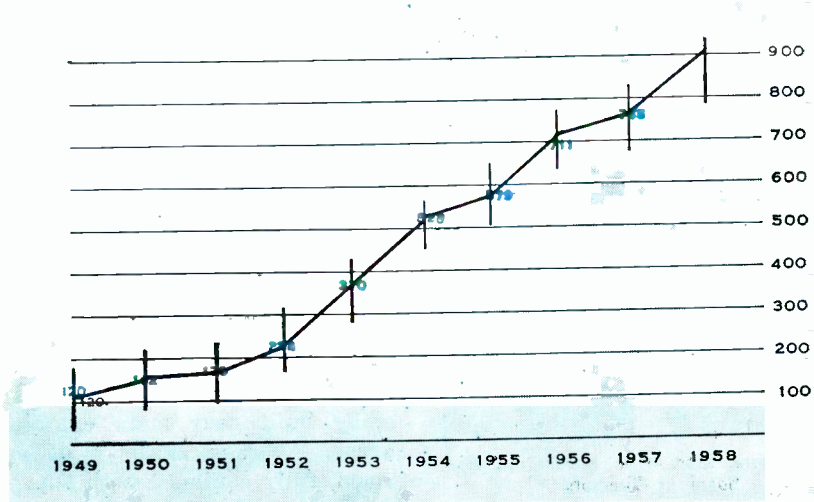
WESCON ATTENDANCE

Interest in WESCON has climbed steadily. The staggered curve results from the every-other-year scheduling of the show and convention. Peak attendance is attained when Los Angeles is the site, because of the greater number of engineers in that area. This year with the show moving to San Francisco attendance is expected to be slightly lower than last year when the event took place in Los Angeles.



WESCON EXHIBIT BOOTHS

In this, the tenth year of WESCON the number of exhibit booths will be just under 1,000. Only a handful of manufacturers—120—were on hand for the first WESCON show 10 years ago. This remarkable growth reflects the increasing role that WESCON and the western states are playing in the electronic industry.



Western Electronic Show Opens August 18

O. H. Brown
Show Director

A. J. Morris
Conv. Director

B. M. Oliver, Chrmn.
Exec. Committee

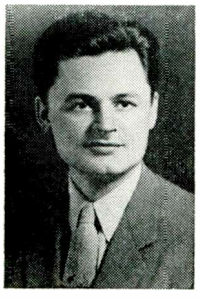
D. Larson
Business Mgr.

J. J. Howard
Rec. Secretary

Dr. H. F. York, Spkr.
Industry Luncheon

B. S. Angwin, Mbr.
Board of Directors

D. C. Duncan, Mbr.



H. P. Moore, Mbr.
Board of Directors

W. E. Peterson, Mbr.

MORE than 30,000 engineers and executives are expected to turn out for the four-day Western Electronic Show and Convention which opens at San Francisco's Cow Palace on August 18.

A record number of electronic manufacturers — close to 1,000 — will feature product exhibits. The 42 technical sessions will include the presentations of 120 technical papers.

Outstanding examples of electronic industrial design will be honored for the first time in the inauguration of an annual Industrial Design Competition.

Featured speaker at the All-Industry Luncheon on August 21 will be Dr. Herbert F. York, director of defense research and engineering and one of the top policy-makers in the U. S. Dept. of Defense.

A special evening session on August 19 at the Mark Hopkins will feature Dr. Lloyd V. Berkner, president of Associated Universities, speaking on "The International Geophysical Year In Retrospect."

Technical Sessions

The majority of the 42 technical sessions will be staged in the Cow Palace, in five meeting rooms specially built near main exhibition areas. Average capacity of each room, fully equipped with supporting audio visual equipment for presentation of papers, is over 500 persons.

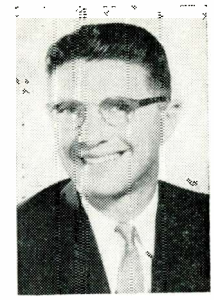
Dr. Karl Spangenberg, who heads the technical program, with a committee of 29 prominent Bay Area engineers, has introduced two diversions from the normal pattern of technical conferences. First, each session is limited to three technical papers. Second, each session will have, in addition to authors of the three selected papers, a panel of recognized authorities on the subject under discussion. The panelists will have opportunity to review the technical papers in advance of the presentations and will be expected to comment from their knowledge and experience, to ask authors for clarification or amplification where necessary and to stimulate questions from the floor.

Future Engineers

As part of the third annual Future Engineers feature of WESCON some 30 examples of outstanding high-school work in electronics and allied sciences will be exhibited.

The youngsters, selected from the nine western states and Hawaii, will be on hand with their school instructors to demonstrate their projects. The youngsters will be competing for $2,500 in scholarships.

B. J. Baker, Chrmn. Public Relations Committee



J. Ingersoll, Chrmn. Cocktail Party Committee

E. Cameron, V.Chrmn. Committee

Showcase of western electronic industry opens at San Francisco's Cow Palace on August 18. The four-day show and convention will feature exhibits by more than 900 manufacturers and a technical program of 120 papers.

E. H. Ross, Chrmn. Distributors-Exhibitors Conf.

E. Feige, V. Chrmn.

Show Committees

Responsibility for the various show functions has been delegated to 15 committees, representing both the technical and business sides of the electronic industry.

Since WESCON is co-sponsored by the Western Electronic Manufacturers Association and the Los Angeles and San Francisco sections representing IRE's Seventh Region, the committees represent virtually every segment of the western industry.

Field Trips

The program of field trips for WESCON visitors is being related directly to the technical program. The various visits to major Bay Area firms and Stanford University are being classified according to the professional groups of the IRE.

Tours on Wednesday, Aug. 19 will cover Military Microwave—Dalvo Victor Co. (Military Microwave) and the new IBM computer center at San Jose (Computers).

On Wednesday afternoon a trip is planned to Hewlett-Packard Co., Palo Alto (Electronic Instrument Production Techniques).

Thursday tours include Eitel-McCullough (Applications of Ceramics to Vacuum Devices), and Lockheed (Solid State Material Applications).

On Thursday afternoon tours will cover Ampex, Stanford Univ. and Stanford Research Institute.

Field trips on Friday will include Varian Associates and W. W. Hansen Biophysics Lab. at Stanford Univ.

J. Froman, Chrmn. Field Trip Committee

R. J. Reynolds, V.Chr.

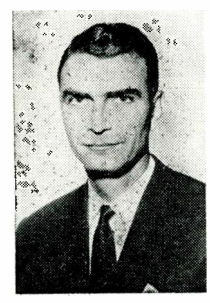
T. Moreno, Chrmn. Future Engineers Show

G. A. Walters, V.Chr.

J. H. Granger, Chrmn. All-Industry Luncheon

J. S. McCullough Committee

W. Selsted, Chrmn. Arrangements Committee



R. Craig, V. Chrmn. Committee

H. W. Lindsay, Chrmn. Industrial Design Exhibit

C. J. Clement, V.Chr. Exhibit

WESCON *(Continued)*

O. B. Sundberg, Chrmn.

R. E. Johnston, V. Chrmn.

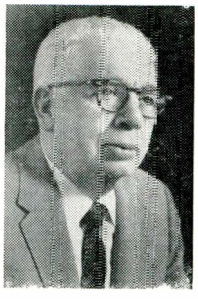
Registration Committee

C. Ault

F. Quement

Show Advisory Committee

C. Kierulff



W. Bert Knight

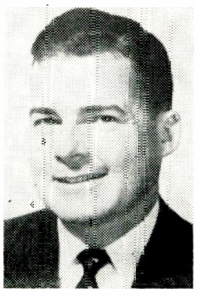
Show Advisory Committee

K. R. Spangenberg, Chrmn.

W. E. Edson, V. Chrmn.

Technical Program Committee

J. Stenson, Chrmn.



N. Hiestand, V. Chrmn.

Visitors Housing Committee

TECHNICAL PAPERS PROGRAM

SESSION 1—ULTRASONICS

Tues., Aug. 18, 10:00 AM to 12:30 PM

"An Ultrasonic Method for the Determination of Stress," R. W. Benson.
"A New Type Directive Sound Source for Long Range Sonar," Donald R. Church.
"Nondestructive Measurement of Tensile and Compressive Stresses," Rabah Shahbender.

SESSION 2—RELIABILITY 1
RELIABILITY ANALYSIS

Tues., Aug. 18, 10:00 AM to 12:30 PM

"Electronic Design: Reliability vs Manufacturing Cost," N. L. Kreuder.
"The Statistical Dynamics of Preventive Replacements," D. M. Brender.
"Some Aspects of Disposal at Failure Maintenance of Military Airborne Electronic Equipment," Robert O. Stone.

SESSION 3—SPACE ANTENNA PROBLEMS

Tues., Aug. 18, 10:00 AM to 12:30 PM

"Electromagnetic Effects Associated with Hypersonic Re-entry Vehicles," R. F. Whitmer.
"Estimating Voltage Breakdown Performance of High-Altitude Antennas," W. J. Linder and H. L. Steele.
"Interferometer Phasing Problems at Microwave Frequencies," G. Swarup and K. S. Yang.

SESSION 4—COMPUTERS 1

Tues., Aug. 18, 10:00 AM to 12:30 PM

"Transistor Circuit Techniques for a Core Memory with 500 Millimicrosecond Cycle Time," V. J. Sferrino.
"A Versatile Character Generator with Digital Input," Earle D. Jones.
"An Error Correcting Encoder and Decoder for Phone Line Data," K. E. Perry.

SESSION 5—SEMICONDUCTOR DEVICES 1

Tues., Aug. 18, 10:00 AM to 12:30 PM

"Tunnel Diodes for Low Noise Amplification," K. K. N. Chang, H. Nelson, R. Steinhoff, P. Schnitzler, and H. S. Sommers, Jr.
"Germanium and Silicon Tunnel Diodes-Design, Operation and Application," M. W. Aarons, N. Holanyak, Jr., V. S. Davidsohn, and I. A. Lesk.
"Variable Capacitor with Large Capacity Change," J. L. Moll.

SESSION 6—AUDIO

Tues., Aug. 18, 2:00 PM to 4:30 PM

"A New Stereophonic Projection Console," Benjamin B. Bauer and George W. Sioles.
"Novel Compression-Expansion Method for Audio and Video Use," W. Ross Aiken and Charles Susskind.
"A Resonance-Vocoder and Base-Band Complement: A Hybrid System for Speech Transmission," J. L. Flanagan.

SESSION 7—ENGINEERING MANAGEMENT

Tues., Aug. 18, 2:00 PM to 4:30 PM

"An Industrial Dynamic Management Approach to Research and Development," Abraham Katz.
"Leadership: Man and Function," Alex Bavelas.
"Getting Started in the Electronics Business," J. V. N. Granger.

SESSION 8—MICROWAVE ANTENNAS

Tues., Aug. 18, 2:00 PM to 4:30 PM

"Electronically Scanned Microwave Arrays Employing Synchronous Ferrite Phase Shifters," A. Clavin, L. A. Kurtz, and S. A. Rosen.
"Logical Pattern Synthesis," A. Ksienski, G. G. Comisar, and O. R. Price.
"The Effects of Wide-Band Signals on Radar Antenna Design," Lt. L. R. Dausin, Lt. K. E. Niebuhr, and Lt. N. J. Nilsson, Rome Air Development Center.

SESSION 9—COMPUTERS 2

Tues., Aug. 18, 2:00 PM to 4:30 PM

"Megacycle Magnetic Rod Logic," Donal A. Meier, Bruce Kaufman, and D. W. Rock.
"Evaporated Films and Digital Computers," David W. Moore.
"BIAX High Speed Magnetic Computer Element," C. L. Wanless.

SESSION 10—SEMICONDUCTOR DEVICES 2

Tues., Aug. 18, 2:00 PM to 4:30 PM

"A Stepping Transistor Element," L. A. D'Asaro.
"Recovery Time of PNPN Diodes," A. N. Baker, J. M. Goldey, and I. M. Ross.
"Silicon Mesa Transistors for Use as Saturating Switches," by V. H. Grinich and R. N. Noyce.

SESSION 11—CIRCUIT THEORY 1
NETWORK THEORY AND APPLICATION

Wed., Aug. 19, 10:00 AM to 12:30 PM

"The Relation Between Kron's Method and Classical Methods of Network Analysis," F. H. Branin, Jr.
"Practical Applications of Time Domain Theory," J. T. Banger.
"Synthesis Techniques for Gain Bandwidth Optimization in Passive Transducers," H. J. Carlin.

SESSION 12—PRODUCTION TECHNIQUES

Wed., Aug. 19, 10:00 AM to 12:30 PM

"Lenkurt Automatic Wiring Process," John M. Caffin.
"Thermal Evaporated Thin Film," Frank Ura.
"Investigation of Printed Circuit Board Solder Joints," Sidney Levine and associates.

SESSION 13—RADIO WAVE PROPAGATION

Wed., Aug. 19, 10:00 AM to 12:30 PM

"Optimum Transmission Rate for Low Power Meteor Burst Propagation," Bruce M. Sifford.
"Radio Propagation Measurements in the 100 to 118 KMC Spectrum," A. W. Straiton and C. W. Tolbert.
"L-Band Multipath Propagation in an Airborne Pulse System," G. E. Hart and H. M. Lamb.

SESSION 14—VACUUM TUBES 1

Wed., Aug. 19, 10:00 AM to 12:30 PM

"Measurements of Internal Reflections in TWT's Using Millimicrosecond Pulse Radar," H. T. Classon and D. O. Melroy.
"Fast Longitudinal Space Charge Wave Parametric Amplifiers," J. S. Cook and William Louisell.
"Miniaturized Low-Noise Traveling Wave Tubes for Airborne Application," C. L. Cuccia, H. J. Wolkstein, and J. J. Napoleon.

SESSION 15—SEMICONDUCTOR DEVICES 3

Wed., Aug. 19, 10:00 AM to 12:30 PM

"Molten Dot Technique for Alloy Junction Fabrication," Robert C. Ingraham and Robert E. Hunt.
"Three Layer Compensated Avalanche Diodes," G. Smoot Horsley.
"The Annealing of Neutron Damage in Silicon Mesa Transistors," C. Sheldon Roberts and V. H. Grinich.

SESSION 16—MICROCIRCUITRY

Wed., Aug. 19, 2:00 PM to 4:30 PM

"Dynamic Testing of Microfilm Circuits," W. D. Fuller.
"Microcircuitry with Refractory Metals," D. A. McLean.
"Micro-Miniature Electronic Circuitry for Space Guidance," Edward Keonjian.

SESSION 17—CIRCUIT THEORY 2
ACTIVE NETWORKS

Wed., Aug. 19, 2:00 PM to 4:30 PM

"A Network Synthesis Approach to Wide-Band Amplifiers," N. DeClaris.
"Synthesis of Driving-point Impedances Using Active RC Networks," B. K. Kinariwala.
"Transistor—RC Network Synthesis," B. R. Myers.

SESSION 18—RELIABILITY 2
RELIABILITY ENGINEERING

Wed., Aug. 19, 2:00 PM to 4:30 PM

"Electronic Circuit Tolerances," K. S. Packard.
"Meeting AGREE Reliability Requirements for Airborne Tacan Equipment," Harry C. Romig and A. L. Floyd.
"De-Rating: Its Meaning and Limitations," J. R. Isken.

SESSION 19—VACUUM TUBES 2

Wed., Aug. 19, 2:00 PM to 4:30 PM

"Design Theory and Characteristics of the Heli-tron, A New Microwave Oscillator," George Wada and Richard Pantell.
"Broadband High-Power Klystrons," W. L. Beaver, G. Caryotakis, A. Straparans and R. S. Symons.
"Studies on the Magnetron Type Hollow Beam Electron Gun," G. R. Brewer and E. G. Todd.

SESSION 20—PROF. GP. ON MILITARY ELECTRONICS I

Wed., Aug. 19, 2:00 PM to 4:30 PM

"A Two-Way Air-Ground Digital Data Link for Use with Meteor Burst Propagation," Arthur C. Lytle, Jr.
"An Application of Digital Computation to a Problem of Army Tactics," Julius H. Brick.
"An Optimum Maintenance Procedure for Airborne Electronic Equipment," Maj. Donald F. Mileson, USMC.

SESSION 21—SPECIAL EVENING SESSION

Chairman: Lloyd V. Berkner, President of the Associated Universities, Inc.

"The International Geophysical Year in Retrospect."

SESSION 22—SELF ADAPTIVE SYSTEMS

Thurs., Aug. 20, 10:00 AM to 12:30 PM

"Plastic Neurons as Memory Elements," D. G. Willis.
"A Class of Machines Which Determines the Statistical Structure of a Sequence of Inputs," J. D. Foulkes.
"Adaptive Sampled—Data Systems—A Statistical Theory of Adaptation," B. Widrow.

SESSION 23—STEREOPHONIC BROADCASTING

Thurs., Aug. 20, 10:00 AM to 12:30 PM

"An Optimized Compatible AM Stereo Broadcast System," Daril T. Webb and H. B. Collins.
"A Stereophonic System for AM Stations," Leonard R. Kahn.
"FM Multiplex Stereo Receiver," Harold Parker.

SESSION 24—CIRCUIT THEORY 3
PARAMETRIC AMPLIFIER CIRCUIT THEORY

Thurs., Aug. 20, 10:00 AM to 12:30 PM

"Circuit Considerations in Traveling-Wave Parametric Amplifiers," C. V. Bell and G. Wade.
"Circuit Aspects of Parametric Amplifiers," G. R. Hermann and H. Seidal.
"Four-Terminal Equivalent Circuits of Parametric Diodes," C. S. Kim.

SESSION 25—SPACE ELECTRONICS AND TELEMETRY

Thurs., Aug. 20, 10:00 AM to 12:30 PM

"Delta Modulation for Cheap and Simple Telemetering," F. K. Bowers.
"Interplanetary Telemetry," G. E. Mueller.
"The Tracking of Pioneer IV; the Elements of Deep Space Tracking System," Henry L. R. Richter, Jr., and Robertson Stevens.

SESSION 26—MILITARY ELECTRONIC II DATA PROCESSING FOR MILITARY USES

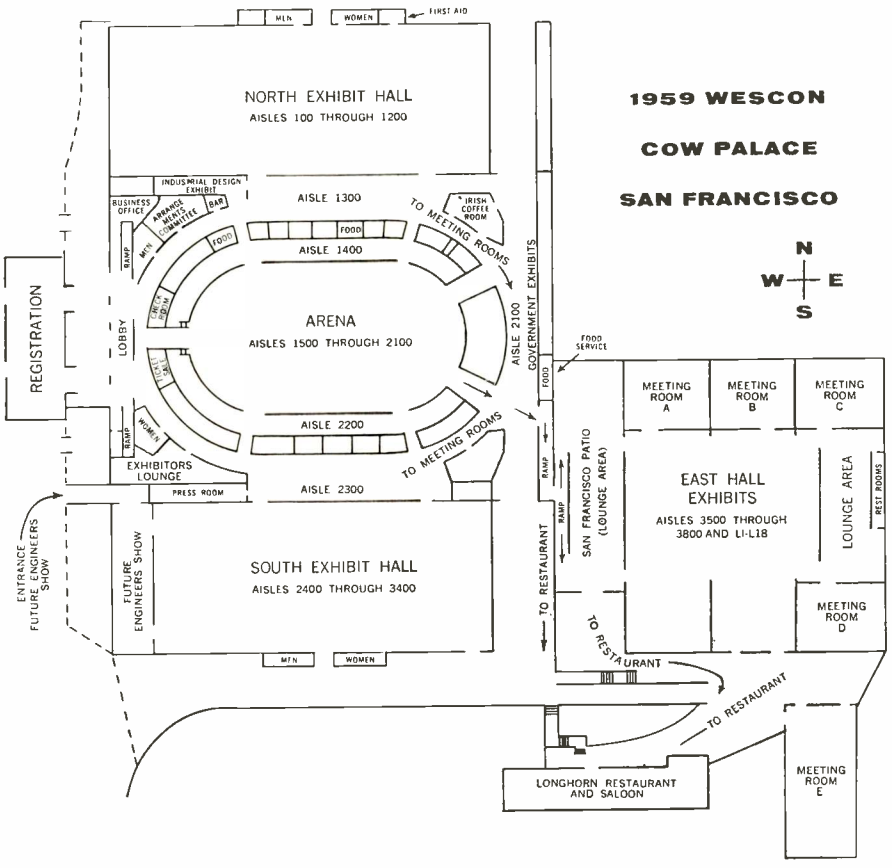
Thurs., Aug. 20, 10:00 AM to 12:30 PM

"Automatic Data Transmission to Multiple Receivers within the Missile Monitor System," L. H. Kurkjian.
"A New Airborne Data Recorder," Paul N. A. Veenhuyzen.
"Some New Techniques in Airborne Data Acquisition," E. P. Brandeis and M. E. Harrison.

SESSION 27—INFORMATION THEORY

Thurs., Aug. 20, 2:00 PM to 4:30 PM

"Linear Estimation of Deterministic Signals," Samuel Zahl.
"Some New Results for the Prediction of Derivatives of Polynomial Signals in Additive Stationary Noise," I. Kanter.
"A Non-Parametric Technique for the Detection of a Constant Signal in Additive Gaussian Noise," J. Capon.



V. Zachariah, Chrmn. B. Melchior, V. Chrmn.
Visitor's Service Committee

Mrs. P. M. Cook, Chrmn. Mrs. R. Krause, V. Chrmn.
Woman's Activity Committee

SESSION 28—HUMAN FACTORS

Thurs., Aug. 20, 2:00 PM to 4:30 PM

PANEL DISCUSSION: "The Role of Human Factors in Electronics."
MODERATOR: O. B. Moan.
Stanley N. Roscoe, Hughes Aircraft Company, Culver City, Calif.
Lawrence J. Fogel, Convair, San Diego, Calif.
George Long, Boeing Aircraft Company, Seattle, Wash.

SESSION 29—CIRCUIT THEORY 4
TRANSISTOR ANALYSIS AND APPLICATIONS

Thurs., Aug. 20, 2:00 PM to 4:30 PM

"Semiconductor Comparator Circuits," G. L. Hoehn, Jr.
"An Evaluation of Transistor Low Pass Broadbanding Techniques," D. O. Pederson and R. S. Pepper.
"Stored Charge Analysis of Transistors," J. M. Early.

SESSION 30—AUTOMATIC CONTROL

Thurs., Aug. 20, 2:00 PM to 4:30 PM

"A Parameter Tracking Servo for Adaptive Control Systems," Maier Margolis and C. T. Leondes.
"Maximum Effort Control for an Oscillatory Element," Harold K. Knudsen.
"Identification and Command Problems in Adaptive Systems," E. Mishkin and R. A. Haddad.

SESSION 31—MICROWAVE THEORY AND TECHNIQUES 1
MICROWAVE VARIABLE REACTANCE AMPLIFIERS

Thurs., Aug. 20, 2:00 PM to 4:30 PM

"Low-Noise Microwave Reactance Amplifiers with Large Gain-Bandwidth Products," P. P. Lombardo and E. W. Sard.
"A Low Noise Up-Converter Parametric Amplifier," E. M. T. Jones and J. S. Honda.
"Parametric Amplifiers and Superregenerative Detectors," J. J. Younger, A. G. Little, H. Heffner and G. Wade.

SESSION 32—MEDICAL ELECTRONICS

Thurs., Aug. 20, 8:00 PM to 9:30 PM

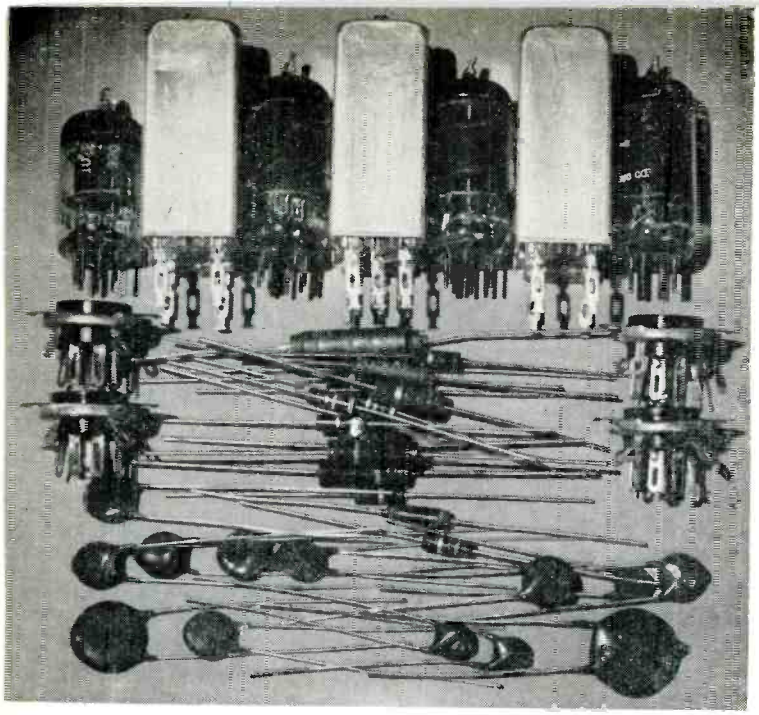
"New Techniques in Physiological Recording Under Dynamic Conditions," Harve M. Hanish.
"Unitary Transistorized Artificial Larynx," Harold L. Barney.
"A Rapidly Convergent Orthogonal Representation for EEG Time Series and a Special Electronic Analyzer for Measuring the Series Parameters," Bernard Saltzberg and Neil R. Burch.

SESSION 33—COMPONENT PARTS

Fri., Aug. 21, 10:00 AM to 12:30 PM

"New Ceramoplastic Insulating Material for

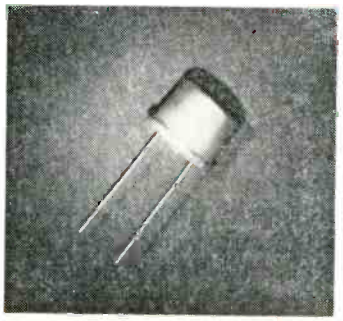
(Continued on page 188)



Functions of all these components can be handled by "tunnel diode"

Tunnel Diode— New Electronic Work Horse!

This new device, little over a year old, is now both better understood and closer to commercial application as a result of intensive research.



THE tunnel diode, first reported in 1958 by Japanese scientist Leo Esaki, is first cousin to a transistor, but operates on a different principle and offers advantages that the transistor does not. Before long it should find its way into high-speed computers, television sets, communication equipment, nuclear controls, satellites and space vehicles, according to Dr. Guy Suits, GE Vice President and Director of Research.

As a result of intensive research, improved practical tunnel diodes appear to be on the commercial horizon. To spur progress in circuit design, General Electric's Semiconductor Products Department now plans to offer limited quantities of experimental samples for such use around September or October 1959. Estimated price for such units will be approximately $75.00 each. Both germanium and silicon types are to be available.

One of the most significant advances in scientific understanding of the device originated with some observations of mysterious "wiggles" in performance curves. These were first noted by Drs. Nick Holonyak, Jr., and Arnold Lesk at GE's Advanced Semiconductor Laboratory, in Syracuse, N. Y. A theory that successfully explained the puzzling effect was subsequently worked out at the General Electric Research Laboratory in Schenectady, N. Y., by Drs. Jerome J. Tiemann, Robert N. Hall, and Henry Ehrenreich.

The tunnel diode takes its name from the physical phenomenon that makes it possible: "quantum-mechanical tunneling." The term is used to describe the manner in which the electrical charges move through the device. Such motion takes place with the speed of light, in contrast to the relatively slow motion of electrical charge carriers in transistors.

The high speeds at which electrical charges travel in

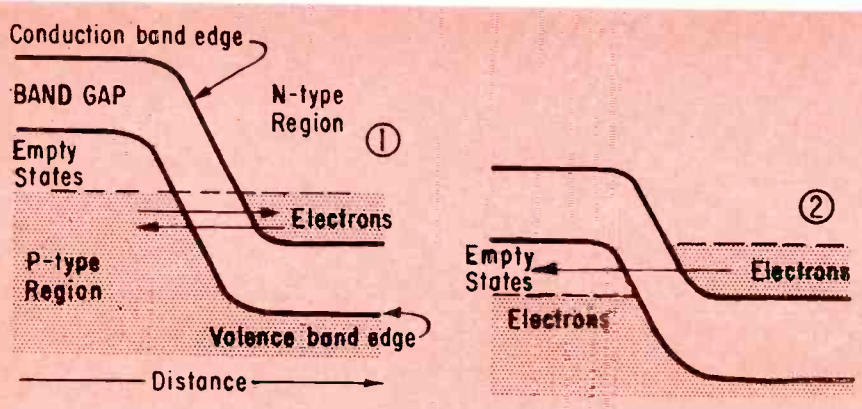


Fig. 1 (far left): Electrons at same level on both sides of junction. No net current.

Fig. 2 (left) Electrons on right side are raised until they are opposite empty states on left. Strong current flows right to left.

the tunnel diode make it possible for the device to operate at extremely high frequencies. Oscillation frequencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future.

The device's high-speed response also suggests applications in computers. When used as switches, tunnel diodes have functioned in a fraction of a milli-microsecond—from 10 to 100 times as fast as the fastest transistor.

The device also resists the damaging effects of nuclear radiation. Because it is less dependent on the structural perfection of its crystal than is the transistor, it is much less affected by the damage that radiation can do to such crystal structures. In this respect it outranks transistors by more than 1000 to 1. Semiconductors that have been used by GE scientists for making tunnel diodes include silicon, germanium, gallium arsenide, gallium antimonide and indium antimonide.

The tunnel diode is smaller than a transistor and, because of a simpler structure, ultimately will be a small fraction of its present size. It also is little affected by environmental conditions. Silicon tunnel diodes made by General Electric work at temperatures as high as 650°F; conventional silicon diodes will not operate above 400°F. As a matter of fact, the operating temperature range of tunnel diode is greater than that of germanium and silicon transistors combined.

As an electrical circuit element, the tunnel diode exhibits a unique combination of electrical properties including "negative resistance" over part of its operating voltage range. These characteristics allow it to be used in a wide variety of applications, such as an amplifier, a generator of radio-frequency power, and a switching device. The simplicity of this device makes possible the development of "integrated circuits," in which entire circuits for some applications may be formed on a single semiconductor structure. It is superior to vacuum tubes and transistors for applications in low-noise amplifiers and mixers for high frequencies. Many parametric amplifier jobs, for example, could be performed more easily by tunnel diodes.

Operation

Conventional amplifying devices as transistors and vacuum tubes depend on emitting a charge carrier into a region where its motion can be influenced by a signal electrode, and on subsequently collecting the charge carrier on an output electrode. The speed of this conventional amplification process is limited by the time it takes a charge carrier, having left the emitter, to traverse the control region, and appear on the collector.

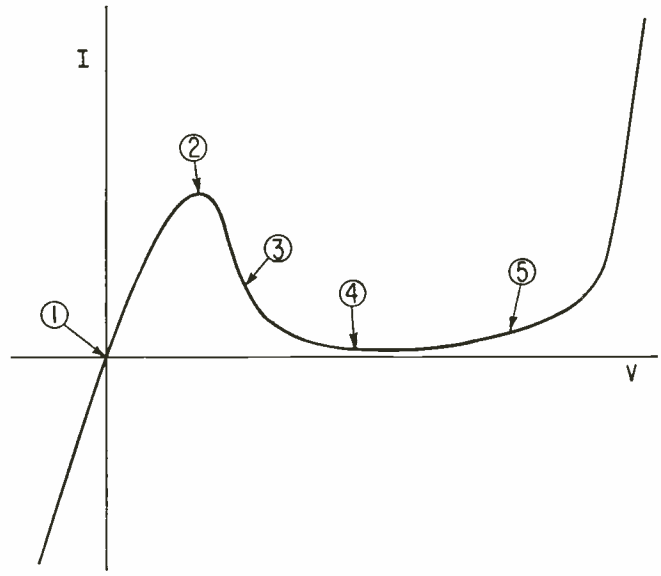


Fig. 6: Various bias conditions of the tunnel diode. The numbered points on the curve correspond to the diagram below.

This time is generally quite long compared, for example, to the time it takes for a signal to travel an equivalent length along a copper wire. The reason is that, in the wire, the signal is carried by the electric field of all of the electrons in the wire, rather than by the motion of a particular group of electrons. Each electron in the wire moves only a microscopic distance, and those coming out the other end are not the same ones that went in as signal. The signal in a tunnel diode moves with the same rapidity as does a signal traveling along a copper wire. It is for this reason that the diode has such a short response time.

The difference betweeen the tunnel diode and the copper wire, of course, is that the copper wire cannot amplify. The wire has a positive resistance: that is, an increase in the voltage results in an increase in the current. In the tunnel diode, an increase in the voltage can result in a *decrease* in the current. That is, it has a *negative* resistance. The characteristic may per-

(*Continued on page* 182)

Fig. 3: Electrons on right raised more. Some are opposite "forbidden band gap," some opposite empty states. Current decreases.

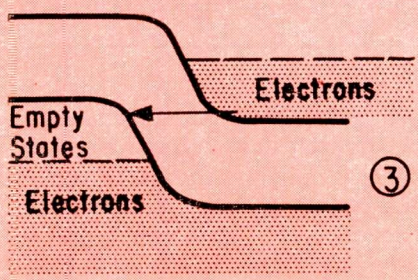


Fig. 4: Electrons are all opposite forbidden gap. Very small current is flowing.

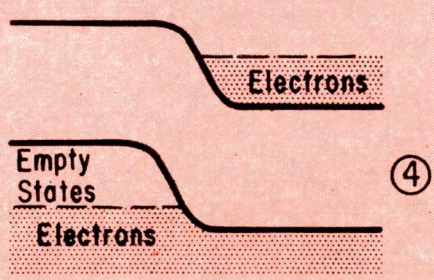
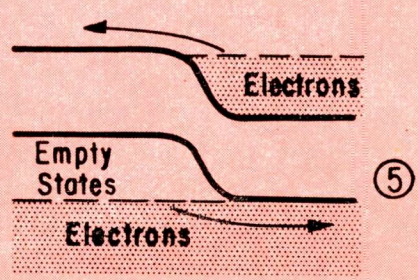
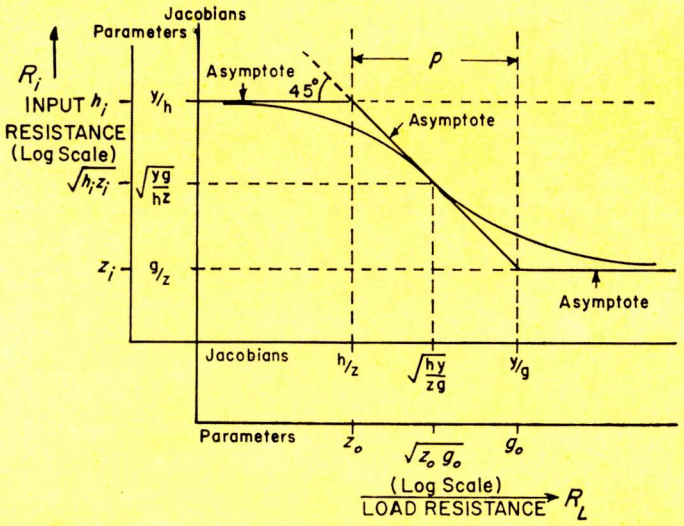


Fig. 5: Electrons raised until they spill over the barrier. Current increases.





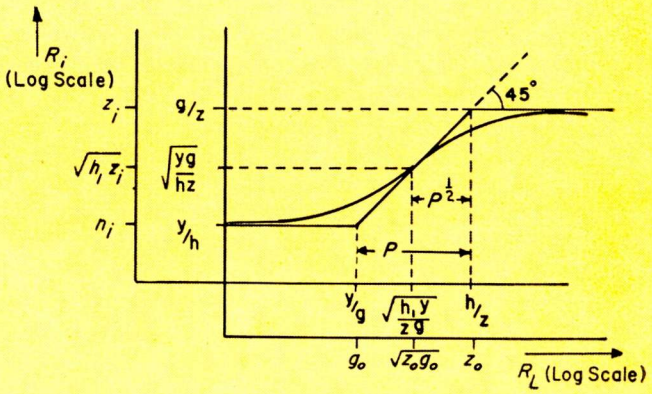


Fig. 1 (left): Common emitter relationships. The projection ratio, P, is numerically the ratio of the two coordinates.

Fig. 2 (above): Common base and common collector version.

For Transistors . . .

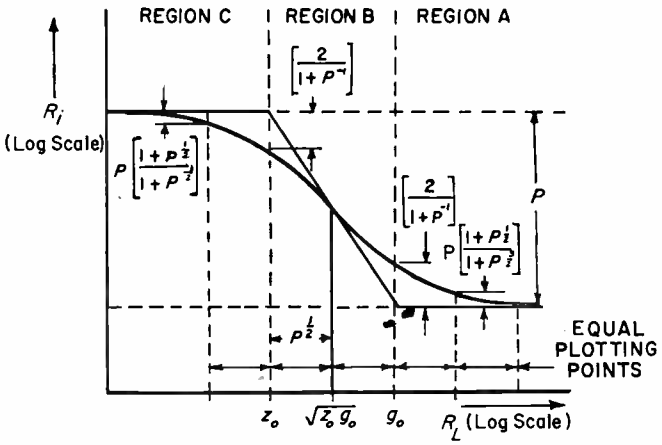
Asymptotes

THE use of asymptotes depends upon a general concept of the curve of $y = (p + qx)/(r + sx)$ and the transistor parameters are selected to conform with this concept. Fortunately, an easy method exists for translating between different parameters.[1] The various plots and asymptotes may be drawn very quickly for any of the graphs described in this article.

Though the system stands up in its own right, analysis of the methods is greatly facilitated by using Jacobians to define the various transistor parameters and signal flow graphs to deal with the algebra.

The general case for the asymptotic plotting of $y = (p + qx)/(r + sx)$ is dealt with in Appendix A. Each of the transistor design curves is treated in terms of the general case, the first fully and the others as briefly as their nature will allow.

Fig. 3: The error ratio at equal plotting points from the center is shown here in terms of the projection ratio.



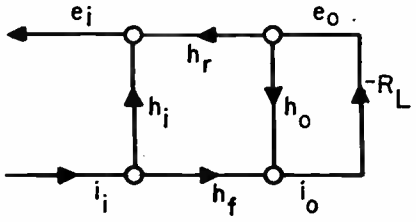
Input vs. Load Impedance

Validity of Asymptotes

The equation for the input impedance of a transistor circuit is

$$R_i = h_i - \frac{h_r h_f R_L}{1 + h_o R_L} \tag{1}$$

as can be seen from the flow-graph or from other methods of analysis. Rearranging terms



(2)

$$R_i = \frac{h_i - (h_i h_o - h_r h_f) R_L}{1 + h_o R_L} \tag{3}$$

Clearly this corresponds to the general case of

$$Y = \frac{P + qx}{r + sx}. \tag{4}$$

Following the pattern established in Appendix A, the asymptotes can be written down directly.

To simplify the algebra, only the ordinates should first be written—when $R_L = 0$, $R_i = h_i$, and when $R_L = \infty$, $R_i = z_i$. If Jacobians are then used to define h_i and z_i (using the symbols from Ref. 1), these two

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By first erecting a framework of asymptotes—the lines towards which a curve converges—one can construct the conventional transistor design curves with remarkable ease. The accuracy achieved is adequate for the majority of practical applications.

Solve Design Problems

terms are respectively the Jacobians y/h and g/z. These Jacobians can now be directly compared with the results of the general case of Eq. 4, which is computed in Appendix A, and illustrated in Fig. 10.

The abscissa of the points of intersecton of the asymptotes therefore become the Jacobians h/z and y/g, which correspond to the values of z_o and g_o for the load resistance. These results are shown in Fig. 1. The 45° slope occurs only if the same logarithmic scales are used for both ordinates and abscissa.

Cross-Over Point

The cross-over point, where $R_L = \sqrt{z_o\, g_o}$ and $R_i = \sqrt{h_i z_i}$ is also the point of inflection of the curve, and it corresponds to the condition for maximum power gain. In the immediate vicinity of the cross-over point, input resistance varies linearly with load resistance.

Error in Terms of Projection

If the inclined asymptote is projected on either the x- or the y-axis and the projection ratio referred to as P, then the error between the curve and the asymptote can be expressed in terms of P. The projection ratio of the graph in Fig. 1 is h_i/z_i, or g_o/z_o, and is always greater than 1.

At the mid-point of the inclined asymptote (mea-

Fig. 4: The asymptotes of the different circuit configurations follow this general pattern when drawn on a common graph.

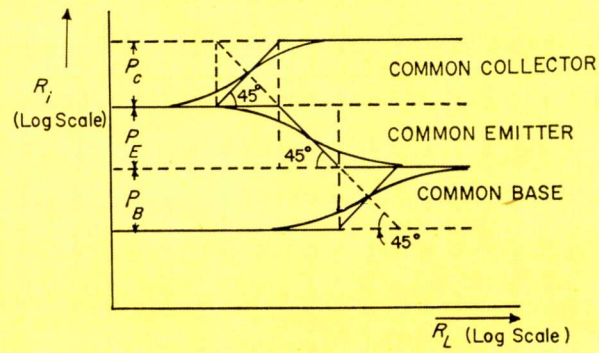
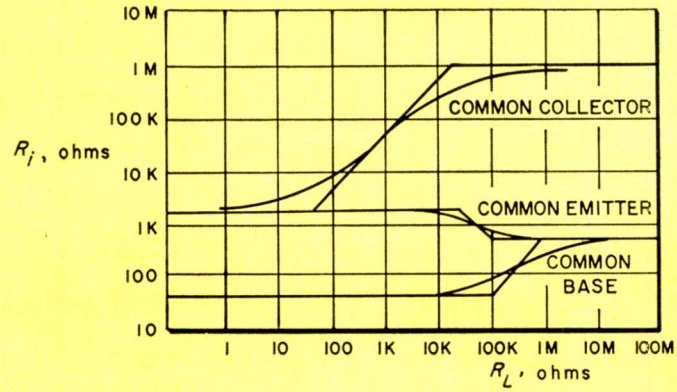
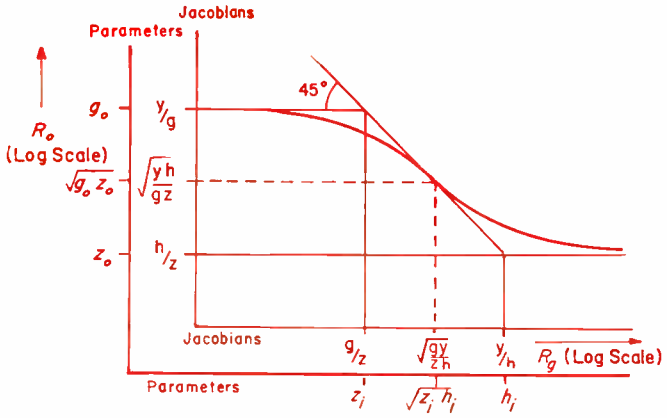


Fig. 5: A practical case of asymptotes and curves for a transistor.





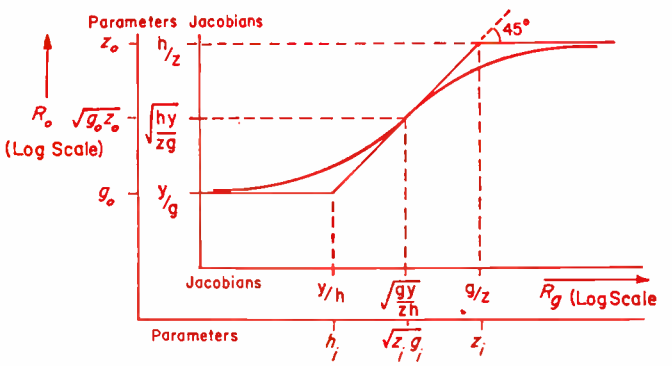


Fig. 6 (left): Common emitter curve and asymptotes for output resistance vs. generator resistance.

Fig. 7 (above): Common base or common collector curve and asymptotes for output resistance vs. generator resistance.

Asymptotes *(Continued)*

sured distance), the error is zero, or in the terminology used here, the error ratio is 1. At either extreme, i.e., at z_o or g_o, the error ratio is $2/1+P^{-1}$. At a distance beyond z_o equal to the distance between

$$\sqrt{z_o g_o}$$

and z_o in Fig. 3, the error ratio is

$$(1 + P^{1/2})/(1 + P^{3/2}).$$

The curve is symmetrical about the central cross-over point, and the error is the same at corresponding points on each side, Fig. 3.

For practical purposes, it is usually sufficient to compute the error at one position beyond z_o and g_o and at z_o and g_o themselves. With the central point of zero error, this gives five accurate plots, which together with the asymptotes, make the plotting of the curve quite a straightforward operation. Further information on the error is given in the Appendix.

Relation for Three Configurations

For the designer who uses one type of transistor in different applications, a useful graph is that of input resistance vs. load resistance for all three circuit configurations. Here again, it may be mentioned that the use of Jacobians greatly facilitates conversions between the different configurations.

Because of space limitations, detailed analyses and calculations have been placed in an Appendix. A copy of this appendix may be obtained by writing on company letterhead to

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The asymptotes for common collector, common base and common emitter follow a regular pattern, Fig. 4. The fact that the curves merge into each other can readily be confirmed from the circuit similarity of common emitter and common collector when $R_L = 0$, and of common emitter and common base when $R_L = \infty$.

Proofs of the asymptotic structure are given in the Appendix, and an example of a practical case is given in Fig. 5. The ratio of the three projections $P_C : P_E : P_B$ is the same as that of $\Delta^{gB} : 1 : \Delta^{hc}$ (see Appendix C).

Output vs. Generator Impedance

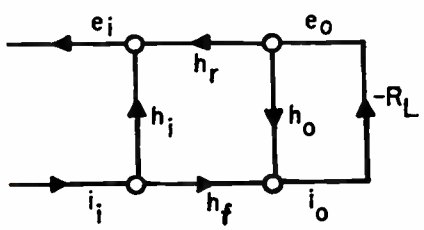
What has been done for the curve of R_i versus R_g in the previous paragraphs can be done very similarly with the curve of R_o versus R_g. The results are shown in the corresponding diagrams, Figs. 6 to 9.

Current and Voltage Gain

In this section, the design curves for current and voltage gain are dealt with, and the asymptotes and error ratios derived. The current gain is analyzed in detail, and the results given for a similar analysis of voltage gain. Finally, power gain is dealt with, and a practical method is described for rapid calculation of the error ratios. The algebra of the network analysis is condensed as before by the use of flow-graphs.

Current Gain

For a transistor, described by its h parameters, and an external load R_L, the set of equations can be written thus:



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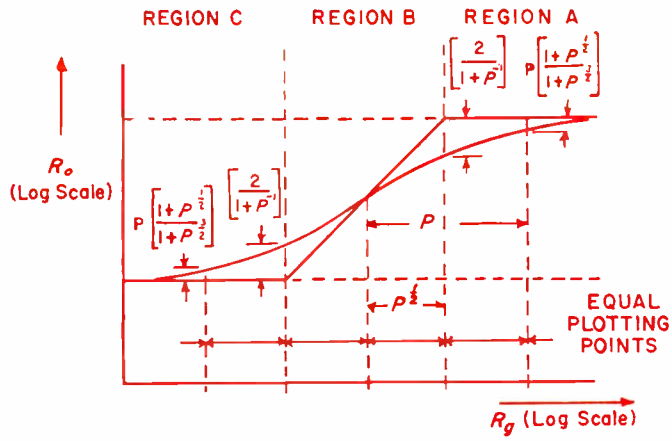


Fig. 8: The error ratio at equal plotting points from the center is given in terms of P, for conditions of Figs. 6 & 7.

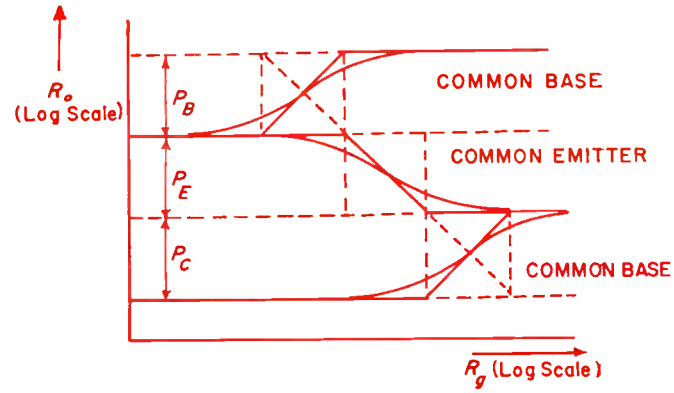


Fig. 9: Configuration of asymptotes for output resistance vs. generator resistance follows a similar pattern to that shown in Fig. 4.

The current gain of the system is

$$A_i = \frac{i_o}{i_i} = \frac{h_f}{1 + h_o R_L} \qquad (22)$$

Comparison with the general equation $y = (p + qx)/(r + sx)$ shows a one-to-one correspondence, provided that $q = 0$. The general equation is examined in the Appendix, and the asymptotes follow the rules established there for Fig. 10.

Since $q = 0$, however, $q/s = 0$ and $P/q = \infty$, i.e., the asymptotes consist only of two lines instead of three, and their appearance is as shown in Fig. 12.

At $R_L = 0$, the current gain is h_f, and the point of intersection of the two asymptotes occurs at $x = r/s$ for the general equation, or $R_L = 1/h_o$ in this particular case.

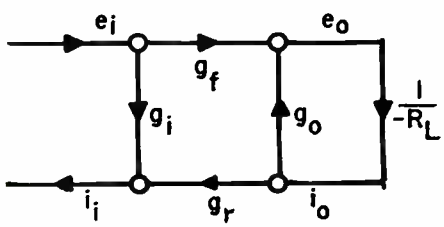
Current Gain Error Ratios

The error ratio of asymptotic to true value of current gain is the same either side of the point $R_L = 1/h_o$, being $1 + 1/R_L h_o$ and $(1 + R_L h_o)$ in Regions A and B, respectively. It reaches a maximum value of 6 db at $R_L = 1/h_o$.

There is, of course, no reason why an error ratio should not be calculated outside of its own region, provided that it is measured from the correct asymptote or its extension. In fact, this technique is used later (Appendix E4), to avoid altogether any reference to the horizontal asymptote for power gain error ratios. The mathematics of the current gain error ratio calculation is given in Appendix D.

Voltage Gain

The voltage gain can be expressed most easily from the g parameters, in the flow-graph



(23)

whence

$$A_r = \frac{e_o}{e_i} = \frac{g_f}{1 + g_o (1/R_L)} = \frac{g_f R_L}{g_o + R_L} \qquad (24)$$

This follows the general case of $y = (p + qx)/(r + tx)$ where $p = 0$, and the relationships shown in Fig. 13 can be derived.

Voltage Gain Error Ratios

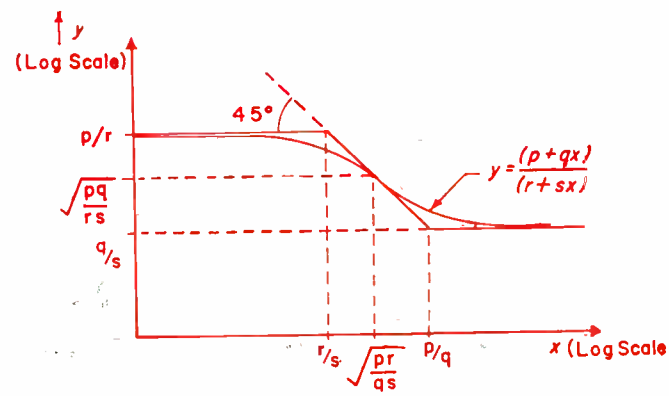
The error ratio to the left of $R_L = g_o$ is $(1 + R_L)/g_o$ and to the right is $(1 + g_o)/R_L$, reaching a maxium of 6 db at $R_L = g_o$ (Fig. 13). Again, the error ratio may be measured to the extension of an asymptote, provided the correct formula is used, and again the mathematics of the treatment is given in Appendix D.

Power Gain

Since power gain is the product of voltage gain and current gain, the final manipulation is to add together the y coordinates (on log scales) of voltage gain and current gain.

The mathematical details of the calculations are summarized on the basis of the general form of equation used previously, in Appendix E, and Jacobians are used to translate from the general results to the transistor parameters shown in Fig. 14.

Fig. 10: General case of curve and asymptotes for $y = (p+qx)/(r+sx)$.



Asymptotes *(Continued)*

Three asymptotes are used, with 45° slopes if identical log scales are used for ordinate and abscissa. For constructional purposes, it should be noted that the points of intersection of the asymptotes do *not* fall at z_o and g_o on the load resistance scale.

Power Gain Error Ratios

The "Projection Ratio" is, somewhat illogically, defined as the ratio of g_o to z_o. This justification for this definition, of course, is that it makes for simpler formulas for the error ratios.

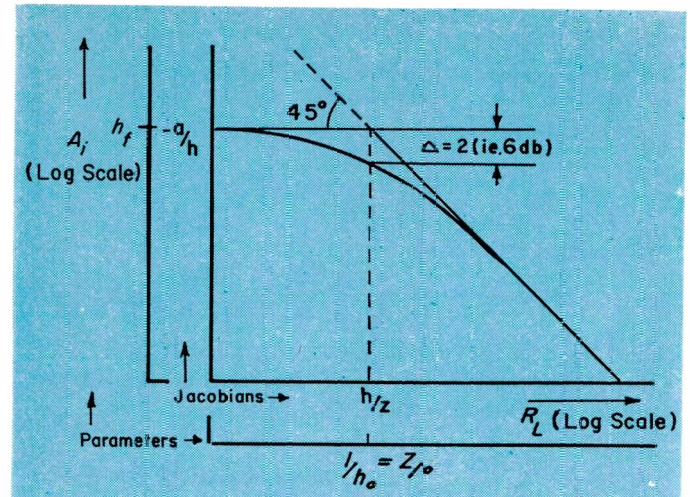


Fig. 12 (above): Sketches for current gain vs. load resistance.

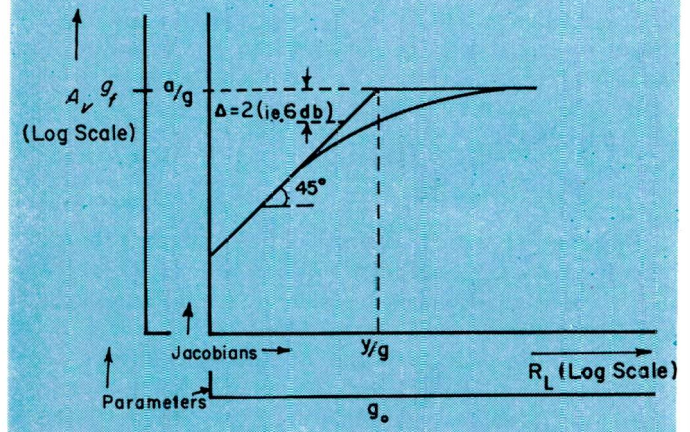
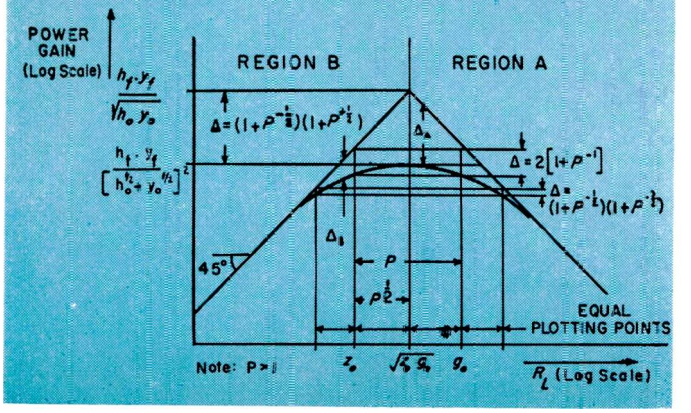


Fig. 13 (above): Relationship of voltage gain and load resistance.

Fig. 14 (below): Common emitter relationships. Note that the horizontal asymptote is used only to establish the maximum height of the curve. Error ratios are measured only to the sloping asymptotes.



In a treatment similar to that given the impedance curves, "equal plotting points" are established on the abscissa, but the error ratio is in all cases related only to the inclined asymptotes and not to the horizontal asymptote. The error at an abscissa value located at n plotting points from the central ordinate of symmetry,

$$\sqrt{z_o\, g_o}$$

is

$$(1 + P^{-(n+1)/2})\,(1 + P^{-(n-1)/2})$$

where $P^{1/2}$ is the (log scale) ratio of adjacent marking points, as in Fig. 14.

The power gain is at a maximum of

$$h_f \cdot y_f/[h_o^{1/2} + y_o^{1/2}$$

at a load resistance of

$$\sqrt{z_o\, g_o}.$$

At this value, the error is

$$[1 + P^{-1/2}]\,[1 + P^{1/2}]$$

where $P = g_o/z_o$. At the first plotting point either side of the central line of symmetry, the error ratio is

$$2\,[1 + P^{-1}],$$

and at the second plotting point the error ratio is

$$[1 + P^{-1/2}]\,[1 + P^{-3/2}].$$

For any given type of transistor, there is a production spread of parameters which itself represents a complex mathematical problem insofar as it relates to the design curves. Variation of the selected value of emitter current will also change the transistor parameters, and the popular design method of including a small unbypassed resistor in the emitter lead of a transistor introduces further changes to the network parameters. A change of ambient temperature will change the parameters, and will probably change the emitter current, too, resulting in further changes.

These and other agencies may be at work separately or simultaneously to cause very considerable fluctuations in the parameters which have been assumed to remain constant. To say that these changes are outside the scope of this article may be true, but not very consoling.

To some extent, the effect of variations in transistor parameters can be limited by the use of negative feedback. Then a new set of parameters can be written for the network, including the negative feedback, and the methods outlined here can be used to provide design curves which will be a little more stable.

In any event, the present methods possess the merit of being easily applied, and taken in conjunction with the method of converting transistor parameters previously described[1], they provide a useful first approximation in many of the problems associated with transistor circuit design.

Reference

[1] T. R. Nisbet and W. W. Happ, "Jacobians—a New Computational Tool," *Electronic Industries*, November 1958.

Page from an Engineer's Notebook

#49 Accuracy of a Constant Voltage Device

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NORMALLY a constant voltage device consists of two elements connected in series. Element 1 has a characteristic with a sharp knee, whereas element 2 has a straight characteristic and acts as a current limiting device. The voltages across these elements are E_1 and E_2. E_1 is the stabilized voltage. As shown in the graph, it is possible to get a common characteristic (dotted line) of the device by combining the characteristics 1 and 2 by means of adding up the voltages at a selected current value.

It is recognized easily that characteristic 1 reaches its knee-voltage at a certain line voltage E_{LL} from where Element 1 takes up its stabilizing function.

This line voltage E_{LL} is often called cut-in voltage.

Let R_1 denote the resistance of the characteristic 1 (dynamic impedance) above the knee and R_2 the resistance of characteristic 2. Furthermore:

E_{LL} = Low Line Voltage
E_{LH} = High Line Voltage
E_{1L} = Voltage across element 1 at low line voltage
E_{1H} = Voltage across element 1 at high line voltage
E_{2L} = Voltage across element 2 at low line voltage
E_{2H} = Voltage across element 2 at high line voltage
Δi = Change in current due to line voltage change from E_{LL} to E_{LH}

Then the lowest line voltage

$$E_{LL} = E_{1L} + E_{2L} \quad (1)$$

at the highest line voltage

$$E_{LH} = E_{1L} + \Delta i\, R_1 + E_{2L} + \Delta i\, R_2 \quad (2)$$

Subtracting (1) from (2) yields

$$E_{LH} - E_{LL} = \Delta i\,(R_1 + R_2)$$

= total change in line voltage $= \Delta E_L \quad (3)$

For characteristic 1 alone,

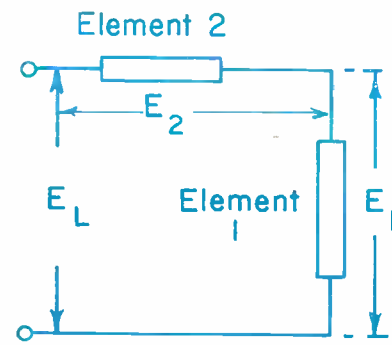
$$\Delta E_1 = \Delta i\, R_1 \quad (4)$$

Dividing (4) by (3)

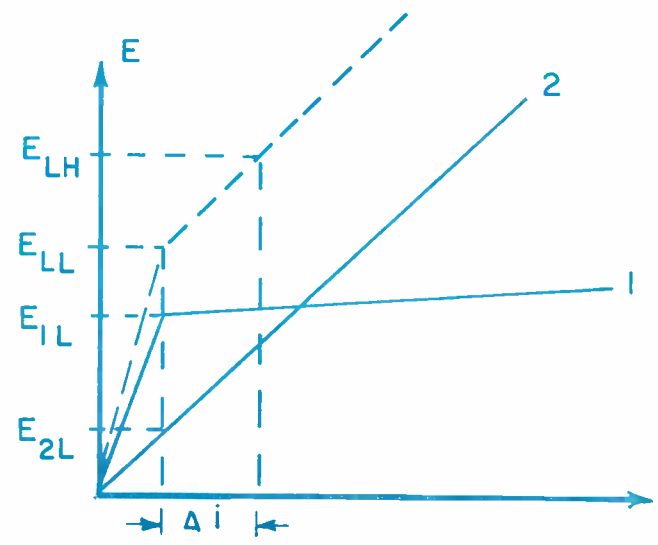
$$\frac{\Delta E_1}{\Delta E_L} = \frac{R_1}{R_1 + R_2} \quad \text{absolute ratio} \quad (5)$$

This equation tells us that the change across the stabilizing Element 1 is $\frac{R_1}{R_1 + R_2}$ times smaller than the line voltage change. This relation, however, does not give a clear picture as ΔE_1 itself may be small, relatively. However, it could be high. Therefore, it is of interest to know what percentage change across the stabilizing element is caused by what percentage change of line voltage. Therefore, ΔE_1 is put in relation to E_{1L} and ΔE_L in relation to E_{LL}

Equation (5) multiplied by $\frac{E_{LL}}{E_{1L}}$ yields



A constant voltage device normally consists of two elements connected as shown.



Element 1 has a characteristic with a sharp knee while element 2 has a straight characteristic and acts as a current limiting device.

Accuracy *(Concluded)*

$$\frac{\frac{\Delta E_1}{E_{1L}}}{\frac{\Delta E_L}{E_{LL}}} = \frac{R_1}{R_1 + R_2}\left(\frac{E_{LL}}{E_{1L}}\right) \quad (6)$$

Combining equation (6) with equation (1) yields

$$\frac{\frac{\Delta E_1}{E_{1L}}}{\frac{\Delta E_L}{E_{LL}}} = \frac{R_1}{R_1 + R_2}\left(1 + \frac{E_{2L}}{E_{1L}}\right)$$

As this is a relative relation I want to nominate:

$$\delta E_1 = \frac{\Delta E_1}{E_{1L}} \text{ and } \delta E_L = \frac{\Delta E_L}{E_{LL}}$$

Then we get the relative relation:

$$\frac{\delta E_1}{\delta E_L} = \frac{R_1}{R_1 + R_2}\left(1 + \frac{E_{2L}}{E_{1L}}\right)$$

From this equation it is to be seen that the best stabilizing effect is given, when R_1 (dynamic impedance) is as low as possible whereas, R_2 should be high. On the other hand E_{2L} the voltage across Element 2 at low line voltage should be low and E_{1L} the voltage across Element 1 at low line voltage, should be as high as possible.

For ease of evaluation let us put the last equation into the following form:

$$\delta E_1 = \frac{R_1}{R_1 + R_2}\left(1 + \frac{E_{2L}}{E_{1L}}\right)\delta E_L$$

Let us consider an example.

Given: The line voltage varies from E_{LL} = 40 vdc to E_{LH} = 50 vdc

Hence ΔE_L = 10 vdc and

$$\delta E_L = \frac{\Delta E_L}{E_{LL}} = \frac{10}{40} = 0.25 \triangleq 25\%$$

Chosen:

Zener Diode MZ 4.7

with E_{1L} = 4.7 volt at 30 ma dc

and R_1 = 1.25 Ω from data sheet.

From this we get:

$E_{2L} = E_{LL} - E_{1L} = 40 - 4.7 = 35.3$ volt

$$R_2 = \frac{E_{2L}}{I} = \frac{35.3}{30 \times 10^{-3}} = 1180\ \Omega$$

and the regulation (voltage change) across the Zener diode

$$\delta E_1 = \frac{1.25}{1.25 + 1180}\left(1 + \frac{35.3}{4.7}\right) \times 25\%$$

$$= 0.001055\ (1 + 7.53) \times 25\%$$

$$= 0.225\%$$

PERFORATED PAGES!

In response to many reader requests the pages in the main editorial section have now been perforated. This will enable readers to easily remove material for their reference files. If the copy of Electronic Industries you receive already has pages removed that you want, please let us know. We'll be glad to provide missing pages.

Rota-Form Coil Winder

Abstracted from a paper by Paul L. Kerley and R. H. Opperman, Sandia Corp., Sandia Base, Albuquerque, N. M.

A MACHINE which winds layer-wound transformer coils on uncut "C" cores, used in saturable reactor applications, has been designed by engineers at Sandia Corp., Sandia Base, Albuquerque, N. M. Coils for this type of core obviously cannot be wound and then placed around a leg of the core. Formerly, they were hand-wound on the core by means of a shuttle containing the required amount of wire, or wound on a toroidal winding machine by using a window-winding attachment. Neither of these methods is satisfactory.

Hand-winding is tedious, time-consuming, and subjects the wire to severe handling. For coils of appreciable inductance, it is difficult to hold enough wire in the "shuttle." The toroidal machines do not lend themselves well to the task. Their bobbins hold only a limited amount of wire of a given size. They do not make true layer-windings without objectionable overlapping of turns, and they are very clumsy as regards the placing of layers of insulation between layers of windings. For example, the core must be removed from the window-winding clamp each time a layer of insulation is inserted.

The Rota-Form Coil Winder, Fig. 1, uses a completely new winding technique in that the coil and the coil form are rotated about one leg of the uncut "C" core. This is accomplished by means of a split bobbin or coil form, Fig. 2, which is placed around a leg of the core and glued or taped together to form a solid bobbin.

The core is held stationary in a special recessed holder. The bobbin rests on four rubber-faced drive wheels and is held down by a hinged clamp on which two idler wheels are mounted; thus, the form can be rotated about the leg of the stationary core. A standard-sized wire spool will supply enough wire for many coils.

Access is had to two sides of the bobbin while it is in the machine; this permits easy handling of the wire and the layer insulating material.

The bobbin can be made of any machinable material. For high-

(Continued on page 194)

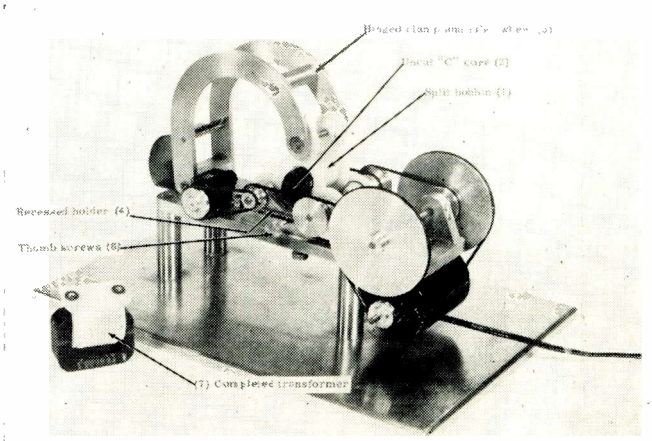


Fig. 1: This winder uses a completely new technique; the coil and coil form are rotated about one leg of the uncut "C" core.

Silicon photovoltaic cells are being used more in satellites and space vehicles as power sources. They are low in weight, have a good conversion efficiency, and can withstand environmental stresses. A new process that makes this possible is described.

For Space Vehicles . . .

Improved Silicon Photovoltaic Cells

By HARRY NASH and WERNER LUFT

International Rectifier Corp.
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El Segundo, Calif.

SILICON photovoltaic cells are finding increasing application in satellites and space vehicles as power sources. The requirements are extreme low weight, high conversion efficiency and ability to withstand the environmental stresses encountered in space.

An improved process for the manufacturing of silicon solar cells has been developed, offering high conversion efficiency and a cell construction that permits reliable mounting. This paper describes the new cell construction and introduces a basic low weight module assembly of these cells designed for space applications. The electrical characteristics of the cells are described and data for solar cell design in space environments and temperature control is presented.

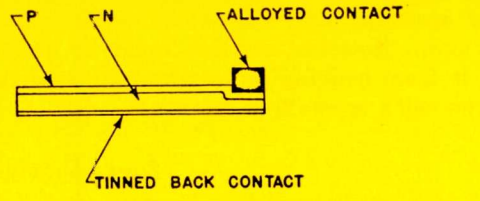
Cell Design

The silicon photovoltaic cell described here is the boron diffused silicon p-n junction device developed by the Bell Laboratory.[1 2] This cell is a high efficiency solar energy converter commonly referred to as the Solar Cell. The innovation to the basic silicon solar cell design is in the use of an alloyed contact strip bonded directly to the p layer to form an integral part of the cell. This process was developed by the International Rectifier Corporation for the Signal Corps* to provide silicon solar cells with non-plated contact strips.

The silicon solar cell consists of the n doped silicon

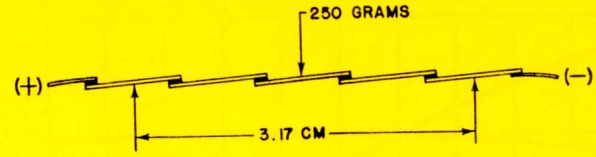
*Contract No. DA-36-039-SC-66469.

Fig. 1a: Cross section of a solar cell



OUTLINE DIMENSIONS:	1 X 2 CM
ACTIVE AREA:	1.8 CM^2
EFFICIENCY OF CONVERSION:	7%, 8%, 9%, 10%
WEIGHT:	.3 GRAM

Fig. 1b: Diagram shows shingle construction of cells



OUTLINE DIMENSIONS:	2 X 4.6 CM
ACTIVE AREA:	9.0 CM^2
EFFICIENCY OF CONVERSION:	7%, 8%, 9%
WEIGHT:	1.5 GRAM AVERAGE

Silicon Cells *(Continued)*

wafer having a boron diffused p layer at the active surface. A cross section of this cell and alloy contact construction is shown in Fig. 1a. The p contact consists of a metal strip bonded to pure aluminum which is alloyed directly into the silicon cell. This aluminum alloy forms a p-n junction contact with the n doped wafer and a very intimate ohmic contact to the boron p layer. The cell is then tinned at the p contact strip which is the electrical positive terminal. The entire back surface of the cell is plated and tinned to form the electrical negative terminal. This design contributes to very low series resistance in the p contact and n contact, thereby offering improved conversion efficiency. In addition, the p contact strip reinforces the silicon wafer to make the contact area the most rugged part of the entire silicon cell.

The "alloyed contact" silicon cell is presently being produced in the 1 x 2 cm configuration that has become standardized for military applications. This cell size is very well adapted to the requirements of high efficiency solar energy conversion.[3] Larger area cells may be produced, but at a loss in conversion efficiency. Smaller area cells may be made of comparable and even higher efficiencies that the 1 x 2 cm size, but area utilization of such cells may be poorer. For space applications these cells can currently be obtained in grades of 8%, 9%, and 10% conversion efficiency. Higher efficiency cells have been produced in prototype quantities, but these are not yet offered for space power designs.

Fig. 2: E-I characteristics of a 1 x 2 cm 10% efficiency cell

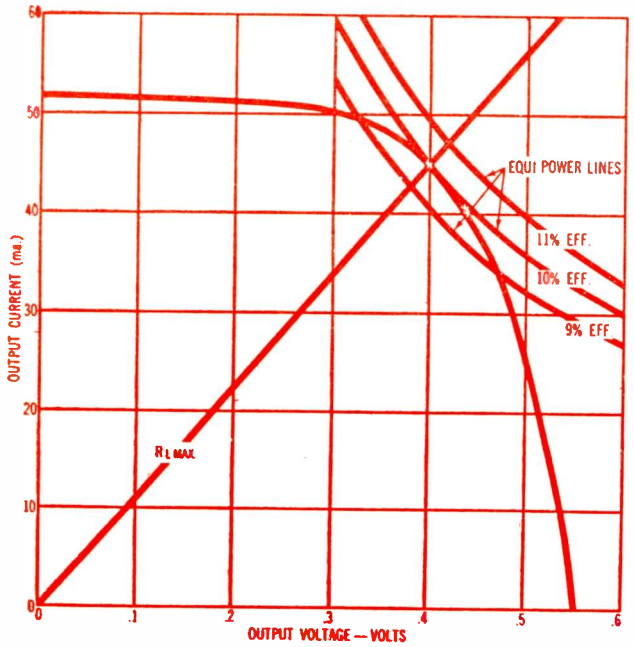


Fig. 3: Typical variation of max. power output vs. cell temp.

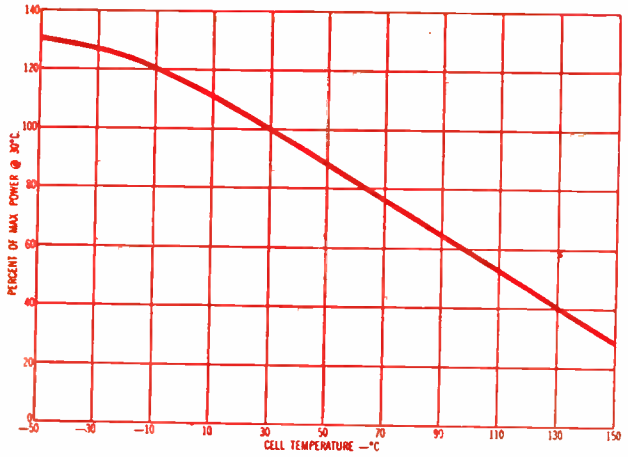
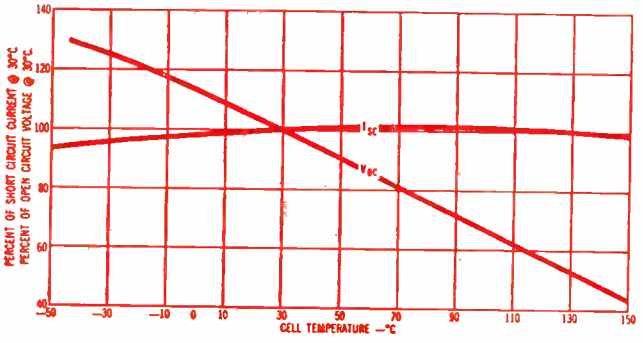


Fig. 4: Typical variation of short circuit current and open circuit voltage versus the cell temperature.



Light Weight Module Assembly

The superior ruggedness and contact strength of this new silicon cell construction becomes evident when cells are assembled in series combinations as basic module units. The method for interconnecting silicon cells to obtain the highest efficiency per unit area is the shingling method. In this assembly, the p contact of one cell is in direct contact with the tinned n contact of the adjacent cell in a series connected string. The entire exposed surface of the shingled assembly, with the exception of the collector strip on the end cell, is an active surface. Fig. 1b illustrates a cross section of this five-cell shingled module. Design tests of this module under simple beam loading have shown the maximum shear and bending stresses to be limited by the silicon wafer crystalline structure, rather than the interconnecting joints. This test is performed on all shingled assemblies in production with a 250 gram load applied at the center of the unit, as shown in Fig. 1b.

The shingled module assemblies are extremely light in weight and offer the optimum power-to-weight ratio for space power designs. The total 1.5 gram weight of the module is a composite of the five individual cells, at 0.3 grams per cell, in this assembly. Yet, the module is strong enough to be readily handled for assembly into sub-panels or directly onto a vehicle skin. However, caution must be observed to protect it from bending or localized stresses that can break the cell's crystalline structure.

Power Supply Design

The design of silicon solar cells into power supplies for space vehicles requires an understanding of their behavior under space environmental conditions. Such influences as magnitude and spectral distribution of solar radiation, thermal equilibrium of the solar collector and damaging effects of micro-meteorite ero-

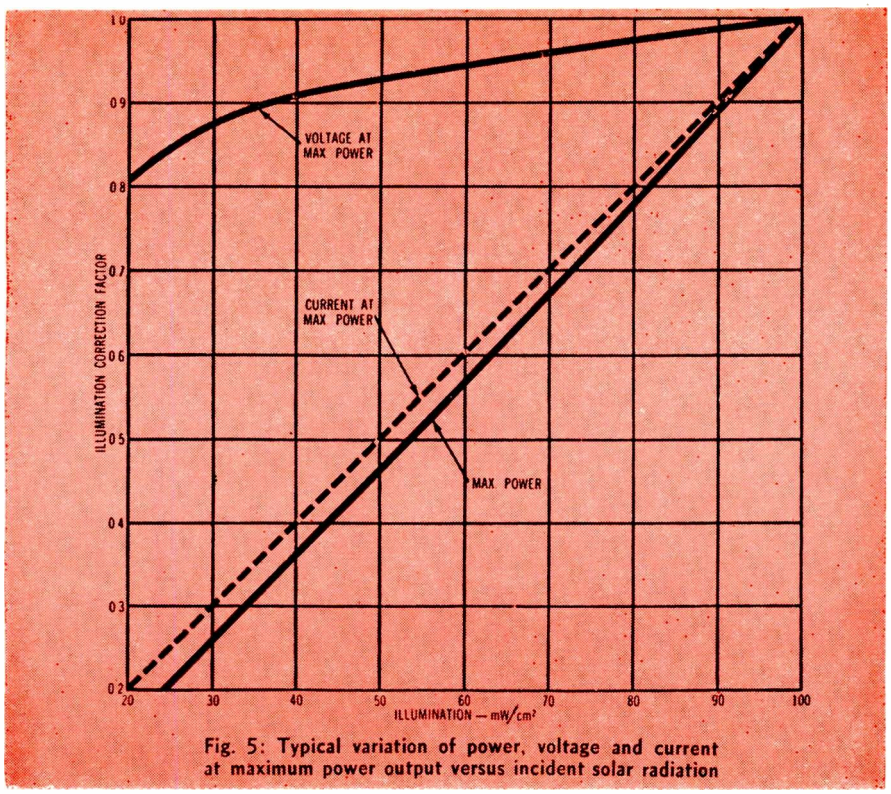


Fig. 5: Typical variation of power, voltage and current at maximum power output versus incident solar radiation

temperatures above 30°C, the maximum power output decreases linearly with increased temperature at a rate of approximately 0.6% per degree C. For temperatures below 30°C, the maximum output power increases at approximately the same rate down to −10°C. Below this temperature, the rate of change in maximum output decreases.

The influence of cell temperature on open circuit voltage and short circuit current is shown in Fig. 4. The open circuit voltage decreases approximately linearly with increasing temperature, whereas the short circuit current is nearly independent of temperature within a wide range.

sion must enter into the design. From our present knowledge of the space environment, good approximations may be made on the cell performance under these conditions.

Before analyzing the space environment influence on solar cells, a brief review of the characteristics of the cells at the surface of the earth is presented.

Basic Electrical Characteristics

Fig. 2 illustrates the voltage-current characteristics of a 1 x 2 cm 10% efficiency cell. The characteristic is shown for standard conditions at which silicon solar cell performance is normally specified. These conditions are:

Incident Radiation Power=100 mw/cm² equivalent solar radiation.

Cell Temperature=30°C.

The radiant energy source used when determining these characteristics is a tungsten lamp. The light beam passes through a 1" water filter and is directed on the cell surface. This water filter is used to obtain a spectral distribution of the radiation falling on the cell which approximates the spectral distribution of solar radiation at the earth's surface. The light source is calibrated at 100 mw/cm² equivalent solar irradiation by comparison with a standard pyrheliometric measurement under direct solar radiation at approximate air mass=1, (Fig. 7).

The cell whose characteristics are illustrated in Fig. 2, delivers a maximum power output of 18 milliwatts at 100 mw/cm² solar radiation, corresponding to a conversion efficiency of 10%. The maximum power output is delivered at 0.4 v at the specified cell temperature of 30°C.

Temperature Effects

Fig. 3 illustrates the influence of cell temperature on the maximum power output of silicon cells. For

Effects of Illumination Level and Spectral Distribution

The output characteristics of a solar cell vary with the amount of incident radiant power. For any given spectral distribution of the incident radiation, variation of the short circuit current is linear with radiation. The same holds true for the output current at maximum power transfer, as shown in Fig. 5. The variation in output voltage at maximum power as a function of incident radiation above a certain light level is nearly linear, but small, as seen from the same figure. Below this level, which is 40 mw/cm² for solar radiation at sea level, the voltage decreases more rapidly with decreased radiation.

The output from a solar cell depends not only on the magnitude of incident radiation received, but also on the spectral distribution of the radiation. The solar cells can convert radiant energy into electrical energy for radiation of wave lengths from approximately 0.4 to 1.1 microns. However, the conversion has the highest efficiency for 0.8 microns wave length. This is seen in Fig. 6, which shows the relative spectral response of the short circuit current for radiation of constant power per unit wave length.

THE SPACE ENVIRONMENT

Spectral Distribution

When the silicon solar cell is elevated to a point just outside the earth's atmosphere it is exposed to a magnitude of solar radiation called the "solar constant." The solar constant is defined as the mean value of solar radiation at normal incidence outside the earth's atmosphere at the mean solar distance. The magnitude of the solar constant has been determined to be approximately 140 mw/cm².[4] Its relative spectral distribution is shown in Fig. 7, at zero air mass (m=0).

Silicon Cells *(Continued)*

In its passage through the earth's atmosphere, the solar radiation is modified by scattering, absorption, and reflection effects that are spectrally selective. Almost all the energy of wave lengths shorter than 0.3 microns is absorbed in the upper atmosphere. Water vapor and atmospheric gases absorb selectively in the visible and near infra-red spectrum. The resulting magnitude and spectral distribution of solar radiation striking the surface of the earth is notably different from that outside the atmosphere. This magnitude is 93 mw/cm² for air mass=1 and 74 mw/cm² for air mass=2.[5] The relative spectral distribution for m=1 and m=2 is also shown in Fig. 7.

Fig. 6: Relative spectral response of short circuit 1 for uncoated cells for radiation of constant power per unit wavelength.

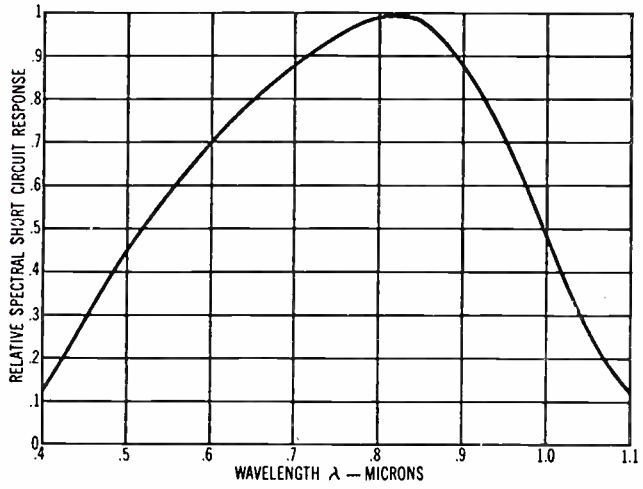


Fig. 7: Relative solar spectral radiation for three air masses.

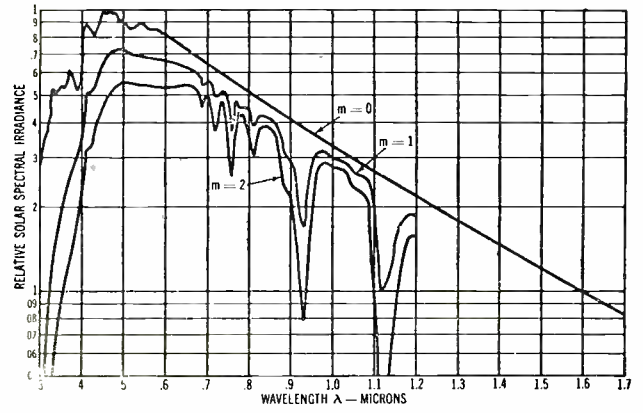
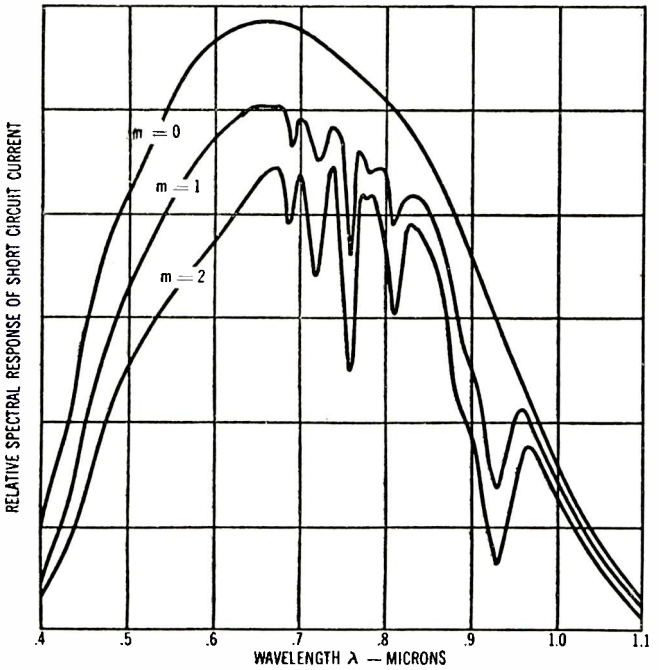


Fig. 8: Relative spectral response of short circuit current for solar radiation (uncoated cell), at three air masses



The efficiency of a silicon solar cell is normally specified at a magnitude of 100 mw/cm² solar radiation, with approximately spectral distribution m=1. For space applications it is necessary to know the corresponding efficiency, for solar radiation at m=0. This efficiency can be determined from Fig. 8, which gives the relative spectral response of silicon cells for solar radiation and which is obtained by point-by-point multiplication of the curves in Fig. 6 and Fig. 7.

The ratio of output from a cell at solar radiation m=0 to solar radiation at m=1 is obtained by taking the ratio of the integrals of corresponding curves in Fig. 8. This ratio is 1.25. Likewise, from Fig. 7, the ratio of the solar radiation for m=0 to m=1 is 140/93=1.5. It is seen that the output from a cell in going from m=1 to m=0 increases less than the increase in solar radiation. The efficiency, at constant cell temperature, for solar radiation of m=0 is, consequently, only 1.25/1.5=0.83 of the efficiency for solar radiation at m=1. This assumes that there is a linear relationship between short circuit current and maximum power output.

From the above analysis a factor of F_λ=.83, equal to the ratio of cell efficiencies for solar radiation m=0 to m=1, is introduced. It is interesting to note that F_λ may be greater than unity for a solar energy converter having a broader spectral response than silicon cells.

Surface Temperature of Solar Collectors

The surface temperature of a solar collector of given configuration in space is determined by its spectral emissivity and internal energy generation or absorption. This surface temperature must be known in order to determine the operating efficiency of the collector. The following data describes the surface characteristics of silicon solar cells and indicates their effect on surface temperature. A practical method for temperature control to obtain maximum solar collector output is discussed.

The temperature of a collector can be expressed in terms of its surface characteristics, i.e., the ratio of its average absorptivity for incoming radiation to its average emissivity at equilibrium temperature. The temperature will also depend on the collector's geometrical configuration. In Fig. 9 this relationship is shown for two collector configurations.

Collector A: Flat plate collector oriented normal to the incident radiation. (No temperature drop across collector.)

Collector B: Rotating spherical collector with axis of rotation normal to the incident radiation.

For both collectors the conversion efficiency for incident solar radiation to electric power is assumed

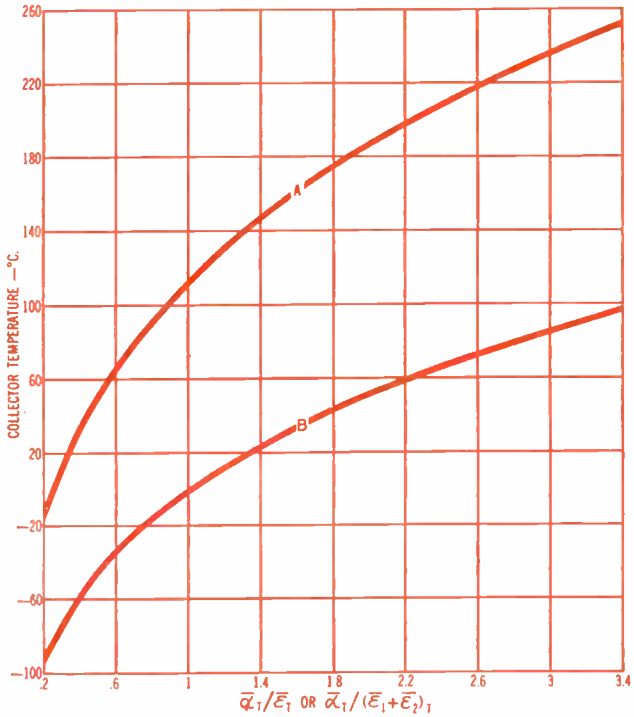


Fig. 9: Surface temperature of solar collectors in space

to be 10% and this power is transmitted away from the collector. It is also assumed that the surface characteristics of the collector not covered by solar cells is identical to the surface characteristics of the solar cells. In addition, the re-radiation to space of the collector is assumed unobstructed and no reflected radiation is received from the earth, moon or other body.

The abscissa of the plot in Fig. 9 represents the surface characteristics of the collector ($\bar{\alpha}_\tau/\bar{\epsilon}_\tau$). These surface characteristics for uncoated solar cells have been determined by measurements (Fig. 10). From this data the average absorptivity (α_τ) for solar radiation at m = 0 has been determined to be 0.91; this value is assumed to be independent of the cell temperature for the temperature range of interest. From the same data the average emissivity ($\bar{\epsilon}_\tau$) of the solar cells as a function of cell temperature has been calculated and the result is shown in Fig. 11.

The temperature of a solar collector in space can be determined from this data. In Table I, the cell temperature for the two collectors considered is presented.

Temperature Control

It can be seen from Table I that solar collectors A and B operate at a relatively high surface temperature and consequently have a lower efficiency than desirable for space power supplies. The surface temperature of the collectors may be considerably reduced by reducing the $\bar{\alpha}_\tau/\bar{\epsilon}_\tau$ ratio of the solar cells.

An increase in average emissivity of the silicon solar cell is obtained by the use of thin coated coverglass applied over each silicon cell. This coverglass is bonded directly to the cell surface to eliminate the "green-house effect." A typical example of the temperature of solar collectors when using coverglass on silicon cells is shown in Table II for the same cases as shown in Table I with non-covered cells. For this design the coverglass has increased the $\bar{\epsilon}_\tau$ of the silicon cells from 0.35 to an estimated 0.92 and the $\bar{\alpha}_\tau$ from 0.91 to an estimated 0.92. The resulting increase in power output for the Collector A is 16% and for the Collector B is 47%, taking into consideration the transmission loss through the coverglass.

The coverglass is extremely light in weight and may be applied to silicon solar cells in any type of assembly. When applied to the standard module shown in Fig. 1b, the entire assembly weight is 2.5 grams. In addition to its function in temperature control, this coverglass also provides protection to

(*Continued on page* 106)

Table 1

Temperature of Solar Collectors with Non-Covered Silicon Cells

Collector	$\bar{\alpha}_T$	$\bar{\epsilon}_{1T}$	$\bar{\epsilon}_{2T}$*	$\frac{\bar{\alpha}_T}{(\bar{\epsilon}_1 - \bar{\epsilon}_2)_T}$	Collector Surface Temperature	F_T Temperature Correction Factor
Flat Plate (A)	0.91	0.35	0.92	0.72	80°C	0.70
Rotating Sphere (B)	0.91	0.35	....	2.65	75°C	0 72

Table 2

Temperature of Solar Collectors With Coverglass

Collector	$\bar{\alpha}_T$	$\bar{\epsilon}_{1T}$	$\bar{\epsilon}_{2T}$	$\frac{\bar{\alpha}_T}{(\bar{\epsilon}_1 + \bar{\epsilon}_2)_T}$	Collector Surface Temperature	F_T Temperature Correction Factor
Flat Plate (A)	0.92	0.92	0.92	0.5	52°C	0.88
Rotating Sphere (B)	0.92	0.92	....	1.0	0°C	1.16

*$\bar{\epsilon}_{2T}$ Average emissivity of rear surface of Collector A at surface temperature T.

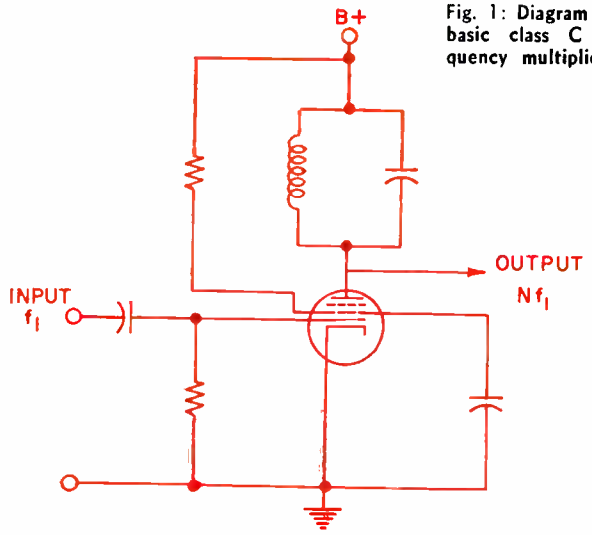


Fig. 1: Diagram of a basic class C frequency multiplier.

By HAROLD T. McALEER
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A Novel Method for

THE process of frequency multiplication can be separated into two operations—harmonic generation and harmonic selection. The commonly employed Class C frequency multiplier shown in Fig. 1 illustrates this process.[1] The voltage applied to the grid of the tube is large enough to bias the tube well below cutoff so that the plate current flows in brief pulses. These current pulses flow into an impedance (the plate tank circuit) designed to emphasize the desired harmonic component and attenuate all others.

Using the methods of frequency-domain analysis, the plate current can be approximated by a train of fractional sine-wave, or perhaps cosine squared, pulses. A Fourier series[2] can be determined for the plate current, and from the impedance of the tank circuit, the various harmonics in the plate voltage can be calculated.

A better physical picture of the circuit performance is obtained from a time-domain description. Using this method, the plate tank circuit is considered to be excited by each pulse of current. In the interval between pulses, the tank circuit "rings" at its own natural frequency. The plate voltage takes the form of an amplitude-modulated wave with an envelope composed of a series of decaying exponential waves. The amount of decay or decrement of the envelope depends on the interval between current pulses and the Q of the tank circuit, or in frequency-domain terms, on the discrimination of the tank circuit to adjacent harmonics.

In the generation of medium (5-10) and high (> 10) order harmonics with the Class C multiplier, efficiency considerations dictate the use of a brief current pulse. For the usual case, the spectrum of the pulse train has a decreasing envelope in the region of interest. That is, the desired harmonic component of the current is smaller in amplitude than the next lower harmonic and greater in amplitude than the next higher harmonic. This condition makes filtering difficult. In many applications, however, efficiency and power handling capability are of secondary importance, the primary goal being the generation of a harmonic voltage with high spectral purity, i.e., a "clean" voltage with low adjacent harmonic content. In this case the usual method is not always the best.

Advantages of a Rectangular Waveform

A study of the spectra of commonly encountered waveforms[2] indicates that, for the generation of medium- and high-order harmonics, the rectangular waveform offers many advantages. In the frequency range up to about 1 MC, several methods exist for the generation of essentially rectangular waves. The spectrum of a rectangular wave extends far into the high-harmonic region with relatively low roll-off compared to the spectra of other common waveforms. The rectangular wave spectrum also exhibits periodic nulls. These nulls represent a disadvantage if a wide smooth spectrum is desired, but for the generation and selection of a single harmonic, the nulls can often be used to advantage.

As illustrative examples of the use of rectangular waveforms, let us take the cases of frequency multiplication by factors of 5 and 10. For multiplication by a factor of 5, or indeed by any odd factor, the spectrum of a square wave displays the desirable property of containing only odd harmonics. That is, the

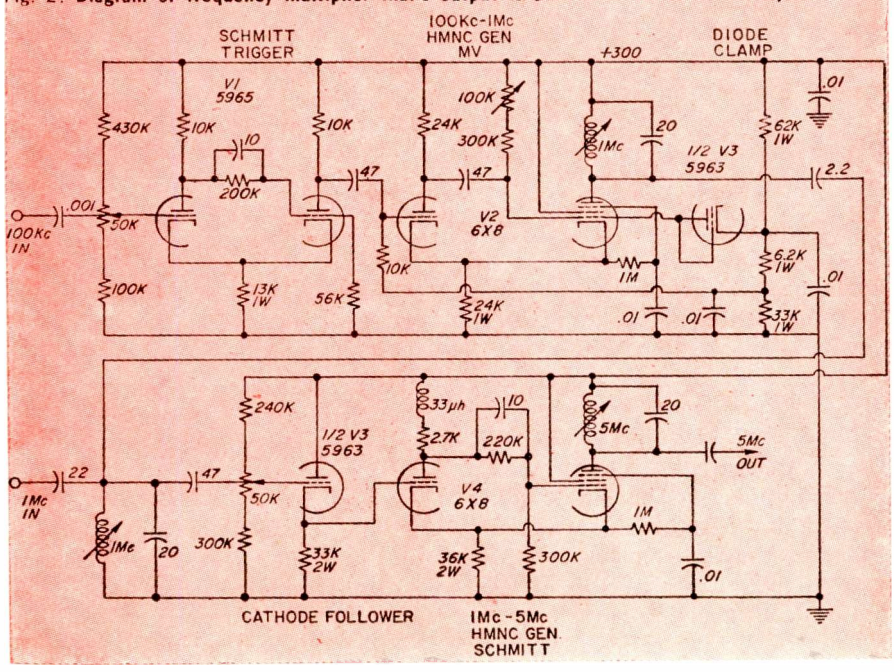
A unique, but relatively simple method of frequency multiplication is described. A multivibrator-type circuit is used to produce a rectangular current pulse. The duty ratio of the pulse is adjusted to maximize the desired harmonic and minimize the adjacent harmonics simultaneously. There are many uses today for frequency multipliers.

Frequency Multiplication

nulls of the spectrum are positioned on the even harmonics. This property simplifies the task of filtering, allowing a relatively clean output. This behavior becomes clearer when the time-domain performance is described. Assume that a square wave of current is passed through the tank circuit of Fig. 1. One transition of the square wave excites the tank circuit which is tuned to the fifth harmonic of the input frequency. The circuit rings for 2½ cycles. At this point, just as the plate voltage is reversing polarity, the next transition of the square wave occurs, exciting the tank circuit in opposite phase and intensifying the natural amplitude of the plate voltage. In the steady state the envelope ripple of the plate voltage displays twice the rate and about half the decrement that would occur if the tank circuit were excited only once a cycle of the fundamental frequency, as by a brief pulse.

Use can again be made of the peaks and nulls of the rectangular-wave spectrum for multiplication by a factor of 10. It can be shown that a rectangular waveform with a duty ratio of 0.45 displays the unique property of maximizing the tenth harmonic and minimizing the ninth and eleventh. By decreasing the pulse duration from 0.5 to 0.45 periods, the spectrum is "stretched" so that a peak occurs close to the tenth harmonic and nulls occur close to the ninth and eleventh harmonics. In the time domain again, this waveform results in two decay regions of the tank voltage, one of 4.5 and one of 5.5-cycle duration. This results in a smaller decrement than would occur if the tank circuit voltage were allowed to decay for the entire 10-cycle interval.

Fig. 2: Diagram of frequency multiplier that's output is 5mc with 0.1 or 1.0mc input.



A Practical Circuit

A circuit utilizing the above principles is shown in Fig. 2. This circuit is used to multiply input frequencies of either 100 KC or 1 MC to 5 MC. If the input frequency is 100 KC, it is first multiplied by a factor of 10 to 1 MC using the 0.45 duty-ratio rectangular pulse discussed above and thence to 5 MC using a square wave.

Frequency Multiplier

(Concluded)

Both halves of V1 are connected as a Schmitt trigger circuit[3] which generates standard trigger pulses independent of the waveform of the 100 KC input voltage. These trigger pulses synchronize the following stage involving V2 and half of V3. The triode half of V2 and the screen grid, control grid, and cathode (a simulated triode) of the pentode half are connected as a cathode-coupled monostable multivibrator[4] which produces a rectangular pulse of current 4.5 μsec. in duration when triggered. The circuit is triggered every 10 μsec. (100 KC), thereby producing the desired 0.45 duty-ratio pulse. The rectangular current pulse is coupled into the plate circuit of the pentode half of V2 which contains a parallel resonant tank circuit tuned to 1 MC. One-half of V3 is connected as a diode to stabilize the action of V2. The 1 MC signal is further filtered in a second tank circuit which also serves as the input point for an input frequency of 1 MC. The well filtered 1 MC signal is applied through the other half of V3 connected as a cathode follower to V4. V4 is connected as a Schmitt circuit which, when driven by the essentially sinusoidal 1 MC signal, produces square current pulses having, theoretically, only odd harmonic components. These current pulses are coupled to the plate circuit of the pentode half of V4 where the fifth harmonic (5 MC) is accentuated by the tank circuit.

Figure 3 shows several of the waveforms produced by the circuit. Waveform A shows the trigger pulses applied to the input grid of V2. A small pulse can be seen on this voltage which is coupled back from the monostable multivibrator when it resumes its stable state. Waveform B shows the typical multivibrator grid voltage at the grid of the pentode half of V2. When the multivibrator action is initiated by a positive trigger pulse, the grid voltage falls rapidly, cutting off the V2 pentode. The grid voltage then rises toward the B+ voltage with a time-constant determined primarily by the coupling capacitor and

A. Trigger pulses at input grid of V2, 100 kc
B. V2 pentode grid voltage, 100 kc
C. V2 pentode plate voltage, 1 Mc
D. Filtered 1-Mc signal
E. Input signal to V4, 1 Mc
F. 5-Mc Output Voltage

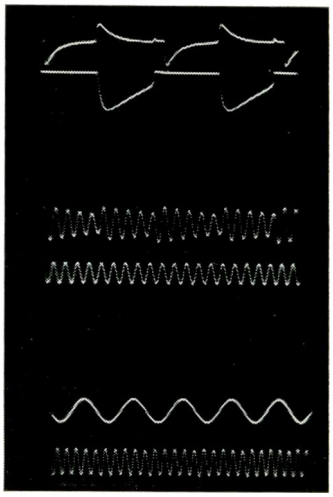


Fig. 3: Multiplier waveforms for circuit shown in Figure 2

the pentode grid-return resistor. When the pentode grid voltage enters the grid base, the multivibrator switches back to its stable state, returning current to the pentode. Waveform C shows the 1MC plate voltage of the V2 pentode. Note the 4.5 and 5.5-cycle portions of the waveform. Waveform D shows the 1 MC signal after the next stage of filtering. The decrement is almost completely absent. Waveform E is an expanded view of this voltage. Waveform F shows the 5 MC output voltage at the plate of the pentode half of V4.

Conclusion

For fundamental frequencies up to about 1 MC, the rectangular wave output of multivibrator-type circuits can often be used to great advantage for frequency multiplication by moderate factors.

References

1. F. E. Terman, "Radio Engineering," McGraw-Hill Book Company, New York, New York, pp. 394-397, 1947.
2. International Telephone and Telegraph Corporation, "Reference Data for Radio Engineers," Stafford Press, Inc., New York, New York, pp. 1002-1024, 1956.
3. J. Millman and H. Taub, "Pulse and Digital Circuits," McGraw-Hill Book Company, New York, New York, p. 164, 1956.
4. Ibid, p. 187.

More on Railroad Electronics

ANOTHER form of closed circuit TV, working in conjunction with an electrostatic printer, may be the next tool to speed-up railroad freight service.

By reducing the manual clerical requirements of freight classification, and increasing the time available, cars may be properly dispatched immediately upon arrival in the freight yard.

The results of a feasibility study conducted by the A. B. Dick Co. at the request of the New York Central System indicate that pictures of a freight train, passing an outlying station at 60 mph, can be made and flashed instantaneously to some central office or freight yard.

If the freight yard has a complete picture of a train several hours before it enters the yards, the car types and numbers could be checked to keep each car heading toward its correct destination. Further, the information could be used to plan the make-up of new trains from arriving cars.

This important railroad activity is now done primarily by men who walk past the cars in outlying stations and note the numbers and types. The information is then telegraphed or telephoned to the next change point. Conventional closed-circuit television is sometimes used for this purpose, but this involves manual recording of car numbers. Further, usual TV framing rates lend to blurring unless the trains move relatively slowly.

Television Printer

The new system employs a version of the Videograph Electrostatic Printer developed at Stanford Research Institute for the

(*Continued on page* 138)

The current in L is in such a direction as to discharge the capacitor, and therefore the energy in the capacitor is transferred to the inductor. The current increases to a peak slightly greater than I. Then energy begins to transfer back to the capacitor and the voltage across the capacitor builds up in the reverse direction. These sinusoidal current and voltage oscillations are pictured during the retrace interval in Fig. 1. They would continue unperturbed except that the switch is closed at the instant when the voltage across the capacitor has returned to E. At this time the magnitude of the yoke current is again I but in the reverse direction. The linear current sweep commences and the cycle repeats itself.

Mathematically, the current in the yoke before and after switching possesses a continuous logarithmic derivative. This follows since both the current and its first derivative must be continuous due to the presence of the capacitor in parallel with the inductance. The retrace period is therefore somewhat longer than one half the period of oscillation, $\pi (LC)^{\frac{1}{2}}$. If the sweep time is much greater than the retrace time, t_r, then the retrace time is very nearly $\pi (LC)^{\frac{1}{2}}$. This is true in television horizontal deflection.

The peak voltage across the switch when it is open during the retrace time is V (Fig. 1). The peak current that the switch must carry is I. From the relations in Fig. 1, i.e.,

$$V = I\sqrt{\frac{L}{C}} \text{ and } t_r = \pi (LC)^{\frac{1}{2}}$$

the volt-ampere rating of the switch may be expressed as

$$V I = (\pi/t_r) LI^2.$$

For deflection of a 110° yoke with 15 kv accelerating potential this becomes

$$V I = 10{,}700/t_r \text{ , } t_r \text{ in } \mu\text{sec.}$$

This is a convenient factor for estimating the capability of a given transistor in this application.

Returning to the switching portion of the cycle, consider what happens if the switch is not opened instantaneously. This means that the current does not become zero at once. The current in the switch decays as the voltage across the switch builds up and consequently there is a loss of energy in the switch. Due to this loss, the oscillation of energy between the inductance and capacitance is damped by a non linear resistance. To investigate the nature of this damping, and other effects of real switching as opposed to ideal switching, an assumption is made regarding the nature of the switching.

It is assumed that the current in the switch decays exponentially. Such an assumption is reasonable because of the nature of the diffusion process on which transistor action relies. In terms of the hybrid-pi equivalent circuit for transistors, the exponential waveshape is a consequence of the resistive and capacitive input elements, Fig. 2. This latter argument is admittedly somewhat inapplicable for at least one reason, i.e., the hybrid-pi is a small signal equivalent circuit and we are concerned here with large signal operation.

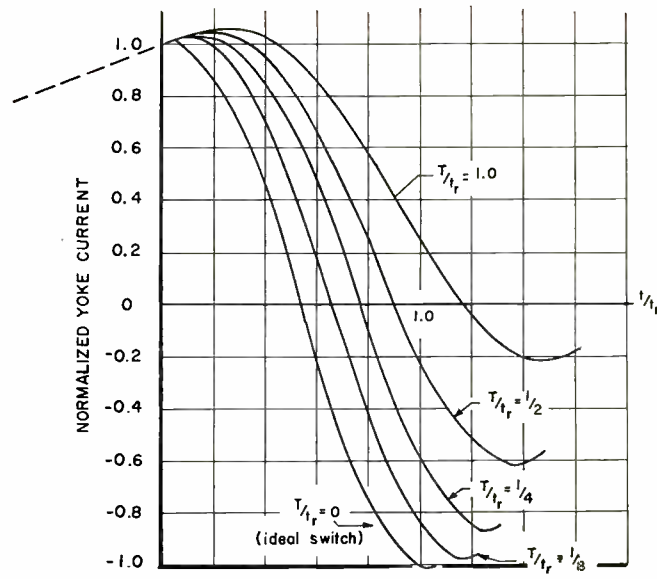


Fig. 3: Retrace yoke current applied to TV horizontal deflection.

However, experimentally, the current decay may be observed to have an exponential appearance. Therefore, for this reason and since only a first order criterion for switching speed is what is presently desired, the exponential assumption appears useful. The current in the switch, furthermore, is assumed to be independent of the voltage across the switch; a reasonable assumption for the collector circuit of a transistor when the collector is reverse biased.

Analysis

The current in the switch from time t = 0, when it is opened will be taken as $i_{sw} = I \exp(-t/T)$,

where, I = value of the yoke current (and switch current) at the time of the opening of the switch, t = 0

T = time constant of the switch, i.e., the time at which the switch current has decayed to 36.8% of its initial value.

With reference to Fig 1, the differential equation for the yoke current is obtained:

$$i_{sw} = i_L + i_C$$

$$i_C = C (dv_L/dt) = LC (d^2i_L/dt^2)$$

$$LC (d^2i_L/dt^2) + i_L = I \exp(-t/T) \quad (1)$$

A particular solution to this Eq. 1 is,

$$\frac{I \exp(-t/T)}{1 + (t_r/\pi T)^2}$$

The complementary solution to Eq. 1 is,

$$A \sin(\omega t + B)$$

in which the constants A and B must be evaluated from the initial conditions of the current and its

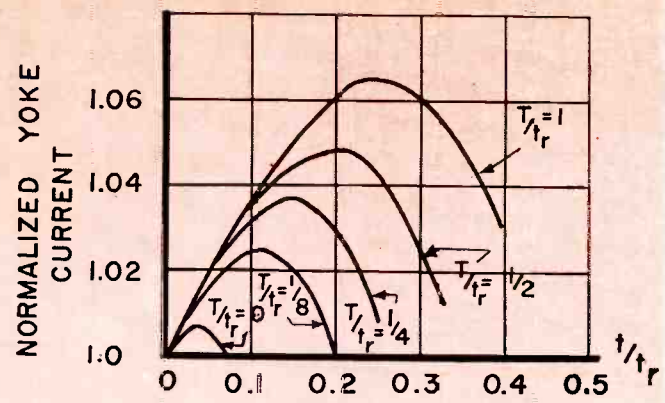


Fig. 4 (above): The initial portions of the retrace yoke current oscillations as shown in Fig. 3 are repeated here to a larger scale.

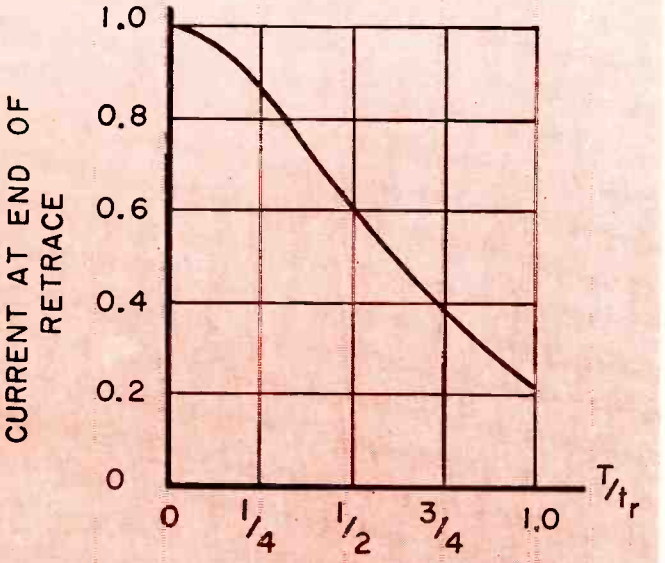
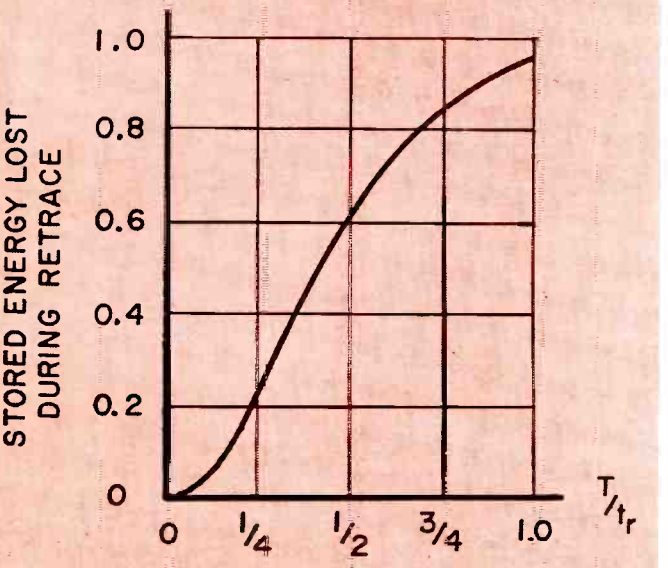


Fig. 5 (above): The value of the yoke current at the end of the actual retrace period is plotted as a function of switching speed.

Fig. 6 (below): To facilitate calculating switch dissipation, the difference in squares of initial & final currents are plotted here. Fig. 9: Increase in retrace time due to decrease in switching speed.



TV Switching *(Continued)*

derivative. The complete solution is the sum of the particular and the complementary solutions. With the constants determined, the exact expression for the yoke current during the retrace time is:

$$\frac{i_L}{I} = \frac{\exp(-t/T)}{1 + (t_r/\pi T)^2} + \frac{\sqrt{1 + \left\{(\pi T/t_r) + (2 t_r/\pi t_s)\left[1 + (\pi T/t_r)^2\right]\right\}^2}}{1 + (\pi T/t_r)^2}$$

$$\sin\left\{(\pi t/t_r) + \cot^{-1}\left[(2 t_r/\pi t_s)\left[1 + (\pi T/t_r)^2\right] + (\pi T/t_r)\right]\right\}$$

In these expressions the quantity

$t_r = \pi (LC)^{1/2}$ is defined as the nominal retrace time. It is very nearly equal to the actual retrace time in practical cases.

Yoke Current During Retrace

To apply this expression to television horizontal deflection let the sweep time, t_s, be 53.5 μsec and the retrace time, t_r, be 10 μsec. The resultant expression is plotted in Fig. 3 for switching time constants, T, of ½, ¼ and ⅛ of the nominal retrace time.

The yoke retrace current for the ideal switch (in which $T = 0$) may be found by matching the logarithmic derivatives of the linear current sweep which precedes the retrace and of the sinusoidal oscillation that constitutes the retrace. The result is: $T/t_r = 0$, $i_L/I = 1.008 \sin[(t/t_r) + 1.45]$. This also appears in Fig. 3.

The initial portions of the oscillations are repeated to a larger scale in Fig. 4. This type of damped oscillation differs from that obtained when a constant resistance is used for damping. In the process described here of "exponentially opening" the switch, the damping is time dependent and eventually disappears. This is evident from the expressions for retrace current, since they consist of a decaying exponential added to a sinusoid. After sufficient time the exponential disappears and only the sinusoid remains. The total energy represented by this sinusoid differs from the initial energy in the reactances by an amount of energy which has been lost in the switch.

In a deflection circuit the oscillation will not attain this steady state unless the switching speed is short in comparison with the nominal retrace time. This is because the retrace period is terminated to start a linear sweep again.

An oscillation damped by a constant resistance, it will be recalled, is a sinusoid with an exponential envelope. The oscillation essentially disappears after a time much greater than the time constant of the exponential.

Referring to Figs. 3 & 4 several effects are observed as the time constant of the switch increases. With slower switching the current in the yoke reaches higher peak values before it reverses. This is because the switch, in taking a longer time to open, main-

Reliable Rugged Recorder

The complete recorder system includes, from left to right, a power converter, electronics box, the remote control unit, the AR-200 tape transport, and a test unit.

RELIABILITY and ruggedness are two of the fundamental characteristics of the smallest instrumentation recorded developed to date for complete flight data acquisition. Displacing only 1.6 cu. ft., it nontheless affords its user 7 to 32 recording tracks of data, depending upon the recording technique selected. Secret of the miniaturization, according to Ampex Corporation, developer of the tiny piece of equipment, is the unusual arrangement of electronics, use of an all-transistor, solid-state electronic system in place of vacuum tubes, and the use of lightweight metals in the construction of the chassis.

The sturdy little unit is 57% smaller and 35% lighter than previously existing recorders of the same reliability. Remarkably compact, the system consists of two units: tape transport and the recorder electronics. Designed primarily for airborne data acquisition, it is equally applicable to undersea research, surface vehicle analysis, and many other areas where shock and environmental requirements preclude the use of other recorders.

Improved magnetic heads, a one-piece aluminum chassis, and a rigid cast cover which opens from both sides to allow operation from any position, are just a few of the assets.

Features

The new unit, known within the industry as the Ampex Series AR-200 recorder, answers the need for a small, versatile recording unit with no sacrifice of the reliability characteristic of the larger recording systems.

Paralleling the size reduction, the AR-200 weighs much less than previous instrumentation recorders with similar capabilities. The complete system with shockmount, reels, and tape weighs only 90½ pounds.

Extremely rugged and unsusceptible to environmental damage, the entire recorder can withstand shocks up to 15 times the force of gravity. It will operate at altitudes of 100,000 feet, and function in up to 95% humidity. Also, it can be subjected to excessive temperature changes, operating over a range of from —65°F up to 160°F.

Recording Techniques

Four basic recording modes are available with the system. For highest frequency response (up to 100,000 cycles at 60 ips) there is direct recording. For greatest amplitude accuracy, frequency modulated carrier recording accurately preserves signal amplitudes over a frequency range of from dc to 10,000 cps. For recording the maximum number of data samples, the AR-200 can record digital information at input rates up to 576,000 bits per second. And, as an alternative for high data-sampling rates, pulse-duration modulation (PDM) is particularly useful for tests where large numbers of temperatures, pressures, positions, flow rates, and other quasi-static variables are to be recorded. Wherever the recorder is employed, it offers its user these four recording modes by a simple change of amplifier.

Electronics for direct record, frequency modulation record, pulse duration modulation, digital write, a control track generator, and regulator reference circuit are all part of the circuitry included in the

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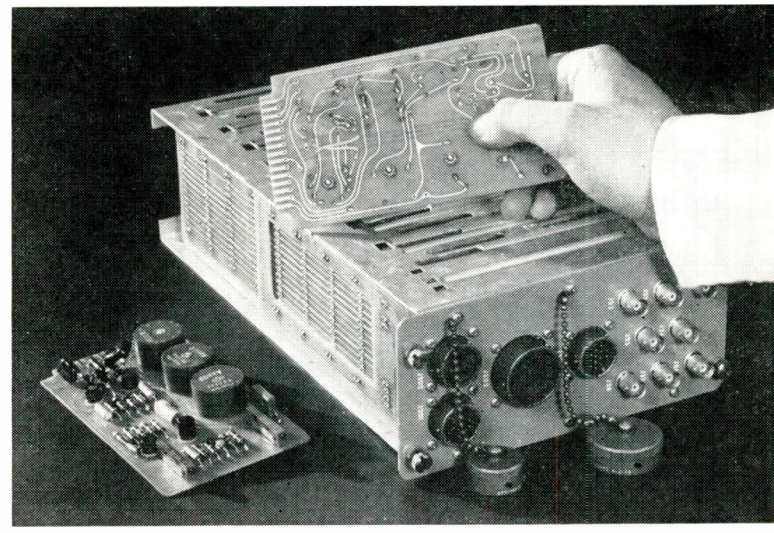


Solid - state devices and etched - board circuitry makes the electronic section of the new mobile recorder a compact unit

What's New . . .

Parametric Amplifier Diode

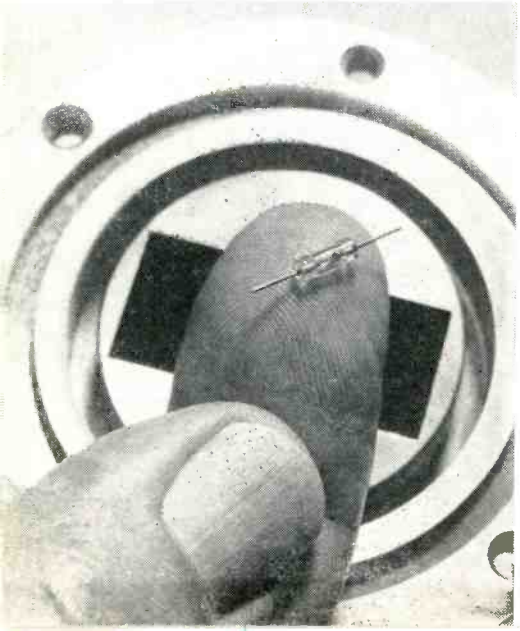
Laboratory comparator magnifies the inner structure of this gold-bonded diode.

NOISE temperatures as low as 100° above absolute zero operating at room temperature have been obtained by Hughes Aircraft Company in a high gain 3000 MC parametric amplifier using diodes of a newly developed type.

Initial production of several hundred of these diodes per week is in effect and they are immediately available to industry, according to the Hughes Semiconductor Division. The diode is the heart of a parametric amplifier but also has other important microwave applications such as switching and harmonic generation. It is available in two rugged and hermetically-sealed versions—one for the region below 1000 MC and a second for the microwave region. Because of newly developed modular line production techniques, these diodes are available at a price in the same range as good microwave mixer crystals.

The parametic amplifier does not require low temperatures for operation. The parametric amplifier does, however, have two channels of amplification, usually called the signal and idler channels, which were used simultaneously to obtain the low noise temperatures quoted above. As a further comparison, the best reported low noise microwave tubes have noise temperatures of about 300° K at 3000 MC, but have the advantage of single channel amplification and electrical tunability.

This rice grain size, gold-bonded diode is the key component of a parametric amplifier which may solve many of the jet-age air traffic control problems of the near future.



With the noise temperature 100° K obtained at room temperature, the 3000 MC amplifier gives 30 db of amplification with 2 MC bandwidth or 10 db of amplification with 25 MC bandwidth. Such amplifiers would, of course, be useful in many applications of microwave and UHF receivers where greater sensitivity or lower receiver noise is required.

The production models of the Hughes diode, designated HPA-2800 and HPA-2810 have a nominal cutoff frequency of 70,000 MC at maximum back bias with a nominal zero-bias capacitance of 2.5$\mu\mu$f, it was disclosed. Its exceptional noise performance is attributed to its low equivalent series resistance at microwave frequencies.

A comparison of the parametric amplifier with conventional microwave receivers reveals a number of distinct advantages for the paramp. By far the most important is the improvement in noise figure by 3 to 8 db over the best superheterodyne receivers. In radar applications this can increase radar range by 100%.

A second major paramp advantage lies in improved overload characteristics. The paramp will amplify smaller signals than the conventional receiver, and at the same time withstand higher incident power levels without burnout or degradation of performance. This could alleviate in part the duplexing problem which exists in present radar systems.

A similar comparison of the diode amplifier with other paramp types, and with masers, reveals the following reasons for current emphasis being placed in the diode paramp development.

1. No large external auxiliary equipment such as field magnets and focusing coils are required as is the case with ferrite amplifiers, electron beam amplifiers, and masers.

2. Pump power requirements are less than for ferrite amplifiers.

3. Low noise amplification is obtained without need for cooling to liquid helium temperature. (This is true of the parametric amplifier in general.) The paramp noise fig-

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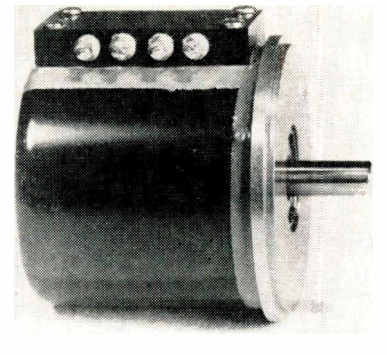
Humidity Resistant Potentiometer

Abstracted from a paper Gilbert Bassin, Potentiometer Div., Litton Industries, 215 S. Fulton Ave., Mt. Vernon, N. Y.



All joints and screw holes are sealed with a rubber potting compound on this humidity resistant Potentiometer. Teflon shield creates moisture barrier for shaft.

To meet the demand for a precision potentiometer capable of operation in a humid atmosphere, the MDH20 humidity resistant potentiometer was developed by Hitton Industries, 215 S. Fulton Ave., Mt. Vernon, N.Y.

The unit is basically a high accuracy (as high as 0.01% lin.) ten-turn, size 20, precision potentiometer in a specially developed humidity resistant package.

To exclude moisture from the internal mechanical and electrical portions of the potentiometer a drawn aluminum case is used and all joints and screw holes are sealed using a rubber potting compound.

Most mechanical methods of hermetically sealing shafts were abondoned because of the resulting increase in torque, prohibitive back lash and mechanical breakdown from rotation.

Instead a protective Teflon shaft shield was developed which creates a moisture excluding barrier. Only a slight increase in the running torque of the unit is experienced. This shield is placed in front of the ball bearing and acts as an effective barrier against salt spray, sand, and dust as well as humidity. Humidity tests conducted after temperature cycling and rotational life tests demonstrate this seal to be effective even after severe changes in temperature and extended use.

Performance

These potentiometers have been subjected to 15 days of humidity-temperature cycling in accordance with the procedure set forth in MIL - E - 5272A. Measurements of torque, insulation resistance between terminals and shaft, and total resistance were taken at 24 hour intervals during the test, with units in the humidity test chamber. The torque remained constant during the test.

The insulation resistance rose considerably on all units tested following a 2 hour air drying period and rose above 2,000 megohms after a 24 hour drying period at 40°C.

At no time during the test did the insulation resistance fall to a point which would have serious effect on the ordinary operation of the unit.

Noise and linearity were checked prior to and immediately following the test and no change was observed.

Electrolysis

MDH 20 units have been sub-

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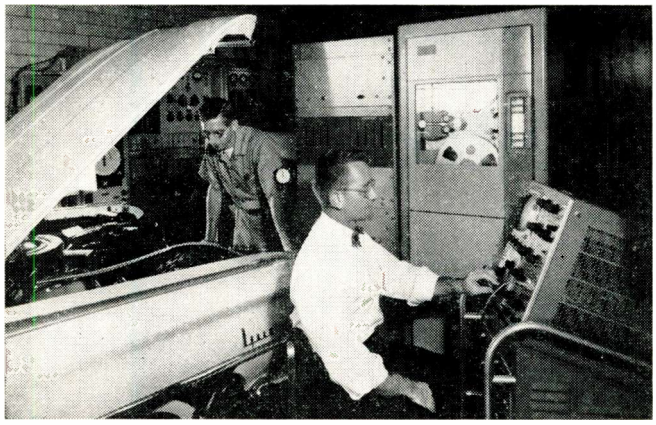
Surface Ignition Analyzer



Knock, pre-ignition, rumble, and thud are ferreted out by this equipment, developed by Du Pont Co. and installed in their Petroleum Laboratory.

ENGINEERS from Du Pont's Petroleum Laboratory have developed a simple to use instrument for measuring the presence and extent of surface ignition which sometimes produces a rumbling noise and loss of power in modern automobile engines.

The instrument makes possible surface ignition studies on any automobile simply by installing special pressure-sensing spark plugs in the car's engine. Further, it will help provide clues to both better fuels and improved high compression power plants. Instrumentation, formerly available, limited surface ignition studies to laboratory test engines, with which it often was impossible to simulate actual service conditions.

Surface ignition is ignition of the fuel-air mixture by glowing carbonaceous deposits in the engine cylinder. The phenomenon, most pronounced in high compression engines, results in an undesirable build-up of pressure in the cylinder. The result frequently is a loss of power and a rumbling noise caused by abnormal combustion pressures and the accompanying engine vibrations.

Significance of the instrument development is two-fold. First, it enables accurate analysis of the cause and frequency of surface ignition; and, second, it provides data which will be helpful in development of better fuels and more efficient high compression engines.

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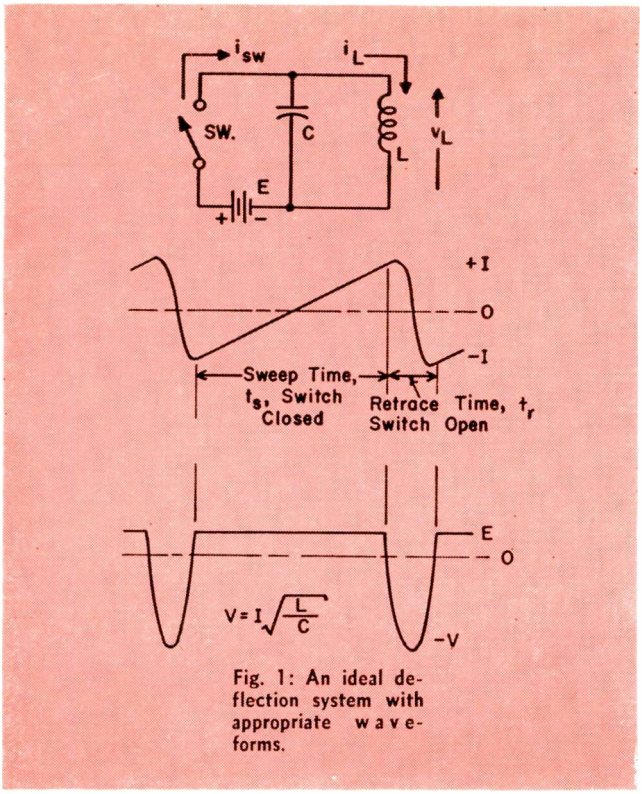


Fig. 1: An ideal deflection system with appropriate waveforms.

Though the pros and cons are treated, this article primarily pertains to the transistor's slow switching speed. An analysis is made to determine the effect on operation; a minimum of value of switching speed may be resolved from the results.

Transistors in TV . . .

Horizontal Deflection Switching

By M. J. HELLSTROM
Supervising Engineer, Radio-TV Div.
Westinghouse Electric Corp.
Metuchen, N. J.

THE transistor, in some respects, is well suited to providing a linear current sweep for horizontal deflection. Its ability to act as a bilateral switch, i.e., conduct in both directions, and its relatively high efficiency as such, are two advantageous properties.

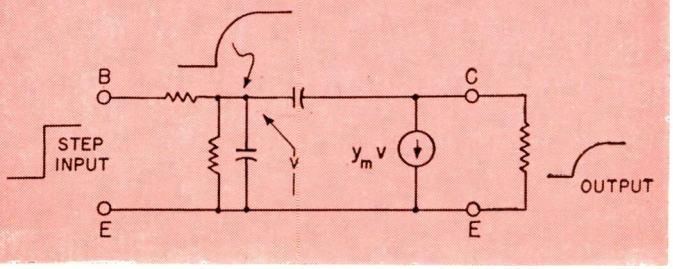
On the other hand, the product of the maximum collector current and maximum collector voltage ratings of currently available transistors is not quite adequate for horizontal deflection in standard TV receivers. Also, the frequency response or, more appropriately, the switching speed of transistors with high collector volt-ampere ratings is low. This article pertains primarily to the latter problem, slow switching speed. An analysis is made in order to estimate the effects of switching speed on operation. A minimum value of switching speed may be resolved from the results.

Ideal Deflection System

A familiar model of an ideal deflection system is illustrated in Fig. 1. The switch is lossless, i.e., it has zero resistance when closed and infinite resistance when it is open. The switch opens and closes instantaneously at the proper time within the cycle. Operation may be explained briefly with aid of the waveforms pictured in Fig. 1.

During the sweep interval, t_s, the battery is connected across the yoke, L. Therefore the yoke voltage, v_L, is equal to the battery voltage. Since there is a constant potential, E, across the yoke, the current in the yoke will increase linearly with time as shown in the current waveform in Fig. 1. At the instant the yoke current reaches the value required for full half-angle deflection the switch is opened. The circuit then consists of an inductance in which there is a current, I, and a capacitance across which exists a potential E. Thus there is a small amount of energy in the capacitor and a relatively large amount in the inductance.

Fig. 2: Resistive & capacitive input elements cause exponential wave.



tains the battery voltage, Fig. 1, across the inductance for a longer time. As a result, the current tends to increase at the same rate as before the switch started to open.

Loss of Sweep

In a deflection circuit the retrace oscillation would be terminated when the slope of the yoke current again reaches the value that it had during the linear sweep. In Fig. 8, at the end of the actual retrace time, the magnitude of the current in the yoke is smaller than the initial value. This represents a loss of energy and a loss in peak to peak sweep current. The slower the switch the greater these losses.

In Fig. 5 the value of the yoke current at the end of the actual retrace period is plotted as a function of switching speed. Since for ideal, lossless switching, peak to peak sweep is twice the initial value of the retrace current, a final value of 22.2% for example, means a loss in peak to peak sweep of ½ (100 — 22.2)% = 38.9%. This happen at $T/t_r = 1$.

Switch Dissipation

The retrace period begins and ends with the same value of yoke current slope. Therefore the voltage across the capacitance, and hence the energy therein, is the same at the beginning and end of the retrace interval. The net decrease in the yoke current then accounts for the total loss of energy in the L-C circuit during the retrace. That is, $\Delta W = \frac{1}{2}L\ (I^2 - I'^2)$, where ΔW is the energy loss, I′ is the yoke current at the end of the period and, as before, I is the initial value. Since there are no other dissipative elements in the circuit all of this energy must be lost in the switch. In transistor deflection circuits this dissipation is important due to the limited power ratings of devices presently available.

As a first step to facilitate the calculation of this switch dissipation, the difference in the squares of the initial and final currents has been plotted in Fig. 6. When the switching time constant is ½ t_r, the loss in current squared, or energy, is about 64%. This represents energy dissipated in the switch equal to 64% of ½ LI^2. Note, however, that this does not constitute all of the energy dissipated in the switch. Although we have accounted for the energy lost in reactive circuit during the retrace period, we have not accounted for the power supplied by the battery during this same interval. This energy, which must also be dissipated in the switch, may be easily calculated since the battery current is equal to the switch current. Thus,

$$\Delta W' = \int_0^{t'_r} EI \exp(-t/T)\, dt$$

$$= (\tfrac{1}{2} LI^2)\left(4 - \frac{T}{t_s}\right)\left[1 - \exp(-t'_r/T)\right]$$

where $\Delta W'$ is the energy supplied by the battery.

In these expressions t'_r is the actual retrace time which is somewhat longer than the nominal retrace time, t_r. This energy, supplied by the battery and dissipated in the switch, has been plotted as a function of switching speed in Fig. 7. The energy is normalized with respect to ½LI^2.

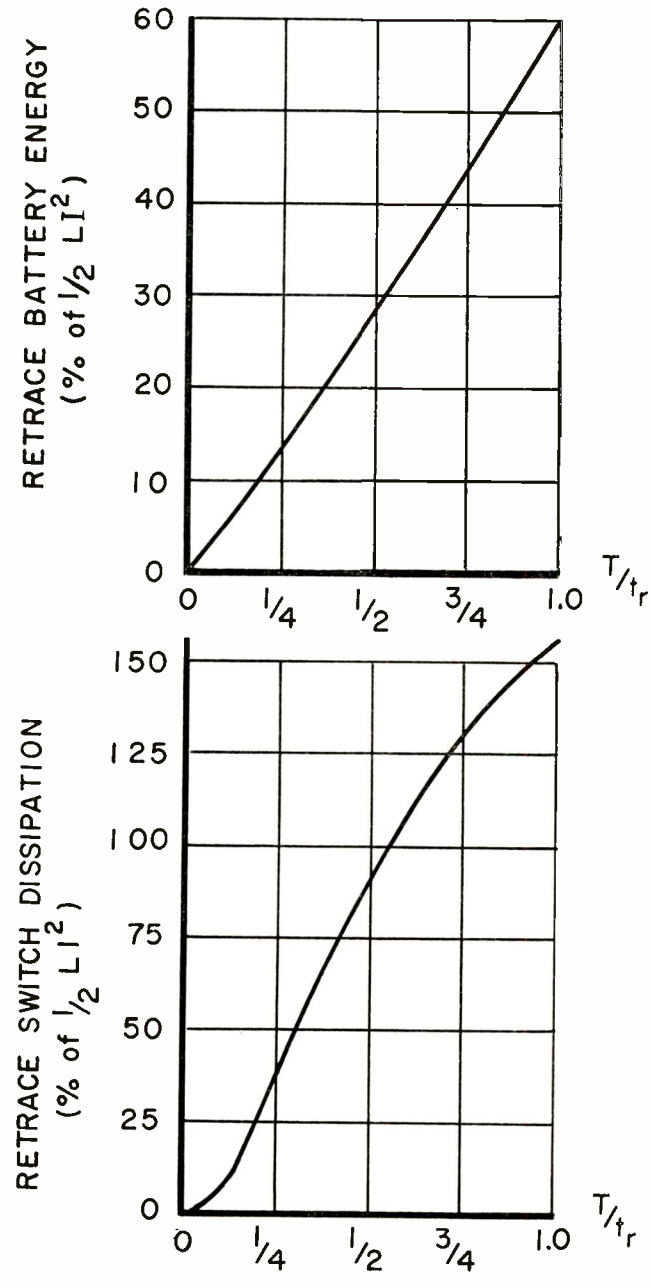
To obtain the total energy dissipated in the switch during the retrace interval the ordinates of the curves in Figs. 6 and 7 are added together to obtain the curve of Fig. 8. Thus, Fig. 8 displays the normalized total energy dissipated in the switch during the retrace interval as a function of switching speed. From these curves it is evident that there is considerable energy lost in the switch when it does not open quickly.

Retrace Time

As mentioned before, the retrace period ends when the slope of the yoke current returns to its initial value. From Fig. 3, the values of the retrace times may be determined. For perfect switching the actual retrace time, t'_r is about 7.7% longer than the nomi-

Fig. 7 (top): Energy supplied by battery and dissipated in the switch during retrace is plotted as a function of the switching speed.

Fig. 8 (bottom): Ordinates of Figs. 7 & 8 are added to obtain the total energy dissipated in the switch during the retrace interval.



TV Switching *(Concluded)*

nal retrace time. This value, $t'_r = 1.077\ t_r$ is taken as the normalization basis in plotting Fig. 9 which shows the increase in retrace time due to a decrease in switching speed.

Use of Curves

In a horizontal deflection system in which $\frac{1}{2}LI^2 = .0017$ watt-seconds it is desired to have a retrace time, t_r, of 10 μsec. The transistor available has a switching speed of 2.5 μsec. The following observations may be made. Since $T/t_r = \frac{1}{4}$ the retrace yoke current waveform is pictured in Fig. 3. From Fig. 5 it is seen that there is a loss in peak to peak sweep of ½ (1 —0.87) or about 6.5% from the ideal case. Fig. 6 shows that about 24% of 0.0017 or 0.000408 watt-seconds of energy is lost in the switch from the reactive elements.

The battery, in addition, supplies 13.8% of 0.0017, or 0.000234, watt-seconds of energy to the switch, Fig. 7. The total is 0.000642 watt-seconds, Fig. 8. From Fig. 9, the retrace time is about 18.9% longer than for the ideal switch. Since the ideal switch has a retrace time of $1.077\ t_r$ the retrace time for this is (1.077) (1.19) (10) = 12.8 μsec. A switching speed of 2.5 μsec is not too prohibitive therefore. In practice, speeds better than this have been obtained with high power transistors. The average power dissipated in the switch during the retrace interval is (0.000642)/(0.0000128) = 50 watts. Averaged over the entire period this represents 10 watts.

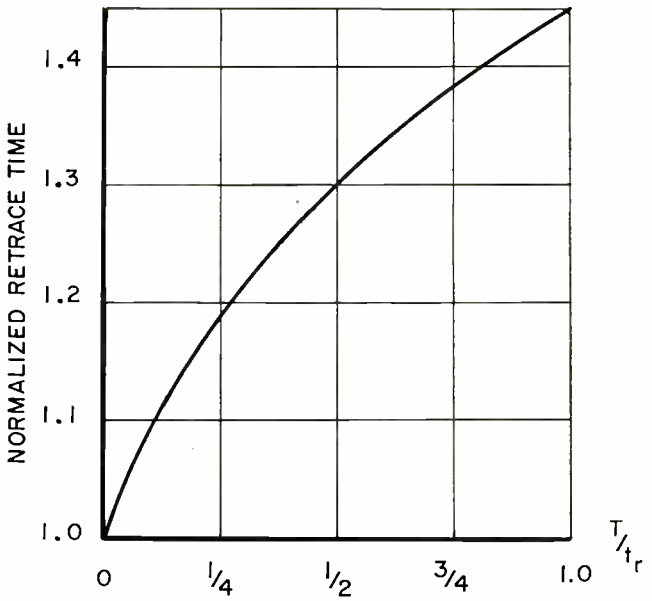


Fig. 9: Increase in retrace time due to decrease in switching speed.

Silicon Cells

(Continued from page 95)

Fig. 10: Typical spectral emissitivity of uncoated cells

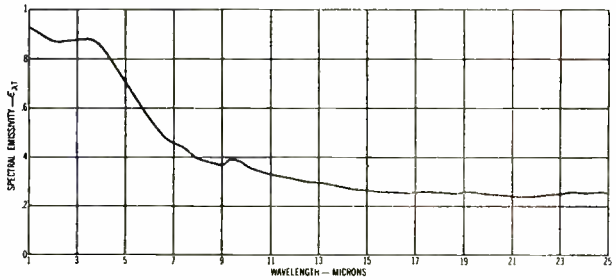
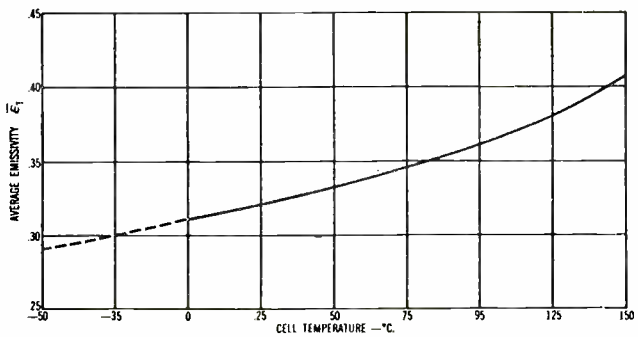


Fig. 11: Average emissivity of uncoated cells vs. cell temp.



the sensitive cell surface against micro-meteorite erosion in space. The effects of this erosion on cell efficiency may be estimated[6] and compensated by conservative design.

Conclusion

It has been shown that the power output of a solar collector in space can be predicted from the cell characteristics obtained from tests performed under laboratory conditions. With this data and information about the collector configuration and orientation with respect to the sun, the temperature of the cells can be determined. This temperature can be controlled within certain limits by various means.

Silicon solar cells have high conversion efficiency and a high power-to-weight ratio.

All these factors are of prime importance when designing a proper power supply unit for space vehicles.

References

1. D. M. Chapin, C. S. Fuller, and G. L. Pearson, *Journal of Applied Physics,* Vol. 25, p. 676, 1954.

2. D. M. Chapin, C. S. Fuller, and G. L. Pearson, *Bell Laboratories Record,* Vol. 33, p. 241, 1955.

3. M. B. Prince, "Silicon Solar Energy Converters;" *Journal of Applied Physics,* Vol. 26, No. 5, May, 1955, pp. 534-540.

4. F. S. Johnson; "The Solar Constant," *J. of Meteorology,* Vol. II, 1954, p. 431.

5. P. Moon, "Proposed Standard Solar Radiation Curves for Engineering Use," *J. Franklin Inst.,* Vol. 230, Nov., 1940, p. 583.

6. F. L. Whipple, "The Meteorite Risk to Space Vehicles," *Vistas in Astronautics,* Pergammon Press, p. 15.

PLUG AND SOCKET BODIES SHOWING CONTACT ARRANGEMENT AND STANDARD LOCK WHEN A CAP IS NOT REQUIRED

PATENT PENDING

INSURE POSITIVE CONTACT

CINCH HINGE CONNECTORS

MAXIMUM NUMBER OF CONTACTS IN MINIMUM SPACE

50 CONTACT ASSEMBLY WITH CABLE CLAMP SHOWING ALTERNATE LOCK WHICH FITS INTO SLOT IN TOP OF CAP. CANNOT BE ACCIDENTALLY UNLOCKED.

Positive wiping contact, clean at all times. By releasing the lock, the units instantly separate by the spring action of the contacts. Units are held together by a simple, yet positive lock. Standard units are supplied with General Purpose insulation and cadmium plated contacts. However for more severe conditions of temperature and humidity glass filled Diallyl-phthalate insulation (Type GDI—30 per Mil. M-19833) can be supplied with contacts having gold plate over silver. Contact tails will take either conventional solder wiring or AMP "78" series Taper Tab receptacles. The Cinch "H" series is made in 20 to 100 contacts in multiples of 10 contacts.

(Left) Lifting up top section releases lock prior to unlocking Pulling out on spring unlocks assembly

Write today for complete information

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; La Puente, California; St. Louis, Missouri

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BOOTH NOS. 3310-3312
WESCON SHOW

CINCH MANUFACTURING COMPANY
1026 South Homan Ave., Chicago 24, Illinois
Division of United-Carr Fastener Corporation, Boston, Mass.

Circle 53 on Inquiry Card

New Tech Data for Engineers

Data & Conversion Charts

Conrad, Inc., Conrad Sq., Holland, Mich. offers a series of conversion charts and technical data covering altitude pressure and temperature from —5000 ft. to 1,800,000 ft. altitude in accordance with ARDC model atmosphere. Also included is C to F conversion factors from absolute 0 to 1000° and conversion factors for materials, heat, velocity, and vacuum. Two other charts list dry bulb and temp. differential for relative humidity.

Circle 166 on Inquiry Card

Switch Guide

Bound reference catalog, ES-59, 52-pages, on electrical switches and actuators contains a comprehensive discussion of switch terminology, basic design types, operating methods, and environment application data. This reference volume contains photos, dimension drawings, specifications and modification information. Electrosnap Corp., Switch Div., 4218 W. Lake St., Chicago 24, Ill.

Circle 167 on Inquiry Card

Rectifiers

A 6-page, brochure from North American Electronics, Inc., Lynn, Mass., has information on the company's stud type rectifiers, axial lead type rectifiers, silicon junction rectifiers, high voltage cartridge rectifiers, silicon power regulators, axial lead regulators, and silicon rectifier stacks. Information is presented in tabular form.

Circle 168 on Inquiry Card

Solvent & Equipment

An 8-page bulletin from Cobehn, Inc., Caldwell, New Jersey, describes equipment for spray-cleaning instrument bearings, jewel bearings, contact points, and electronic components and assemblies. Included are descriptions of a remote controlled sprayer, automatic cleaning machines, portable cleaners, and a bench unit.

Circle 169 on Inquiry Card

Transistor Tester

Specification for the Model TT-300 transistor testor, manufactured by Avionics Corp. of America, Horsham, Pa. are available from the company. The tester is a sensitive dc β measuring device. It can be used for high accuracy lab. measurements or as a go-no-go inspection or production tester.

Circle 170 on Inquiry Card

Portable Switches

Literature from Joy Mfg. Co., Electrical Products Div., Dept. S-182, 1201 Macklind Ave., St. Louis, Mo. features the pendant push-button station, a weathertight, corrosion-proof design completely insulated and encased in Hycar, an improved synthetic rubber compound, and listed as available in 4-, 6-, and 8-button styles. Also included are illustrated descriptions of the Joy attachable pendant toggle switches, molded-to-cable precision switches, standard push-button switches, side-mounted toggle switches and end-location toggle switches.

Circle 171 on Inquiry Card

Vulcanized Fibre

Six standard grades and 5 special grades of vulcanized fibre are described in a 4-page folder (data Sheet No. 2-0) from Taylor Fibre Co., Norristown, Pa. A large chart lists suggested uses, corresponding NEMA grade, applicable specifications, sheet colors and sizes and engineering data for the 6 standard grades. A fold-in describes the special grades and illustrates various applications for vulcanized fibre. A table lists the weights of 56 x 90 in. sheets in thicknesses from 0.004 to 1 in.

Circle 172 on Inquiry Card

Snap-action Switches

Unimax catalog No. 359, 28-pages, has detailed information on the expanded line of Unimax snap-acting precision switches. A pictorial index shows where to find dimension drawings, descriptions, force and movement spec tables, and electrical ratings for each Unimax switch listed. Data on bases, terminals, circuit arrangements and NEMA standard definitions on sensitive switch terms are also included. Unimax Switch Div., The W. L. Maxson Corp., Ives Road, Wallingford, Conn.

Circle 173 on Inquiry Card

Test Instruments

An 8-page brochure from Technical Information Corp., 41 Union Square, New York 3, N. Y., describes a new concept of industrial procurement designed to save engineering man-hours in tracking down the right instrument, locating qualified manufacturers, and in comparing and evaluating competitive specs and prices. Excerpts illustrate the information obtainable in the TIS Directory on standard electronic test instruments and manufacturers.

Circle 174 on Inquiry Card

Bandpass Filters

An 8-page illustrated 2-color brochure, describing a line of miniature ceramic i-f bandpass filters is available from Clevite Electronics Components Div., Clevite Corp., 3311 Perkins Ave., Cleveland 14, Ohio. The brochure lists a wide range of bandpass characteristics and includes attenuation curves for narrow and wideband applications in military and commercial equipment. It discusses insertion loss, shape factor and impedance transformation. Typical applications are also included. Characteristics of the piezoelectric material, PZT (lead-zirconate-titanate), are listed. Radial mode of operation which suppresses spurious responses is also illustrated.

Circle 175 on Inquiry Card

Transistor Circuits

"An application note on transistor circuits I," is a set of circuit diagrams. Included are: A transformerless intercom, Class B bias circuit, light flasher, megaphones, photoflash circuits, TV deflection circuits, Hi-fi stereo amplifier, 2 w portable amplifier, modulators, power packs, and other circuits. Bendix Aviation Corp., Red Bank Div., 201 Westwood Ave., Long Branch, N. J.

Circle 176 on Inquiry Card

Recorders

Recorders and Recording Controllers, GEA-6887, 12-pages, describes G. E.'s continuous self-standardizing strip-chart recorders and recording controllers for measurement of electrical and process variables. Included are product photographs, application data, typical control system schematics, specifications, and dimensions. General Electric Co., Schenectady 5, N. Y.

Circle 177 on Inquiry Card

Motor Frame Design

A brochure on their line of basic induction motor frame designs is available from Air-Marine Motors, Inc., 369 Bayview Ave., Amityville, N. Y. In addition to specifying cooled and non-cooled designs, the 4-page brochure offers scaled drawings and mechanical specs on each design.

Circle 178 on Inquiry Card

Capacitors

A 6-page, 2-color catalog on subminiature electrolytic capacitors from Illinois Condenser Co., 1616 N. Throop St., Chicago 22, Ill., includes pictures, diagrams, technical information shorts, and general information.

Circle 179 on Inquiry Card

New Tech Data for Engineers

C-R Tube Chart

The physical and electrical characteristics of over 60 single and multi-gun cathode ray tubes for industrial and military applications are given in handy chart form by the Electronic Tube Corp., 1200 E. Mermaid Lane, Philadelphia 18, Pa. ETC tubes listed in the chart range from 2 to 12 in. and include square and rectangular face types for modern oscillography and many special purpose tubes.

Circle 180 on Inquiry Card

Pulse Generator

Bulletin, Form 3022-0, describes the Tullamore Model PRG-256, a 256-step precision pulse generator, for calibration of multi-channel pulse height analyzers. Covered are: suggested uses, principle of operation, features of the instrument, and performance data. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 181 on Inquiry Card

Insulating Oil Tester

The new Model 4505-A Hypot insulating oil tester is described in a bulletin from Associated Research Inc., 3777 W. Belmont Ave., Chicago 18, Ill. Some features of Model 4505-A are: reduced size, to only 8½ x 16 x 8 in.); test voltage continuously adjustable from 0 to 35 kv ac at a 2 kva rating to meet ASTM and Federal specs. and measurement of test potential directly at the test electrodes for accuracy.

Circle 182 on Inquiry Card

Magnetic Laminations

Precision-made, high permeability, transformer laminations, magnetic head laminations, servo motor rotors and stators and special shape laminations are illustrated and described in a 2-color, 4-page folder, Bulletin TB104, from G-L Electronics, 2921 Admiral Wilson Blvd., Camden 5, N. J. Charts showing characteristics are also included.

Circle 183 on Inquiry Card

Selenium Rectifiers

The 27-page booklet, ECE-402, contains basic information on junction rectifiers, capacitive loading, purposes of capacitance in the load, how to boost the output voltage, and the effect of capacitance on voltage regulation. In addition, other sections in the application notes discuss recommended incoming test specifications for selenium rectifiers, frequency characteristics of the devices, protective finishes, and forced air cooling. General Electric Co., Semiconductor Products Dept., Liverpool, N. Y.

Circle 184 on Inquiry Card

Microwave Ferrites

Bulletin No. 259 from General Ceramics Corp., Keasbey, N. J. is illustrated with graphs showing magnetic and dielectric properties vs. frequency, magnetic induction vs. temperature, and hysteresis loops. Information on typical applications is also provided.

Circle 185 on Inquiry Card

D-C Power Supplies

Information (Publication ref GEA-6926) on a new line of tube-type and semiconductor high voltage dc power supplies for electronic applications may be obtained from General Electric's High Voltage Specialty Transformer Section, Holyoke, Mass. Particularly suitable where self-protected, highly-integrated systems are required, the full line of complete power supply packages is designed for such applications as hard tube radar modulators, tube and high frequency structural testing installations, wind tunnel charging supplies, and linear accelerators for atomic research.

Circle 186 on Inquiry Card

Metal Film Resistors

New release, Bulletin 155, provides data on company's line of Series 77 Metal Film Precision Resistors. New sizes provide smaller units for miniaturization and larger sizes which expand the resistance range. Included is information on the equivalent styles under MIL-R-10509C and MIL-R-19074B. Ohmite Mfg. Co., 3629 Howard St., Skokie, Ill.

Circle 187 on Inquiry Card

Impedance Measurement

Measurement of impedance and its associated parameters in waveguide systems through use of a sliding termination with specific reflection characteristics is discussed in "PRD Reports," Vol. 6, No. 2, entitled "Waveguide Sliding Shorts, Sliding Terminations, and Standard Mismatches." Use of sliding shorts for precision measurement of impedance (scattering matrix), insertion loss, attenuation and propagation constants, dielectric constant, slotted section curves, wavelength, and frequency is discussed. Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N. Y.

Circle 188 on Inquiry Card

Oscilloscope

Data sheet from The Scopes Company, Inc., 511 Victor St., Saddle Brook, N. J. describes the Model S31 wide band oscilloscope. The two-color data sheet has complete specifications for the unit.

Circle 189 on Inquiry Card

Crucibles

Brochure KTM-9 presents detailed information on crucibles and KU-112 "Hi-Dens" alloy and parts. Crucibles are designed for high temp. research where a high melting point metallic container is required, in high vacuum —inert or reducing atmospheres. A chart of available sizes gives all the necessary dimensions. Typical crucibles are shown. In the KU-112 section, the properties and uses of this high density metal are described. Illustrations of typical parts are shown. Kulite Tungsten Co., 1040 Hoyt Ave., Ridgefield, N. J.

Circle 190 on Inquiry Card

Automation Age

Amusing cartoon booklet illustrates the effect of electronics on life today. Reprinted from leading periodicals, the booklet is entitled, "A Study of the Unique Influence of Space-Automation Technology on the Present-Day Environment with Special Attention to its Implications for the Behavioral Sciences." Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

Circle 191 on Inquiry Card

Moon Map

Moon probes, an astronautical reality that is just around the corner, will create an increasing need for familiarity with lunar geography. Printed in large size, a moon map from General Electric Co., Missile and Space Vehicle Dept., Room 4C, 3198 Chestnut St., Philadelphia 4, Pa., makes all charted geography of the visible side of the moon easily identified and located.

Circle 192 on Inquiry Card

Voltage Regulator

Data sheet from Avionics Corp. of America, Horsham, Penna., describes the Model VR-203, voltage regulator. The transistorized regulator will hold the output to any 20-50 v power supply to ± 1.0% regulation for load variations of from 0-2 a and reduce its ripple by a factor of 80.

Circle 193 on Inquiry Card

R-F Load, Wattmeter

Mobile, RF loads and wattmeters for use with aural or visual transmitters operating on any assigned frequency from 54 to 215 MC, including FM, are described and pictured in a bulletin by the Standard Electronics Div. of Radio Engineering Laboratories, Inc., 29-01 Borden Ave., Long Island City 1, N. Y.

Circle 194 on Inquiry Card

Latest Western Literature for Engineers

Power Inverter

Two-color data sheet gives detailed technical data on the Model 591J transistorized regulated power inverter. Unit is used to drive ac gyros and other ac devices from a battery source. The text describes a circuit in the Model 591J which eliminates the tendency of ac gyro spin motors to hunt when near synchronous speed. Also described is a short circuit and input over-voltage protection feature. Arnold Magnetics Corp., 4613 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 195 on Inquiry Card

Sonar

A Sonar brochure on current research, development and engineering projects in the field of underwater acoustics and communications is available from Electronics Div., Stromberg-Carlson, 1400 N. Goodman St., Rochester 3, N. Y. The brochure also describes the company's new test tank, which is 48 ft. in dia., 30 ft. deep, and has a capacity of 400,000 gal. Its completely open top permits unrestricted positioning, within the confines of the tank, of transducers and targets up to 5,000 lbs. in weight.

Circle 196 on Inquiry Card

FCC Rules

An interpretation of the FCC rules and regulations affecting mobile communications effective September 11, 1958 is available from Kaar Engineering Corp., 2995 Middlefield Rd., Palo Alto, Calif. All Frequencies available in business radio, manufacturer's radio, telephone maintenance radio, public safety radio, and citizens radio, are listed with the respective conditions and provisions for their use in tabulated form.

Circle 197 on Inquiry Card

Transformers

Data sheets describing 3 new power transformers for use with silicon rectifiers are available from Triad Transformer Corp.., 4055 Redwood Ave., Venice, Calif. All units provide output voltages of 40CT/20CT/10, with current ratings of: 100ma (F-90X), 300ma (F-91X) and 1 amp (F-92A).

Circle 198 on Inquiry Card

Acceleration Testers

A 6-page brochure from The Rucker Co., 4700 San Pablo Ave., Oakland, Calif., describes their Centrifuge Acceleration Test Machines for fast, accurate, G-testing as required by MIL-E-5272A. The brochure describes the company's line of machines, operational performance features and optional accessories.

Circle 199 on Inquiry Card

Potentiometers

New, 100-page, catalog from Spectrol Electronics Corp., 1704 South Del Mar Ave., San Gabriel, Calif., contains complete specification sheets for ordering standard wire wound single and multi-turn precision potentiometers. It also describes Spectrol's facilities and qualifications for designing and producing special tolerance wire wound potentiometers, special non-linear potentiometers, and precision mechanisms. Also included are drawings and specifications.

Circle 200 on Inquiry Card

Diodes

Short Form Catalog from U. S. Semiconductor Products, Inc., 3540 W. Osborn Rd., Phoenix, Ariz., contains basic information on the company's diodes together with 1N numbers and brief descriptions of the various lines. Included are: temperature compensated voltage regulating diodes, alloyed junction low power zener diodes, diffused junction medium power zener diodes, alloyed junction low power rectifier diodes, diffused junction medium power and commercial rectifier diodes, high voltage rectifiers, double anode diodes, solid tantalum capacitors, and tables of ordering information.

Circle 201 on Inquiry Card

Moisture Meter

Bulletin from the Henry Francis Parks Laboratory, P. O. Box 1665, Lake City Station, Seattle, Wash., describes the Model 101 Moisture Gage, a direct-reading, moisture percentage meter for soils and other granular materials. Transistorized, the portable, battery powered meter, features high sensitivity and $\pm 2\%$ accuracy at 70°F ambient for materials with d-c resistance between 0 and 85,000 ohms.

Circle 202 on Inquiry Card

Jet Flight-Path Computer

Bulletin 500 from Colorado Research Corp., Broomfield, Colorado, describes the Model 500 jet aircraft flight computer. The Model 500, an analog computer, is designed to preselect the optimum flight path for a jet aircraft on a domestic, overseas, or charter routes.

Circle 203 on Inquiry Card

Infrared Analyzer

Four-page Bulletin, No. 700, describing the company's Series 700 infrared analyzer, has been revised to reflect improvements made in the instrument. The bulletin describes its operation in detail and gives complete specs. Analytic Systems Co., 980 N. Fair Oaks Ave., Pasadena, Calif.

Circle 204 on Inquiry Card

Switches

Brochure from Thermocal, Inc., 1631 Colorado Ave., Santa Monica, Calif., describes the Thyrastat, a critical temperature sensitive switch, and the Pyristor, a surge current sensitive switch. Included in the brochure is a short description of the company's engineering and production capabilities and its research and development facilities.

Circle 205 on Inquiry Card

Tape Recorder

A 3-color, 12-page brochure on its AR-200 airborne magnetic tape recorder from Ampex Corp., Instrumentation Div., 934 Charter St., Redwood City, Calif., gives information, including specs. on the modular, miniaturized unit designed to fulfill the needs of modern airborne data acquisition.

Circle 206 on Inquiry Card

Transmitting Tubes

The 1959 printing of the Eimac Quick Reference catalog has condensed technical information in thumb-indexed form on the company's commercial line of over a hundred tube types and accessory items, arranged in easy-to-find categories. Eitel-McCullough, Inc., San Carlos, Calif.

Circle 207 on Inquiry Card

Facilities

A 40-page catalog, No. AV-100, describes the facilities and products of the Avionics Div. of Electronic Specialty Co., 5121 San Fernando Rd., Los Angeles 39, Calif. Products covered include static time delays, standard time delays, missile fuzes and programmers, flashers, voltage and frequency sensors, meter relays, power supplies and inverters, automatic check-out equipment and specialty devices. Systems include miss-distance indicator, terrain clearance system, zero delay radar augmenter, proximity fuze, command guidance receiver, word warning, coded flasher, autopilot, aircraft electrical supply sensor and controller, and flight control system analyzer.

Circle 208 on Inquiry Card

TV & Radio Coils

A 44-page general catalog offers detailed specs and pricing info on 1300 standard TV, radio, and transistor coils, plus listing of industrial coils and chokes. The illustrated catalog, No. 60, included a cross-reference of original parts to Miller equivalents, and 117 i-f—r-f schematic diagrams. Listings on color TV items are also included. J. W. Miller Co., 5917 So. Main St., Los Angeles 3, Calif.

Circle 209 on Inquiry Card

utmost in performance

TYPE 33M

MOLDED mylar* CAPACITOR

applications | *computers · instrumentation · test equipment filter networks · transistor circuitry · amplifiers*

Sangamo Type 33M molded mylar* capacitors combine the excellent electrical performance characteristics of mylar* dielectric material with a molded case of high moisture resistant thermosetting plastic.

Temperature Range: "The Type 33M is designed to operate over the temperature range of —55°C. to +85°C. Satisfactory performance at 125°C. can be obtained by derating the voltage to 50% of the 85°C. value."

Dissipation Factor: The dissipation factor of the Type 33M capacitor does not exceed 1% at normal equipment operating temperature over the complete audio frequency range.

Tolerances: Available in capacitance tolerance values of ±5%, ±10%, ±20%.

Life Test: These units will withstand a life test of 250 hours at 125% of rated voltage at 85°C. Life tests at 125°C. should be made at 125% of the derated voltage.

Dielectric Absorption: Dielectric absorption of Type 33M capacitors is less than half that of oil impregnated paper capacitors.

Moisture Resistance: Type 33M capacitors will successfully withstand the moisture resistance tests specified in Spec. MIL-C-91A.

Insulation Resistance: The insulation resistance of these capacitors will exceed 5,000 meg/mfd. over the normal operating temperature range.

• Write for engineering bulletin TSC-206A

*DuPont's trademark for polyester film.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

SC-59-6

Latest Western Literature for Engineers

Magnetic Recording Heads

Illustrated 4-page brochure plus data sheets give specifications, outline dimensions and general information on magnetic tape and drum heads. Also included are design sheets with spaces for electrical and mechanical parameters to aid in the design of a tape or drum head to customer specifications. General Transistor Western Corp., Magne-Head Div., 2660-64 So. La Cienega Blvd., Los Angeles 34, Calif.

Circle 210 on Inquiry Card

Fasteners

Catalog from Western Sky Industries, 21301 Cloud Way, Hayward, Calif., contains information on the company's line of heavy duty Stand-Off fasteners, light duty Stand-Off fasteners, and Heli-Coil Mid-Grip inserts. The catalog also gives typical equipment installations, vibration test data, drafting templates and other pertinent information.

Circle 211 on Inquiry Card

Engineering Opportunities

A colorful brochure is available from Philco Corp's Government and Industrial Div., Western Development Laboratories, Palo Alto, Calif. Aimed at attracting engineering talent, the brochure outlines the Company's advanced systems research, systems development engineering, communications engineering, tracking systems, computers, data handling, instrumentation and special projects.

Circle 212 on Inquiry Card

Variable-Speed Drive

Bulletin, No. 195, from Sterling Electric Motors, Inc., 5401 Telegraph Rd., Los Angeles 22, Calif., features: Photographs of the basic types of variable-speed drives with modifications, suggested variable-speed applications, detailed information regarding horsepower, duty, speed variation, mounting styles, enclosures, and electrical characteristics, an accurate cutaway depiction of the Speed-Trol's operating mechanisms, including an illustration of exclusive positive pulleys, and detailed information on remote controls.

Circle 213 on Inquiry Card

Delay Lines

Technical article discusses delay lines, defines parameters, and describes methods of measuring the electrical characteristics of delay lines using both pulse and c. w. techniques. Microsecond Electronics, Inc., 3213½ E. Washington, Phoenix, Ariz.

Circle 214 on Inquiry Card

Nameplate Designing

A twenty-page booklet from H. G. Dietz Products Co., 12-16 Astoria Boulevard, Long Island City 2, N. Y., is a guide to the engineer designing or specifying nameplates for new products in the development stage. The manual of instructions covers: Lettering, composition, step by step procedure for drawing a rough nameplate layout, useful information, selection of materials, nameplate processes, fastening of nameplates, steps in manufacturing, odd shaped nameplates, and a checkoff list for nameplate buyers.

Circle 215 on Inquiry Card

Gyros

Two new 4-page, 2-color brochures, one on floated free gyros and one on rate gyros, are now available. Exploded-view, airbrush drawings show typical gyro designs. Major design features and application advantages are called out. Complete specs are provided for two series of free gyros, FC35 and FC45, and for one series of rate gyros, R-51. Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.

Circle 216 on Inquiry Card

Laboratory Chromatograph

Consolidated Electrodynamics Corporation's Type 26-201A Laboratory Chromatograph is featured in a new 16-page booklet, Bulletin 1831. The illustrated brochure has sections on the principles of chromatography, applications, natural gasoline analysis, accessories, specifications, and descriptions of the features of the instrument. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.

Circle 217 on Inquiry Card

Leak Detector

Data sheet from American Electronics, Inc., American Nuclear Div., 9459 W. Jefferson Blvd., Culver City, Calif. describes the advantages and gives information on using Automatic Radiflo leak detection equipment. The unit can check resistors, capacitors, relays, crystals, gyros and other electronic equipment.

Circle 218 on Inquiry Card

Plastics

Data sheets from Illumitronic Engineering, Sunnyvale, California, describes plastics for electronics. Included are: polystyrene, acrylic, phenolic, polyethylene, nylon, teflon, machinable lava, and machinable ceramic sheets and rods. A separate sheet has a table of mechanical and electrical properties of the plastic materials.

Circle 219 on Inquiry Card

Airborne Power Supply

A 4-page, 2-color brochure describes the specifications, operational characteristics, and design features of a new line of airborne strain-gage power supplies. These instruments provide 1 or 3 at 5, 10, or 15 v. output, with 0.1% stability and operation from −55°C to +85°C. Graphs illustrate load regulation, temperature stability, and line regulation. Neff Instrument Corporation, 2211 E. Foothill Blvd., Pasadena, California.

Circle 220 on Inquiry Card

Speed Changers

Bulletin No. 96 describes Series 2 Miniature Adjustable Ratio Speed Changers. Speed ratios are continuously adjustable over a 25.1 range (1:5 up to 5:1 down). Units handle torques from 5 to 40 oz-in. depending on the ratio setting; speeds up to 10,000 RPM; power to 0.025 HP. Choice of work gear, spur gear, thumb screw, lever or miter gear speed adjustment. Metron Instrument Co., 432 Lincoln St., Denver 3, Colo.

Circle 221 on Inquiry Card

Miniature Relays

Illustrated technical bulletins describe Model BR-7 and Model BR-8 miniature relay series. Both series are available in ac and dc models with various header and mounting styles. The BR-7 standard relay will handle dry circuit contact loads to 10 a. Design permits close pull-in to drop-out ratios as well as operating sensitivities down to 40 mw. at ambient temp. with 10 a load. Babcock Relays, Inc., 1640 Monrovia Ave., Costa Mesa, Calif.

Circle 222 on Inquiry Card

Digital Computer

A 6-page illustrated bulletin describes highlights of the G-15 digital computer with particular emphasis on the magazine-loaded photo tape reader which is offered as standard equipment. Also included are descriptions of POGO and INTERCOM 1000 programming systems; accessory punched card, magnetic tape and paper tape equipment; several special purpose devices and G-15 specifications. Bendix Computer Div., 5630 Arbor Vitae St., Los Angeles 45, Calif.

Circle 223 on Inquiry Card

Semiconductors

The complete line of Sperry Silicon diodes and transistors are described in a 12-page, 2-color bulletin. Data include curves on forward and reverse resistance and all pertinent technical characteristics. Sperry Semiconductor Division, Great Neck, N. Y.

Circle 224 on Inquiry Card

He's getting results...

WITH THE NEW BRUSH RECORDER MARK II

So can you. The versatile Mark II is an integrated oscillograph package—a readout tool for engineers and technicians everywhere . . . in the shop . . . in the lab . . . or in the field.

Just plug it in . . . put it to writing . . . anywhere.

PERFORMANCE SPECIFICATIONS

Recordings—Uniform, crisp, easily reproduced. Trouble-free ink writing on precision chart paper.

Channels—Two analog, plus two event markers.

Sensitivity—Maximum of 10 mv/chart line (mm); range, 10 mv to 400 v.

Input—Differential; impedance 5 megs each side to ground.

Frequency Response—D.C. to 100 cps.

Write for free booklet 2521A for complete specifications. Immediately available from stock. Price $1350, f.o.b. Cleveland, Ohio

brush INSTRUMENTS

DIVISION OF

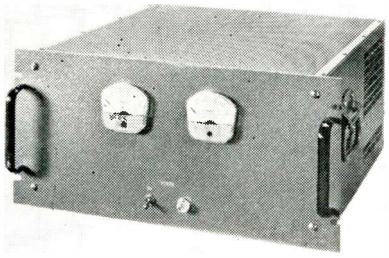
37TH AND PERKINS CLEVITE CORPORATION CLEVELAND 14, OHIO

Circle 56 on Inquiry Card

WESCON Product Highlights

POWER SUPPLY

Model, SR 28-50 has an output capacity of 24-32 v, 50a. Features are: no magnetic amplifiers; no positive transient response characteristic; 0.1% line regulation for changes from

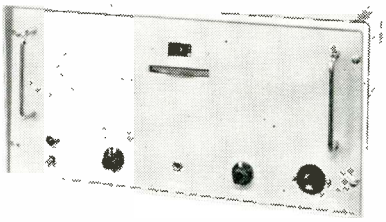


208-230 v. at any output voltage from 0 to max.; 1% load regulation from 0 to max. and max. to 0, recovery time 50 μsec with no positive transient; 1% ripple; 60% eff. at max. voltage; 0.1% stability for 24 hrs.; operates indefinitely into a dead short; temp. coefficient 0.05%/°C. Booth 515. Kepco, Inc., 131-38 Sanford Ave., Flushing, N. Y.

Circle 225 on Inquiry Card

ELECTRONIC GENERATORS

Models 150 and 250 provide output powers of 160 va and 250 va. They provide a fixed output frequency of 400 CPS ±0.25% and a variable output frequency with a range of 350-450

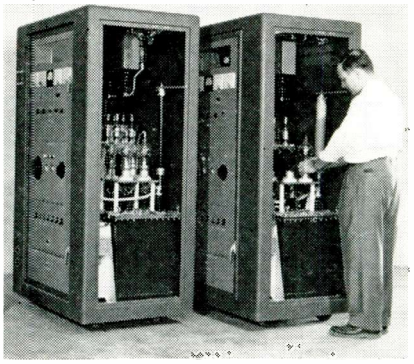


CPS. An input jack is also provided for output frequencies from 50-4000 CPS. Featured are: continuously variable output voltage from 0-120 v. less than 1% output distortion, better than 1% regulation from no load to full load. They can be used with loads of any power factor. Booth 3529. The Industrial Test Equipment Co., 55 E. 11th St., New York 3.

Circle 227 on Inquiry Card

MODULATOR

Models 75M-1,2,3, signal-source modulators are designed for combination with a wide variety of magnetrons of different manufacturers to form high-power pulsed signal sources. This

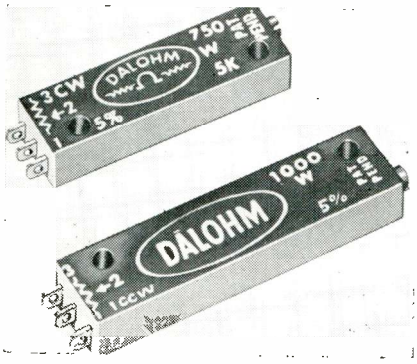


series of modulators is applicable for tube development work or for incoming tube inspection by equipment manufacturers. Combined with traveling-wave tubes, the units become broadband high-power pulsed microwave amplifiers; or, with klystrons, narrowband systems. Booth 305. Levinthal Electronic Products, Inc., Stanford Industrial Park, Palo Alto, Calif.

Circle 229 on Inquiry Card

TRIMMER POTENTIOMETERS

A selection of 5 terminal configurations for Type 750 and Type 1000 trimmer potentiometers. Both T-Pots meet humidity requirements of MIL-STD-202A, Method 106A or MIL-E-5272A, Procedure I. specs: (higher values for Type 1000, lower for 750) —Rated at 2 w, 2.5 w; resistance range, 10 ohms to 30K ohms, 10 ohms to 50K ohms; standard tolerance, ±5%, ±5%; size, 0.180 X 0.300 X

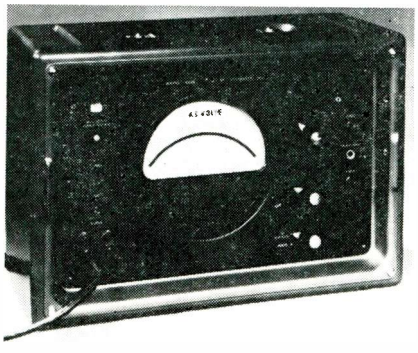


1.000, 0.180 X 0.300 X 1.25; screw adjustment, 17 ±2 rev., 25 ±2 rev.; weight, 2 gr., 2.5 gr.; volume 0.054 in^3., 0.068 in^3. Booth 2714. Dale Products, Inc., Columbus, Nebraska.

Circle 226 on Inquiry Card

A-F VOLTMETER

A-F Voltmeter, Type M-121, measures audio and low r-f signals to an accuracy of ½ of 1%. Full-scale ranges are from 1 mv to 100 v. RMS; frequency range: 20 cps to 400 kc. Input impedance is 10 megohms on the 30- and 100-v. ranges, and is not less than 20 megohms on other ranges. Facilities for balanced and unbalanced inputs are provided at 100,000 ohms and 600 ohms impedance. Two pre-



set controls can be adjusted to set up full scale deflection, at a specified frequency, on any given range. Booth 3521. Wayne Kerr Corp., 1633 Race St., Philadelphia, Pa.

Circle 228 on Inquiry Card

KLYSTRON OSCILLATORS

Tube types, TE-53 and TE-78, mechanically tuned reflex Klystron oscillators for operation at 34,000 to 35,600 MC feature ceramic insulators, dielectric tuning, waveguide output, and an improved electron gun design for stable operating frequency, optimum electronic tuning and power output with low resonator voltage, reduced power input and long operating life. They are designed for microwave

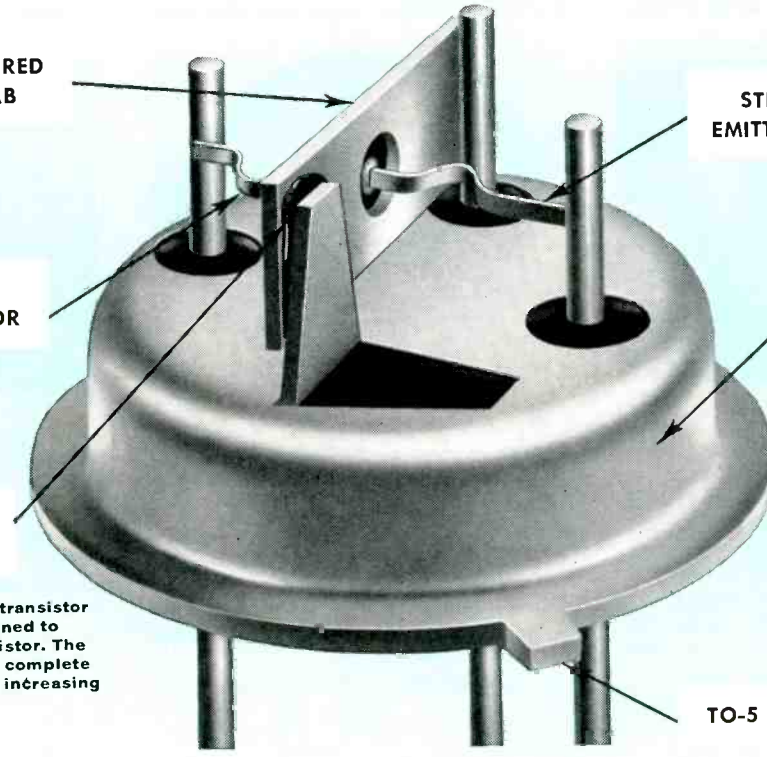
systems such as communications, countermeasures, radar, radio astronomy, spectroscopy, and test equipment. Booth 2007. Bendix Aviation Corp., Red Bank Div., Eatontown, N. J.

Circle 230 on Inquiry Card

"THERMAL BOND"

EXCLUSIVE TUNG-SOL CONSTRUCTION

MEANS NEW STANDARDS OF TRANSISTOR PERFORMANCE IN COMPUTER APPLICATIONS



With "Thermal Bond", the transistor junction tab is securely joined to the base plate of the transistor. The bonding material provides complete electrical insulation, while increasing heat dissipation.

From Tung-Sol, originator of the Cold Weld Seal, comes a new design approach to greater mechanical reliability in computer switch transistors.

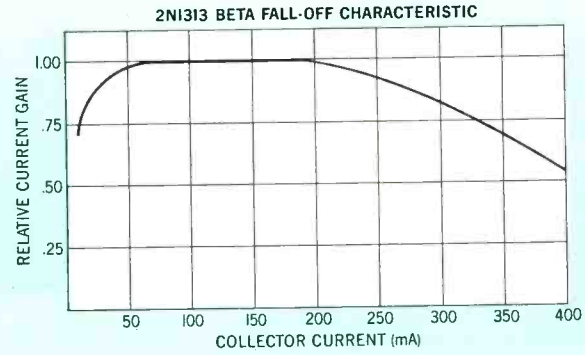
2N1313 (TS1000) is a PNP germanium alloy junction transistor which is designed for use in high current, high speed switching applications. This new transistor provides an ideal balance of the most wanted characteristics as revealed by survey of computer designers.

MAXIMUM RATINGS		TYPICAL CHARACTERISTICS (25°C)	
BV_{CBO}	−30V	$f_{\alpha b}$	12 Mc
BV_{EBO}	−20V	C_{ob}	12 μμf
BV_{CEX} (V_{BE} = 0.1V)	−20V	h_{FE} (I_B = 1mA)	60
BV_{CEO}	−12V	h_{FE} (I_C = 400mA)	40
I_C (continuous)	400mA	(t_r+t_d) (rise plus delay)	0.45 μsec
I_C (peak)	1.0 A	t_s (storage)	0.30 μsec
T_j	−65°c to +85°c	t_f (fall)	0.20 μsec
P_C	175mW	Thermal Resistance	0.350° C/mW
		I_{CBO} @ −12V 25°C	2.5 μA
		65°C	25 μA

1. Withstands 20,000 G centrifuge.
2. Exceeds all MIL environmental specs—shock—vibration —salt spray—centrifuge—moisture resistance, etc.
3. Excellent current gain linearity (low beta fall-off).
4. Thermal resistance derating is lowest for electrically insulated devices (.350° C/mW, typical).
3. Sensibly priced.

Immediate availability

Certainly, more information is available. Write: Tung-Sol Electric Inc., Newark 4, New Jersey



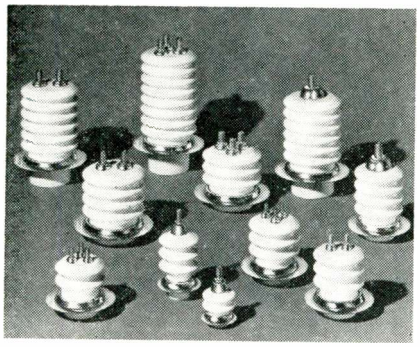
TUNG-SOL®

Wescon Show Booths 1615-1617

WESCON Product Highlights

CERAMIC TO METAL SEALS

Line of over 100 standard sizes of hermetic ceramic-to-metal seals, includes high voltage terminal bushings, feed-throughs, and cable end seals. Made of high-alumina Alite ceramic

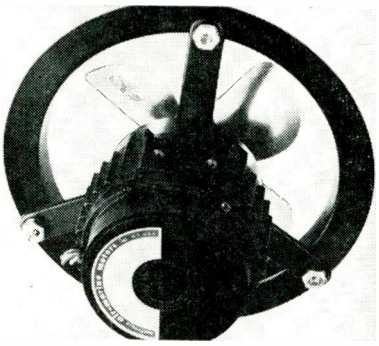


to withstand high temps. and rigorous mechanical requirements, the line offers a choice of standard sizes and voltage ratings for critical applications. Seals are vacuum-tight, have excellent di-electric strength and high corrosion resistance. A number of special units and custom designs will be on display. Booth 726. Alite Div., U. S. Stoneware Co., Akron 9, Ohio.

Circle 231 on Inquiry Card

VARIABLE FREQUENCY MOTOR

A new line of 3ø, variable frequency motors for axial fans and centrifugal blowers are available in 320 to 1000 cycles, 200 volts. These 3ø, variable frequency motors eliminate the need

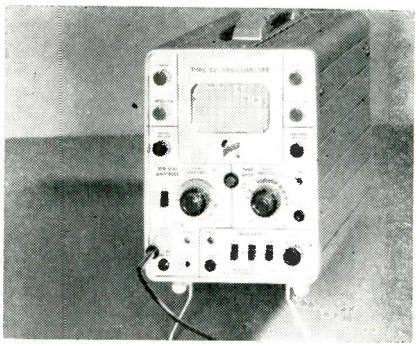


for running capacitors. A 4 in. axial fan (a typical unit) delivers 240 CFM at 0 in. S.P., 400 cycles. Ambient temperature range is −55°C to +125°C. These units have a typical application in airborne radar cooling and meet MIL-E-5400 and MIL-E-5272A. Booth 607. Air-Marine Motors, Inc., 369 Bayview Ave., Amityville, L. I., N. Y.

Circle 233 on Inquiry Card

OSCILLOSCOPE

Type 321 transistorized, battery-operated portable oscilloscope operates 3 hrs. on 10 (Size D) flashlight cells, to 6 hr. on rechargeable cells. It also operates on 11 to 35 vdc, and 110 to

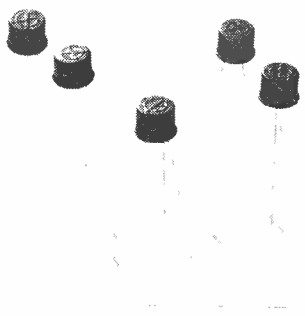


125 v or 220 to 250 v, 50 to 800 CPS. Vertical passband is dc to 5 mc, rise-time is 0.07 μsec, deflection factor is 10 mv/div. Sweep range is 0.5 μsec/-div to 0.5 sec/div in 19 calibrated steps. Accelerating potential is 4 kv on a 3 in. C-R tube. Amplitude calibrator is a 500 mv peak-to-peak 2 KC sq. wave. Booth 1801. Tektronix, Inc., P. O. Box 831, Portland 7, Ore.

Circle 235 on Inquiry Card

TRANSISTOR

The 2N706, fast silicon switching transistor, optimized for saturated logic circuits operating at low current levels, can be operated in a saturated condition with virtually no sacrifice in speed. Typical DCTL propagation delay is 5 μsec per inverter. Reduces circuit complexity further increasing system reliability. It can also be used

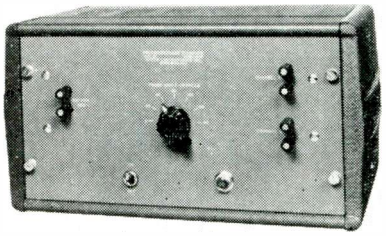


in non-saturating circuits or as a linear amplifier. Typical maximum frequency of oscillation is 400 MC. Fairchild Semiconductor Corp., 545 Whisman Rd., Mountain View, Calif.

Circle 232 on Inquiry Card

SECONDARY PHASE STANDARD

Tenth degree (±0.1°), secondary phase standard, or shifter, Type 714-A, has a single audio frequency (400 CPS standard) to reduce known phase angles at the output terminals; it may be used as either a phase shifter or phase standard, one control —the phase angle selector with choice of 0°, 30°, 60°, 90°, 120°, 150° and

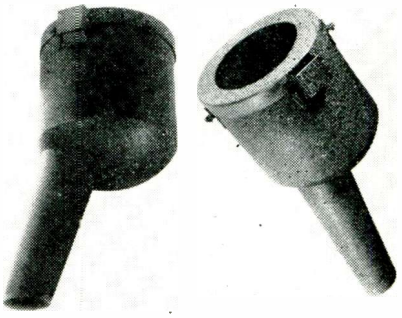


180° or others on special order. Also featured is phase angle stability over a variety of operating conditions. Booth 3508. Acton Laboratories, Inc., 533 Main St., Acton, Mass.

Circle 234 on Inquiry Card

MAGNETIC SHIELD

Netic Co-Netic magnetic shield reduces the effects of high "g" stresses on electron beam structures and retains shielding properties. Shields never require periodic annealing so the potting technique is possible. The tube is located within the shield using a resilient casting compound. If maximum isolation is required, the outer



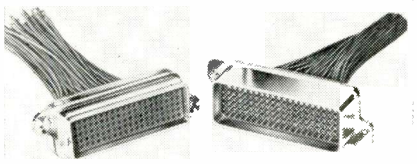
shield structure may be used as a base for attaching a simple shock mounting arrangement. Booth 2214. Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago, Ill.

Circle 236 on Inquiry Card

WESCON Product Highlights

CONNECTOR LINE

A new line of AMP in-cert rack and panel connectors, in 50 and 100 position units for general use as well as critical circuit requirements in difficult environments. The shells are

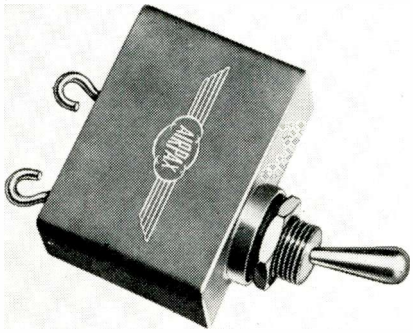


polarized for positive correct mating under all conditions and the solderless contacts are protected against damage by extended alignment skirts on the shells and by bushings which line up the receptacle and plug before the contacts join together in racks and panels. Units tested under vibration, temp. & humidity. Booth 2501. AMP Incorporated, Harrisburg, Pa.

Circle 237 on Inquiry Card

CIRCUIT BREAKER

Airpax Series 500, miniature circuit breaker, resists shocks of 100 g. Electro-magnetic, inverse time delay breaker features an ultimate trip level of 125% of rated current independent

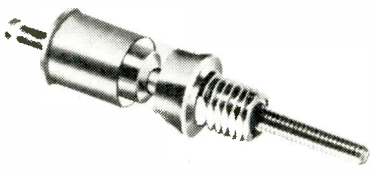


of ambient or operating temp. Units available for interrupting 50dc volts at currents from 0.05 to 10 amperes and for interrupting 120 RMS volts, 60 to 400 CPS at currents from 1.0 to 10 amperes. The toggle handle of the breaker is similar to conventional on-off switches. Booth 521, Airpax Electronics Inc., Cambridge Division, Cambridge, Maryland.

Circle 239 on Inquiry Card

TRIMMERS

The Max-C, variable trimmer series has a wide range of capacity per unit. The electrode band, metallized silver, is laminated to a thin, high dielectric constant, precision-bore glass cylinder.

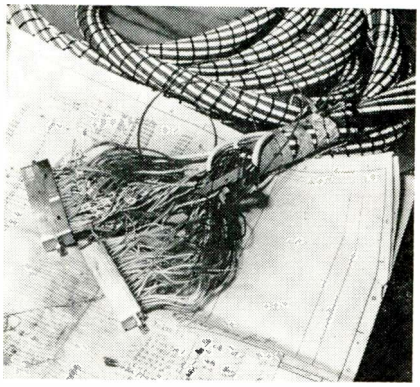


A thicker outer concentric glass cylinder strengthens the assembly. Featured are: Special protective alloy undercoating; improved backlash design; no capacitance reversal while tuning; accurate alignment; low temp. coefficient of capacitance; and low inductance and low loss for high frequency use. Booth 202, JFD Electronics Corp., 1462-62nd St., Bklyn 4.

Circle 241 on Inquiry Card

CABLE ASSEMBLIES

High temperature cable and cable assemblies may have over a hundred and fifty different Teflon insulated conductors. Bondable irradiated Teflon insulated wire, permits easier, more permanent potting. The irradiation treatment allows better potting and more satisfactory printing on the in-

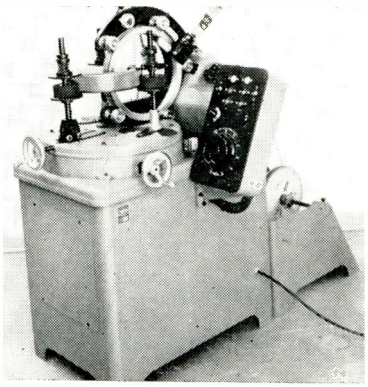


sulation without effecting the ability of the wire to meet MIL-W-16878C. Booth 1412. Tensolite Insulated Wire Company, Incorporated, West Main Street, Tarrytown, New York.

Circle 238 on Inquiry Card

COIL WINDING MACHINE

Model U-14 Toroyd, toroidal coil winding machine for heavy wire winding, was designed specifically for the winding of heavy wire, over a range of #7 to #20 AWG. The machine is also capable of winding a coil up to 14 inches outside diameter and 6 inches high. The positive drive fea-

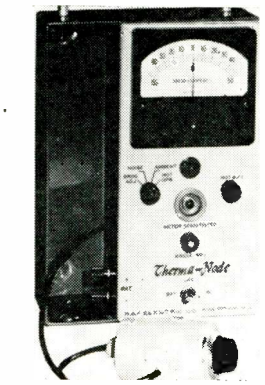


ture of the machine allows a tight and precise winding in the heavy wire range. Booth 1121. Universal Manufacturing Co., Incorporated, 1168 Groove Street, Irvington, New Jersey.

Circle 240 on Inquiry Card

NOISE SOURCE

The Therma-Node, a commercial noise generator based on measurement of the noise temp of a heated resistive element covers the frequency range 0.5 to 1000 MC, fixed or tuned. Accuracy is ±0.1 db. Available noise temp ranges from 2000 to 2400°K, readable to ±2%. Some specs are:



Fixed tuning range: 0.5—500 MC; variable: 0.5—1000 MC. Min bandwidth for max VSWR of 1.4 = 200 MC from 500 to 1000 MC. From 200 to 500 MC bandwidth increases. Below 200 MC the unit is broadband down to 0.5 MC. Booth 3114. Kay Electric Co., Maple Ave., Pine Brook, N. J.

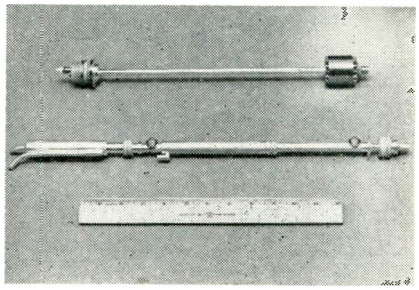
Circle 242 on Inquiry Card

"NEW PRODUCTS" OF THE MONTH BEGIN ON PAGE 176

New Western Products

CERAMIC TW TUBES

The X686, traveling wave tube is especially designed for severe-environment airborne applications. This air-cooled tube covers the frequency range of 4 to 7 KMC. with an output power

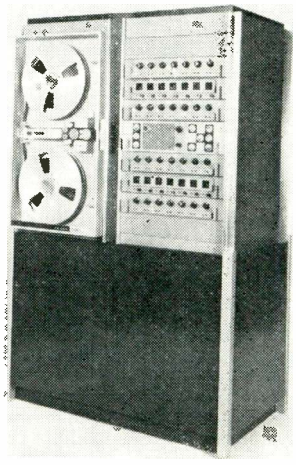


of one watt and a gain of 50 db. The liquid-cooled X620 is rated at 100 watts minimum CW output power in the 4 to 7 KMC. range. It has a saturation gain of 30 db with less than 3 db variation in gain over the entire frequency range. The X620 is designed to be operated at a nominal collector depression of 45%. Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, Calif.

Circle 243 on Inquiry Card

MAGNETIC TAPE RECORDER

Analog magnetic tape recorder, the FR-600 features wide-band techniques for both FM and direct recording. Its head design and advanced electronics permit direct recording of frequencies to 250 KC and FM response from dc to 20 KC within ½ db. FM, pulse-duration modulation, direct, or digital recording modes available; ½ and 1 in. tape are interchangeable. Both 10½



and 14 in. reels can be used. Other features include adjustable end-of-tape sensing and positioning of all controls. Booth 3531—Ampex Corp., 934 Charter St., Redwood City, Calif.

Circle 244 on Inquiry Card

Narda SonBlasters offer the most complete line of lowest-cost mass-produced ultrasonic cleaners!

Narda's mass-production techniques assure you the most complete line of ultrasonic cleaners at the lowest prices in the industry! From the smallest 35-watt to the amazing 2500-watt unit with a tank capacity of 75 gallons, Narda's SonBlasters are available **now**—off-the-shelf—for immediate delivery. And with a full 2-year warranty besides!

What do **you** want to clean? Transistors, semi-conductors, other electronic, automotive, missile and avionic components, instruments, timing mechanisms—Narda's SonBlasters clean 'most any mechanical, electrical or horological part or assembly you can think of—and clean faster, better and cheaper.

No matter what you need in ultrasonic cleaning equipment, you'll find Narda's complete line of production-size units have the quality, power, performance, capacity and appearance of cleaners selling up to three times their price! Write for more details **now** and we'll include a free questionnaire to help determine the precise model you need. Address: Dept. EI-19.

Generator G-202 **Transducerized Tank NT-202**
35 watts **Capacity: ⅜ gallon**

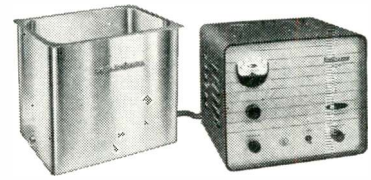
An amazingly efficient, yet inexpensive, ultrasonic cleaner. Duty cycle timer permits operator to turn the unit on, set it, and leave; the SonBlaster will turn off automatically at the end of the cycle. Four choices of timers—from 0-15 min. to 0-120 min. Also available without timer at slightly lower cost (G-201).

$220

Generator G-601 **Transducerized Tank NT-602**
60 watts **Capacity: 1 gallon**

A more powerful production-type unit, with a special circuit and selector switch permitting operator to alternate between two tanks, when items being cleaned require different solutions or a two-step process.

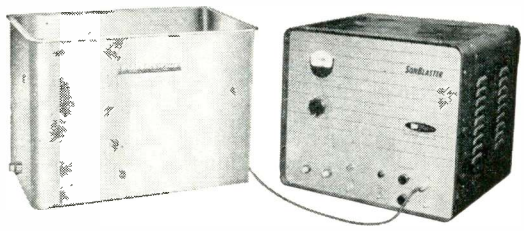
$350



Transducerized Tank NT-1505 **Generator G-1501**
Capacity: 5 gallons **200 watts**

The lowest price in the industry for a tank of this capacity and activity. Generator also will operate 2, 3 or 4 submersible transducers at one time, with just a turn of the load selector switch on the front panel.

$695



Transducerized Tank NT-5001 **Generator G-5001**
Capacity: 10 gallons **500 watts**

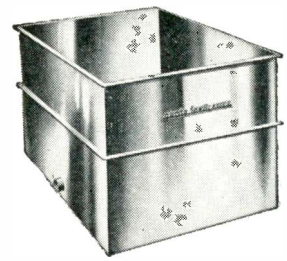
Generator features standby switch for longer life and load selector switch on the front panel to operate up to 8 submersible transducers or 8 NT-602 or 2 NT-1505 transducerized tanks at one time. Larger tanks available on special order.

$1325

Submersible Transducer NT-605

Heli arc welded stainless case, hermetically sealed for safe, leak-proof immersion. Radiating face: 27 sq. in. Effective plane of radiation: 40-50 sq. in. (approximately 10" x 5"). Effective cavitation of volumes up to 1200 cu. in. at 24 in. tank height (5 gal.) and 2400 cu. in. at 48 in. tank height (10 gal.). Bulkhead electrical fitting on back allows all wiring connections to be made on outside of tank. For use in any arrangement or location in any shape tank you desire to use. Also available—model NT-604, identical with NT-605, except for pipe thread instead of bulkhead fitting, permitting electrical connections inside of tank.

$130

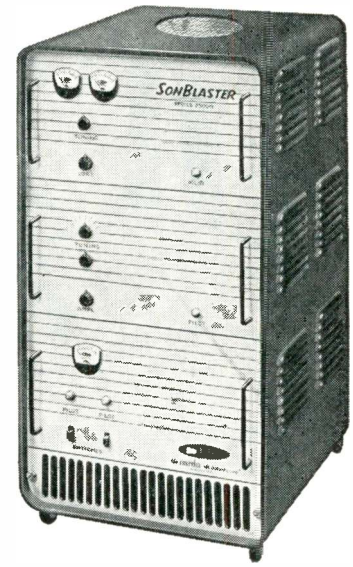


Transducerized Tank
NT-25001
Capacity: 75 gallons

Powerful unit drives the largest mass-produced industrial-size transducerized ultrasonic cleaning tank made! Also energizes up to 40 Narda 60-watt submersible transducers (NT-604 or -605). Capable of energizing tanks measuring up to 150 square feet of area by 2' or 3' high.

$4360

Generator G-25001
2500 watts



Consult with Narda for all your ultrasonic requirements. The SonBlaster catalog line of ultrasonic cleaning equipment ranges from 35 watts to 2.5 KW, and includes transducerized tanks as well as immersible transducers which can be adapted to any size or shape tank you may now be using. If ultrasonics can be applied to help improve your process, Narda will recommend the finest, most dependable equipment available—and at the lowest price in the industry!

For custom-designed installation and unique electro-acoustic applications, including cleaning, soldering, welding, drilling and non-destructive testing, consult our subsidiary, Alcar Instruments Inc., at the address below.

the narda ultrasonics corporation

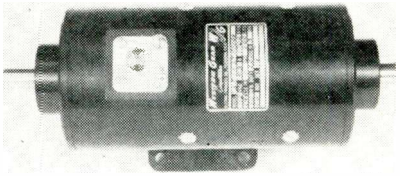
625 MAIN STREET, WESTBURY, L. I., N. Y.
Subsidiary of The Narda Microwave Corporation

Circle 63 on Inquiry Card

New Western Products

GEARMOTOR

Double shaft gearmotor, Model 35YH29RP100, is driven by a 200 vac, 400 CPS, 3 phase motor. Typical of the speeds and torques which can be made available for custom require-

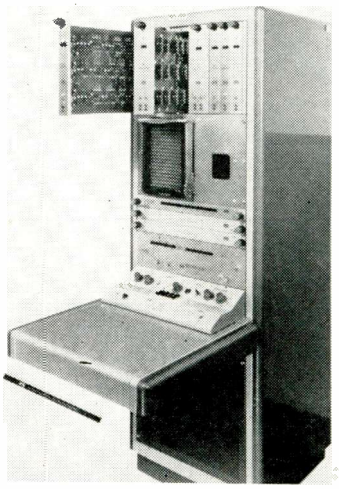


ments by various different types of gear sets are: 1700 RPM at 96 oz. in. of torque on one shaft, and 4700 RPM at 650 oz. in. torque on the opposite shaft. Electro Products Div., Western Gear Corp., 132 W. Colorado Blvd., Pasadena, Calif.

Circle 245 on Inquiry Card

FUNCTION GENERATOR

Digital/Analog Function Table, DAFT provides accurate, repeatable arbitrary function generation for analog computers. The arbitrary function is stored in a plug board as 20 sec. differences. Multiverter converts the independent variable input voltage incrementally. Increments are used to perform a 2nd order interpolation using 3 points, and the result—the dependent variable—is converted



to a voltage to be used in the analog computer. 100,000 increments of the function can be generated with max. delay of 50 μsec. Packard Bell Computer Corp., 1905 S. Armacost Ave., Los Angeles 25, Calif.

Circle 246 on Inquiry Card

In high voltage transformers, other heavy duty electrical and electronic equipment...

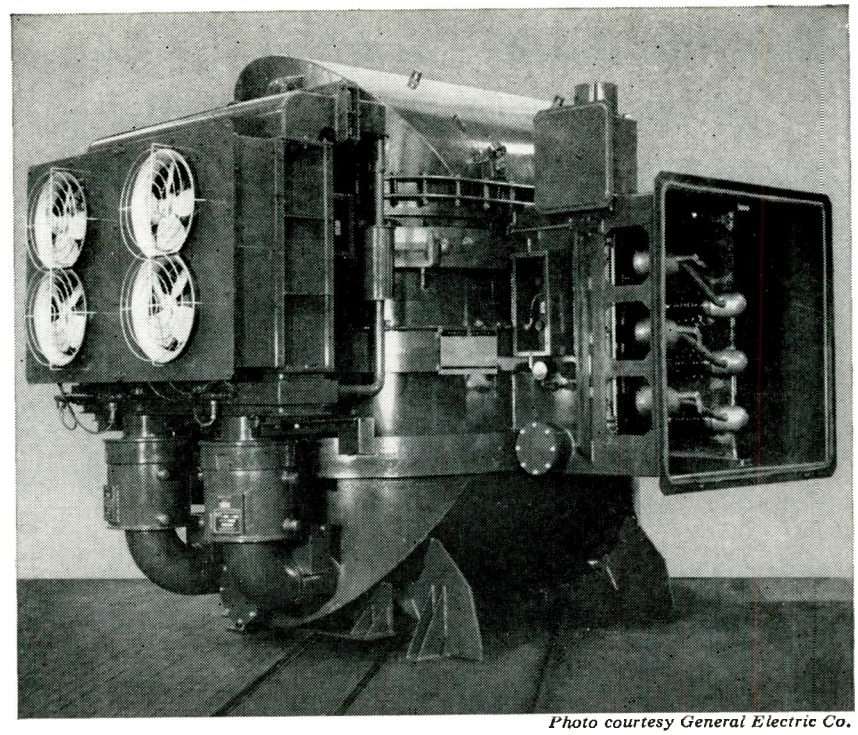


Photo courtesy General Electric Co.

THE TREND IS TO GASEOUS INSULATION WITH B&A® SULFUR HEXAFLUORIDE

The trend in requirements for high voltage equipment is toward higher operating voltages, units of minimum size and weight, greater safety and lower maintenance costs. For these reasons, sulfur hexafluoride is being used to insulate a wide variety of electrical and electronic equipment.

Sulfur hexafluoride is not only the preferred gaseous dielectric—it has also proved superior to liquid insulation in many applications. For example, the use of SF_6 instead of oil to insulate high voltage transformers has the following advantages:

High Dielectric Strength

At atmospheric pressure, SF_6 has a dielectric strength 2 to 3 times that of air, nitrogen or carbon dioxide. This favorable ratio increases with pressure so that in the range of 2 to 3 atmospheres SF_6 has a dielectric value roughly equivalent to transformer oil.

Efficient Over Wide Temperature Range*

SF_6 is stable in the presence of most materials of construction up to temperatures of about 150°C; remains a gas down to −63.8°C.

*Where extreme inertness to other materials is required or when service conditions involve temperatures in the range of 150°C to 250°C (or higher!), Baker & Adamson's Perfluoropropane (C_3F_8) is recommended.

Reduces Noise Level and Weight of Equipment

Both the noise level and weight of transformers can be reduced substantially by insulating with SF_6 rather than with a liquid. The low noise feature is particularly important where residences are nearby. Weight savings pay off for portable equipment and reduce installation costs for stationary equipment.

Safe to Use

SF_6 is non-toxic, chemically and physiologically inert, fire-proof and explosion-proof.

Installation Savings

Installation in fire-proof vaults is eliminated and bus runs can be shortened drastically due to closer proximity of transformer to generator.

Many of these advantages are also applicable to other commercial uses of sulfur hexafluoride, such as in:

Interrupter Switches
Radio and Microwave Frequency Power Transmission
X-Ray Equipment
Audio Equipment
Cathode Ray Accelerators
Van de Graaff Machines
Television Filterplexers
Radar Duplexers
Gap Tubes
Switch Gear
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40 Rector Street, New York 6, N. Y.

Circle 65 on Inquiry Card

New Western Products

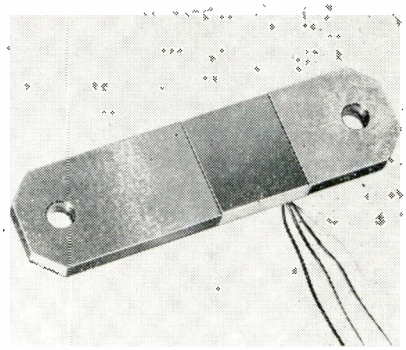
PRECISION POTENTIOMETER

A subminiature single-turn potentiometer, Model 304, offers linearity to 0.3% and a 500,000-cycle life in a package ½ in. in dia. and ⅝ in. in case length. Environmental characteristics: 2.0 watts at 50°C, operates to 125°C, withstands 20g vibration and 30g shock. Machined aluminum cases are used on all models. Stops and locating pins are available as standard optional features. Daystrom Pacific, 9320 Lincoln Blvd., Los Angeles 45, Calif.

Circle 247 on Inquiry Card

STRAIN MULTIPLIER

The Type LTD-105, strain multiplier, is a metal bar, machined to concentrate total applied strains in a relatively short section. Minute strains can be measured with conventional strain gage read-out equipment. One standard model provides a multiplication factor of 16—an applied strain of 10 μin/in. is read out as 160 μin. Other models provide a range of multiplication factors from 4 to 20. Mounting hole center distances range from 3 to 8 in. All standard models contain 4,120 ohm strain gages connected in a full bridge configuration. Waldale Research Co., Inc., 362 W. Colorado Blvd., Pasadena, Calif.



Circle 248 on Inquiry Card

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AiResearch expansion in electronics and electromechanical activity is creating outstanding positions at all levels for qualified engineers.

DATA SYSTEMS RESEARCH

Experience with physical measuring devices using electromagnetic, atomic, thermionic and mechanical approaches.

Openings also exist in the following areas: Flight Systems Research... Controls Analysis ... Flight Data Components... Electromagnetic Development... Instrument Design... Airborne Instrumentation Analysis and Design.

Send resume to: Mr. G. D. Bradley

THE GARRETT CORPORATION

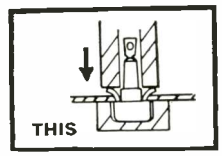
AiResearch Manufacturing Division

9851 So. Sepulveda Blvd., Los Angeles 45, Calif.

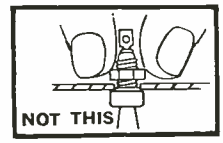
Circle 506 on "Opportunities" Inquiry Card

There is a difference in...

ALDEN "STAK-IN" TEST JACKS



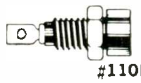
Fast, low cost machine assembly of only one part.



Slow expensive hand assembly of two or more parts.

. . . it's the exclusive Molded-In Eyelet . . . eliminates the need for nuts, washers and sleeves — cuts production costs to one fast low cost eyeletting operation — jack can't vibrate loose, turn or fall out — rugged Nylon insulation — reliable 360° beryllium copper contact . . .

If you're a high volume user of test jacks, it will pay you to investigate the cost saving advantages of Alden Stak-in Test Jacks. For limited quantity applications, use Alden Mini-Test Jacks below . . .

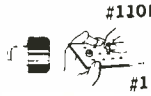


#110BCSI

#110BCSI — Fastens securely by nut. In Nylon or Kel-f. Resilient beryllium copper contact, silver-plated. A standard for many applications.

#110BCSH

#110BCSH — Has safety collar to prevent accidental contact. Phenolic insulated. Long-life silver-plated beryllium copper contact.



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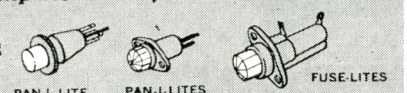
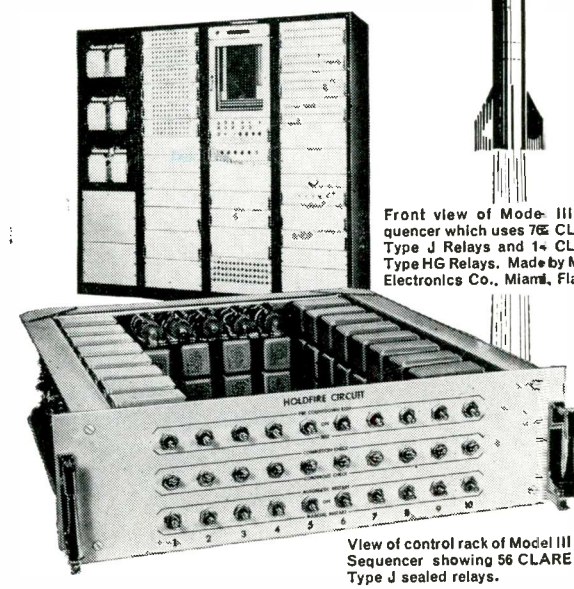


ALDEN PRODUCTS CO. 8123 N. Main St. Brockton, Mass.

Circle 69 on Inquiry Card

A VITAL 100 MINUTES!

Firing Sequencer with 762 CLARE RELAYS gives automatic control



Front view of Model III Sequencer which uses 762 CLARE Type J Relays and 14 CLARE Type HG Relays. Made by Milgo Electronics Co., Miami, Fla.

View of control rack of Model III Sequencer showing 56 CLARE Type J sealed relays.

Automatic control of the countdown at the Air Force's Cape Canaveral Missile Test Center—from X minus 90 minutes to 10 minutes after a missile is fired—is in the hands of a Milgo Model III Sequencer.

The Sequencer, built by Milgo Electronic Corporation, Miami, Fla., automatically controls the myriad operations which must be performed before any missile can be launched. It is preprogrammed to recognize the precise condition that must exist during each of the operations it controls. When any other condition is detected, it will automatically hold fire until the condition is corrected. In a recent instance, it saved a Titan prototype which developed a malfunction after firing but before actual takeoff.

Another of these sequencers is being built by Milgo for installation at the Pacific Missile Range, Vandenberg Air Force Base, Calif.

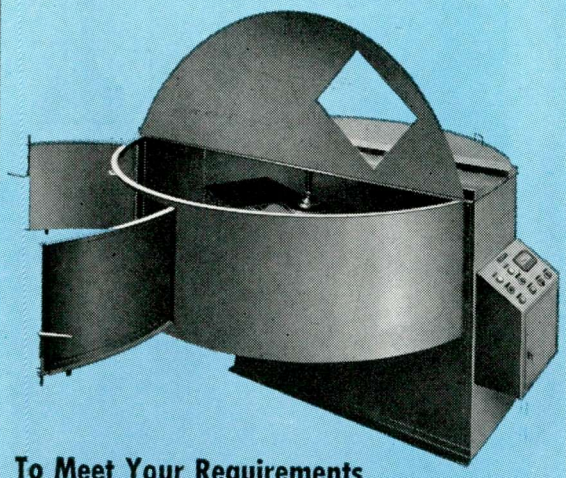
Milgo engineers selected 762 Clare Type J and Type HG Relays for this supremely important device, and not one has ever malfunctioned. Here is convincing proof that, where the safety of personnel and of valuable equipment is at stake and the utmost accuracy is demanded, a designer who rides with Clare relays can rest assured that he has chosen wisely and well.

CLARE RELAYS

C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois.
In Canada: C. P. Clare Canada Ltd., P. O. Box 134, Downsview, Ontario.
Cable Address: CLARELAY

Circle 68 on Inquiry Card

ELECTRONIC SPEED CONTROL EXCLUSIVELY ON RUCKER SMALL CENTRIFUGES



To Meet Your Requirements For Acceleration Testing Under MIL-E-5272 A Procedures I and II

The new electronic speed control circuit—an exclusive feature on Rucker Series I Centrifuges, provides:

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- ✓ PROGRAMMED SEQUENCE OR REMOTE OPERATION
- ✓ G RATING REPEATABILITY
- ✓ DEPENDABLE, QUIET OPERATION
- ✓ FAST TEST CYCLE
- ✓ AUTOMATIC OR PROGRAMMED DYNAMIC BRAKING

OTHER RUCKER FEATURES:

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- ✓ MINIMUM WOW AND DRIFT THROUGH HIGH INERTIA DESIGN
- ✓ HEAVY STEEL CONSTRUCTION THROUGHOUT FOR MAXIMUM SAFETY
- ✓ ELECTRICAL SLIP RINGS
- ✓ CAPACITIES TO 15,000 G POUNDS, 92 INCH DIAMETER
- ✓ 90° SPECIMEN ROTATION DURING OPERATION (Procedure I under MIL-E-5272 A)—(Optional)
- ✓ WAVE GUIDES FOR ALL APPLICATIONS (Optional)
- ✓ CLOSED CIRCUIT TV (Optional)
- ✓ HYDRAULIC-PNEUMATIC ROTARY JOINTS (Optional)

Rucker Series 10 and 20 Centrifuges also available with capacities in excess of 450,000 G pounds and diameters to 70 feet.

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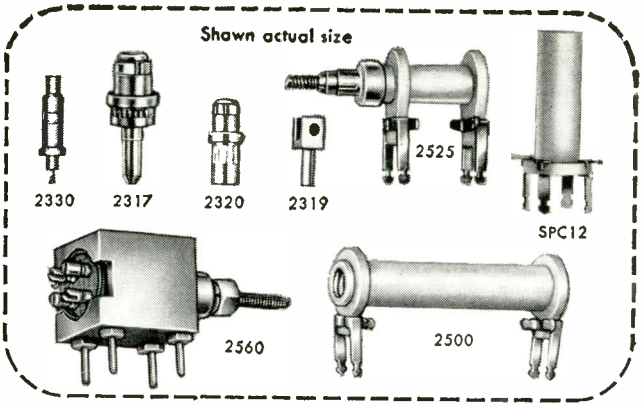

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Available in a wide range of coil forms (shielded, ceramic, phenolic), solder and insulated terminals, plugs and jacks, diode clips, and other components. Use them to build stamina into your product. CAMBION Tools speed assembly and mounting. For details, write Cambridge Thermionic Corporation, 504 Concord Avenue, Cambridge 38, Massachusetts.

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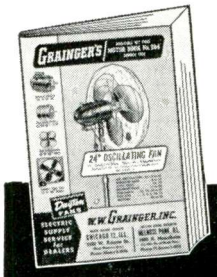

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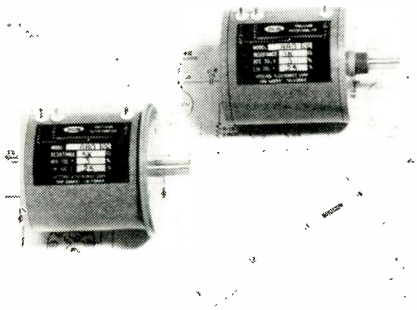
Circle 72 on Inquiry Card

New Western Products

MULTI-TURN POTENTIOMETERS

Line of 3 and 10 turn precision wire-wound potentiometers consists of 8 new models, four 10-turn and four 3-turn. The line features anodized aluminum cases with a 3/16 in.

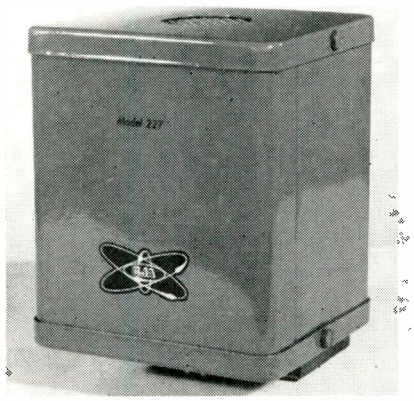


wall thickness for dimensional stability. Units will operate from −55° to 150°C in a relative humidity of 95%. Resistance ranges are to 400,000 ohms, ±3%. Linearity (standard) is 0.25% with special linearities of 0.020%. Up to 111 terminals can be added in the 10-turn series. Units function to 20g vibration from 55 to 2000 CPS, withstand a 30g shock and meet all specs to 30,000 ft. Spectrol Electronics Corp., 1704 S. Del Mar Ave., San Gabriel, Calif.

Circle 249 on Inquiry Card

FILAMENT SUPPLY

Model 227 is a 28 vdc filament supply. Specifications include output, 28 vdc at 1.2 amps max.; ripple voltage, 2% at max. output. Proportionately less at lower output currents; input, 117 vac 60 CPS. The transformer has



5 input taps to adjust to line and load conditions; physical, 3½ x 3¾ x 4½ in. overall seated. Metal case with octal plug base; weight, 2½ lbs. C. J. Applegate & Co., 1840 24th St., Boulder, Colo.

Circle 250 on Inquiry Card

International Electronic Sources

REGULARLY REVIEWED

AUSTRALIA

AWA Tech. Rev. AWA Technical Review
Proc. AIRE. Proceedings of the Institution of Radio Engineers

CANADA

Can. Elec. Eng. Canadian Electronics Engineering
El. & Comm. Electronics and Communications

ENGLAND

ATE J. ATE Journal
BBC Mono. BBC Engineering Monographs
Brit. C.&E. British Communications & Electronics
E. & R. Eng. Electronic & Radio Engineer
El. Energy. Electrical Energy
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel Avtomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
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CIRCUITS

A Two-Stage Amplifier with a Controlled Amplitude Response, G. B. Bogatov. "Radiotek" #4. 1959. 6 pp. The paper describes the circuit and the principle of operation of a two-stage amplifier whose amplitude response can be controlled over wide limits. The amplifier is designed for use as a contrast corrector in television systems. It can also be used for other purposes. Expressions are derived for the transfer coefficient of the amplifier. Experimental results are cited. (U.S.S.R.)

A Thyratron Modulator for a Self-Excited Oscillator, G. P. Grudinskaia, B. T. Zarubin, B. I. Poliakov. "Radiotek" #4. 1959. 2 pp. The paper describes a thyratron modulator which is used in the grid circuit of an oscillator. The design formulas and parameters for the circuit are given. (U.S.S.R.)

On Typicalizing Pulse Circuits, E. N. Baskakov. "Radiotek" #4. 1959. 2 pp. Comment on a letter to the Editor by A. A. Kharkevich. (U.S.S.R.)

Rectifying Bridges with Magnetically Connected Loads at the Output, O. G. Malkina. "Avto i Tel." May 1959. 9 pp. It is shown that rectifying bridges with inductive negatively connected windings at the output and considerable active circuit resistance can be used for measuring the values R and X of the complex resistance Z. As an example there is analyzed current change in identical circuits and in circuits with a.c. diagonal resistances differing from one another. (U.S.S.R.)

On Control Characteristic of Three-Phase Magnetic-Amplifiers, A. L. Pisarev. "Avto i Tel." May 1959. 15 pp. Two magnetic amplifiers with three-phase load are considered. Static work of the amplifiers mentioned is analyzed. Analytical expressions for control characteristics of the amplifiers are obtained. The analysis proves inexpedience of using amplifiers with sequential connection of phase control windings. (U.S.S.R.)

Calculation of A-C Magnetic Reactor Amplifiers with Internal Feedback, N. A. Kaluzhnikov. "Avto i Tel." May 1959. 16 pp. Most characteristic circuits of magnetic reactor amplifiers with internal feedback are considered. Circuits are analyzed in two instances which are extreme from the viewpoint of nonsinusoidal distortions. Possible calculation errors are estimated. Analysis results are given by calculation plots. (U.S.S.R.)

Response of Cascaded Double-Tuned Circuits, Yona Peless. "E. & R. Eng." April 1959. 7 pps. The transient and steady-state responses of cascaded identical double-tuned circuits are developed in terms of the locations of the poles of the transfer function. Results are obtained for two arbitrarily placed complex conjugate pole pair so that the work applies to networks with an amplitude response which is not necessarily symmetrical about the band centre; however, the narrow-band restriction is imposed. (England.)

A New Type of Ring Counter, P. J. Westoby. "El. Eng." May 1959. 4 pps. There are many occasions where a multi-stage ring counter is called for and the number of stages in the more usual schemes has been limited to 12, or so, for reasons mentioned. The article describes a system whereby any number of stages may be employed without the disadvantages met in the previous schemes. (England.)

Cold-Cathode Voltage-Transfer Circuit, J. H. Beesley. "J. BIRE." March 1959. 15 pps. The paper describes a new method of operation of cold-cathode triode switching tubes, which has some distinct advantages compared with the standard "pulse + bias" technique. (England.)

Group Delay and Group Velocity, Concept in Terms of the Transfer Function of a Network, W. Proctor Wilson. "E. & R. Eng." April 1959. 2 pp. (England.)

Ladder and Transformer Filters, Design Procedures and Characteristics, L. Kitajewski. "E. & R. Eng." May 1959. 5 pps. (England.)

Printed Circuits: New Methods for Making Master Drawings and Component Layouts, D. H. Sladek. "Brit. C. & E." April 1959. 3 pps. (England.)

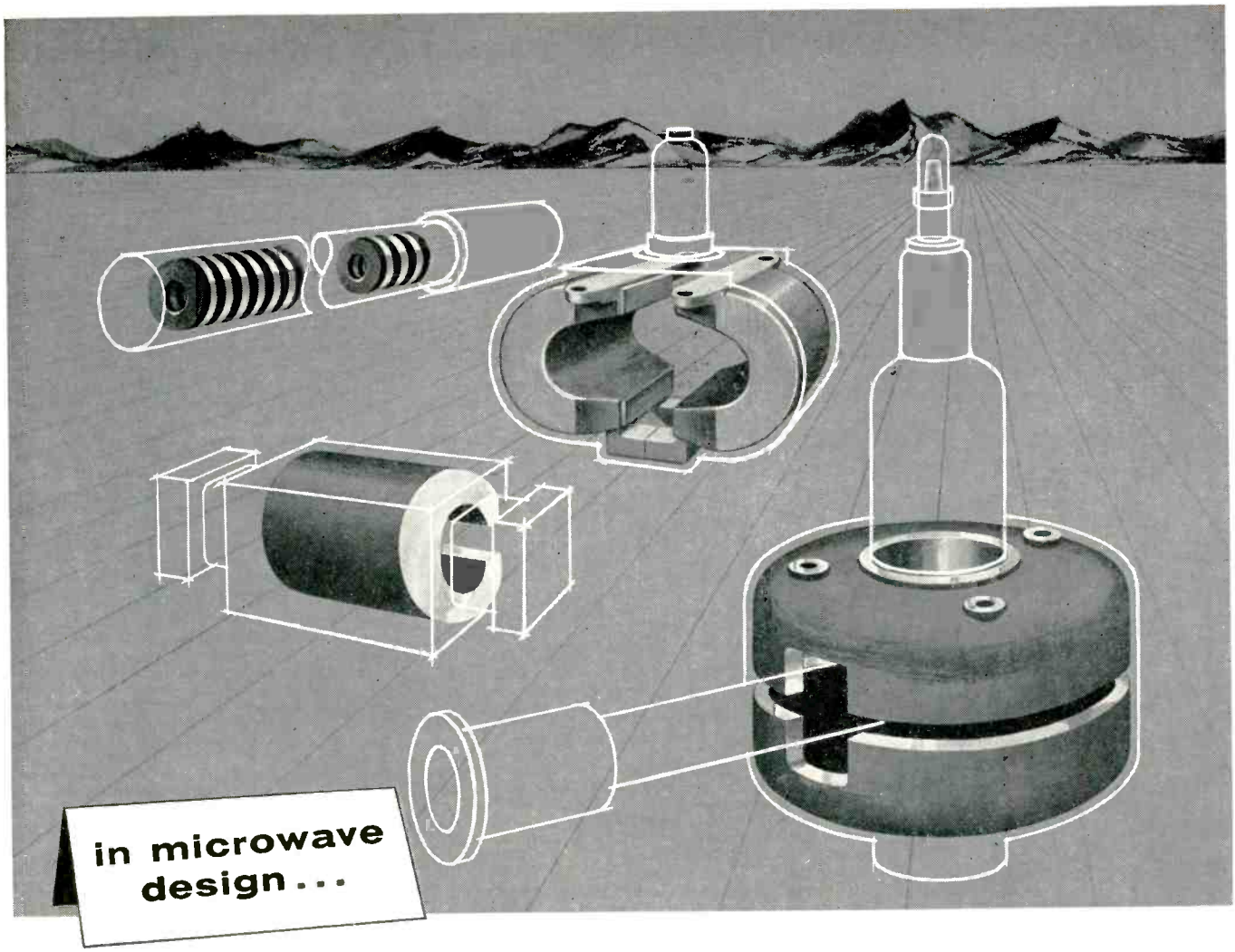
COMMUNICATIONS

Evaluating the Average Rate of Telegraphy for Interrupted Radio-Communication Using Frequency Shift, V. S. Mel'nikov. "Radiotek" #4. 1959. 9 pp. Using the general theory of potential (ideal) noise immunity developed by V. A. Kotel'nikov, an estimate is made of the average rate of telegraphy for interrupted frequency-shift radio-communication. The advantages of interrupted radio-communication are weighed. (U.S.S.R.)

An Electronic Speech Sampler for Studying the Effect of Sample Duration on Articulation. Richard Fatehchand & Rais Ahmed. "J. ITE." March 1959. 3 pp. (India, in English.)

A Miniaturized Radio Telephone Terminal Equipment, E. J. Allen. "El. Eng." May 1959. 3 pps. A radio telephone terminal equipment is described which although only a fraction of the size of conventional equipment provides a comparable performance and provides for the simultaneous operation of up to four commercial grade speech channels. (England.)

Electronics and Communications in Brazil, José I. Caicoya. "Brit. C. & E." May 1959. 7 pps. This article gives an impression of the present position of communications and



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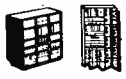
electronic techniques in Brazil together with some details of the manufacturing organizations in that country. The facts and figures will be of particular interest to British companies who are seeking markets in South America. (England.)

Simple Multiplex Vocoder, A. R. Billins. "E. & R. Eng." May 1959. 5 pps. A simple time-division multiplex vocoder is described which economizes in circuit components by using a common rectifier for all channels. This vocoder appears to contravene Shannon's sampling law, but it is shown that sampling ambiguities do not produce any marked change in character or intelligibility of the synthesized speech. (England.)

COMPONENTS

Determination of Main Parameters of Electromagnetic Relays, M. I. Vitenberg. "Avto i Tel." May 1959. 11 pp. Most important relations of conditional work, required power, overheat temperature and electromagnetic relay weight are considered. Experimental characteristics are presented. Formulae are deduced to determine relay conditional work as dependent on core section, required power, overheat temperature and relay weight. (U.S.S.R.)



COMPUTERS

On Coding Long Segments of Binary Symbols, V. A. Garmash. "Radiotek" #4. 1959. 3 pp. The paper analyzes a statistical method for coding messages using a uniform binary code. (U.S.S.R.)

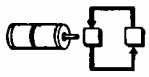
Application of Square Integral Estimate for Finding Optimum Parameters of Pilot with Rate Feedback, V. D. Matytsin and V. A. Ryapolov. "Avto i Tel." April 1959. 7 pps. Stabilization of a pilot with a feedback is treated. Formulae are deduced to determine pilot optimum parameters as dependent on aerodynamic characteristics of a controlled object and on flight conditions. (U. S. S. R.)

New Method of Building a Stability Plane in the Space of Admissible Parameters Values of Control Systems, V. I. Zubov. "Avto i Tel." March 1959. 4 pps. New method of building stability planes in the space of admissible parameters values is described. The suggested way of building stability planes does not require plotting a characteristic polynomial. (U. S. S. R.)

Choice of Non-Linear Speed Feedback Characteristics of a Position Servosystems, B. N. Naumov. "Avto i Tel." March 1959. 11 pps. The paper deals with choice of a nonlinear speed feedback characteristic when position servosystem structure is certain. The nonlinear speed feedback characteristic selected as it is suggested in the paper provides almost desirable transient process. (U. S. S. R.)

Analysis of Stability of Distributed Parameters Automatic Control Systems with Loss, Ya B. Kadymov. "Avto i Tel." April 1959. 3 pps. Stability criterion for distributed parameters controls systems is applied to control systems with loss. (U. S. S. R.)

Extremum Controller with Extremum Tracing, N. V. Grishko. "Avto i Tel." April 1959. 4 pps. Extremum controller with extremum tracing is described. The controller consists of two main parts: unbalance meter and tracing pulse system. (U. S. S. R.)



CONTROLS

The Condition for the Maximum Accuracy of Ferroresonant Voltage Stabilizers, by B. Z. Zilberman. "Radiotek" #4. 1959. 2 pp. The paper studies the relationship between stabilization accuracy, and the efficiency and ratings of the device. (U.S.S.R.)

Stabilizing Current L-C Devices, B. E. Kubyshin and A. N. Mikjakh. "Avto i Tel." May 1959. 6 pp. There are described L-C resonant circuit devices which can stabilize alternating or rectified load current with required accuracy when the load resistance range is widely changed. The introduction of inductive connection among the reactor windings and proper choice of coils results in getting a low stabilized current dependence on frequency variation. Stabilizing current L-C devices may actually be designed for any power limit. (U.S.S.R.)

Electric Drive with Powder Clutch and its Application in Automatic Control Systems, G. F. Konovalov. "Avto i Tel." May 1959. 6 pp. Results of solid filling powder clutches analysis are presented. Formulae for static characteristics and transfer functions of the clutch as well as of the clutch unit are deduced. A structural diagram and the characteristics of the servosystem with a powder clutch electric drive are given. (U.S.S.R.)

On Invariance Principle in Automatic Control Combined Systems, V. I. Dunaev. "Avto i Tel." May 1959. 4 pp. The paper deals with further development of invariance principle in automatic control combined systems with two motors under the same load. (U.S.S.R.)

Calculation of Static Characteristics of Reactor Control Systems, D. A. Alenchikov. "Avto i Tel." May 1959. 11 pp. Graphical solution of nonlinear problems of designing complicated reactor control systems is expounded. Path of operational point of a saturable reactor is plotted with taking into account losses in the saturable reactor. The way of plotting output load characteristics is described. Determination of initial data is proposed to choice or to design controller when the rule of mutual variations of the saturable reactor output load values is known. (U.S.S.R.)

On a Stability Criterion for Nonlinear Control Systems, Chang Szu-Ying. "Avto i Tel." May 1959. 4 pp. (U.S.S.R.)

Analysis of Periodic Motions in Electrical Servomechanism Vibration-Loop with Constant Disturbance, I. N. Krutova. "Avto i Tel." May 1959. 12 pp. Vibration loop with two parallel control channels is considered. Loop motion is described by three first-order equations. Dynamics of the loop is analyzed by means of phase plane and point transformation method. As a result of the analysis stability and singularity of self-oscillations are determined. Parameters of self-oscillations and loop static characteristics are found. (U.S.S.R.)

GENERAL

The Correlation Function for a Random Time Series of Rectangular Pulses, I. N. Amiantov, V. I. Tikhonov. "Radiotek" #4. 1959. 11 pp. Random pulse trains are classified (trains with and without storage, with and without overlap). A general formula is derived for the correlation function. The application of the formula is illustrated using examples. (U.S.S.R.)

A Mercury Thermoregulator with a Reduced Inertia, F. I. Kozhin. "Radiotek" #4. 1959. 3 pp. The paper describes a method for reducing the inertia of a mercury thermoregulator on the basis of using high-frequency heating and air cooling. An experimental test of the device was successful. (U.S.S.R.)

Determination of Transfer Function Coefficients of Linear System with Help of Experimental Frequency Response When $W \rightarrow O_8$, E. E. Dudnikov. "Avto i Tel" May 1959. 7 pp. The paper deals with determination of approximate transfer function coefficients of a linear system with the help of an experimental frequency response. To determine coefficients, initial part of the frequency response is used (when $w \rightarrow O$). The method described is applicable to linear systems with retardation too. Numerical determination of coefficients is given. (U.S.S.R.)

The Effect of Noise on an AGC System, V. V. Shirokov, V. G. Repin. "Radiotek" #4. 1959. 8 pp. The paper studies the effect of a stationary random process, with and without a regular signal, on an AGC system. The statistical characteristics are derived for the random process at the output of the AGC amplifier. The solution is obtained by the method of successive approximation. Recommendations are made concerning the selection of the AGC parameters. (U.S.S.R.)

Temperature Effects on the Impedance of the Standard 2.6/9.5 mm Coaxial Pair, M. C. Fouilleul. "Cab. & Trans." April 1959. 5 pps. A brief account of the experimental work done at the laboratories of Lignes Telegraphiques et Telephoniques on manufacturing lengths of standard 2.6/9.5 mm coaxial pairs. From those experiments, effected by means of an echometer, a variation law for the apparent impedance of the pair has been derived in terms of temperature. (France.)

Continuing Standardization Linked with Electronics Progress, Vincent de P. Goubeau. "El. Comm." April 1959. 3 pps. Every company needs at least one "standardization oriented" individual to dig, question, analyze, reveal, and act upon opportunities. His salary can be your best investment. (Canada.)

An Electrophysiological Amplifier for Students' Use, P. E. K. Donaldson. "El. Eng." May 1959. 2 pps. A compact, signal-sided amplifier is described for action-potential recording from excised nerve or muscle. The apparatus is entirely mains-driven, and it is felt that in this respect, and in view of its simplicity, it may be of interest to other biological laboratories. (England.)

A Rapid Response Recording Cardiotachometer, A. W. Melville and J. B. Cornwall. "El. Eng." May 1959. 4 pps. The instrument described has been designed for use under theatre conditions. It incorporates excellent discrimination against interference, an effective pulse amplitude control circuit and a rate recorder with alternative time-constants, one of which provides a rapid response suitable for the evaluation of fast acting stimuli. (England.)

Electronic Techniques in Gearbox Manufacture and Testing, R. K. Nott. "Brit. C. & E." May 1959. 4 pps. (England.)

Future Trends in World-Wide Telecommunications, R. J. Hitchcock. "Brit. C. & E." May 1959. 2 pps. (England.)

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MEASURE & TESTING

Induction Tachometer as Angular-Acceleration Pick-Up, S. T. Kazarjan. "Avto i Tel." May 1959. 6 pp. D-c induction tachometer is considered when it is used as angular-acceleration pick-up. (U.S.S.R.)

A New High Resolution Interferometer for Solar Studies, M. R. Kundu. "J. ITE." March 1959. 9 pp. (India, in English.)

Multichannel Recorder for High- and Low-Frequency Electrical Functions, G. Roder. "El. Rund." April 1959. 3 pp. This novel registration method enables an immediately visible and evaluable monochrome registration of all time functions on any exchangeable registration scale. (Germany.)

Definition and Measurement of Bandwidth in Radio, U. Schrock. "Nach. Z." March 1959. 8 pp. Various possibilities for the definition of bandwidth are compared with one another. It is shown that the time-frequency-spectrum is a better basis for the definition of bandwidth than the spectrum function. (Germany.)

Phase-Angle Measurement, Null Method Using Heptode Mixer, P. Kundu. "E. & R. Eng." April 1959. 5 pp. This article describes a "product" method of measuring the phase angle between two pre-adjusted out-of-phase sinusoidal voltages. The signals are applied to a heptode mixer whose differential anode current with respect to the reference value for quadrature inputs is a measure of the angle. (England.)

The Measurement of Random Noise in the Presence of a Television Signal. "B B C Mono." 24 March 1959. 10 pp. It is becoming increasingly important for authorities concerned with the generation, distribution, and radiation of television signals to have available an accurate method of measuring random noise in the presence of a signal. This monograph describes two realizations of a simple method which is based upon sampling the random noise in the known minimum-energy regions of the video spectrum. (England.)

The Design of Broadband Circular Wavemeters. P. Andrews. "Brit. C. & E." May 1959. 4 pp. The design of cavity resonators in general is discussed. The TE mode in a right cylinder is then treated and the design parameters are explained. Two examples, the J-band wavemeter XT350 and the K-band wavemeter XT389, are used to illustrate the article which treats the subject from a practical point of view. (England.)

Digital Voltmeter, H. Sutcliffe. "E. & R. Eng." May 1959. 7 pp. A description is given of a digital decade voltmeter in which Dekatron selector tubes are used to control the switching of precise values of current to a chain of precision resistors. (England.)

RADAR, NAVIGATION

Certain Special Features of Visual Indicators for Radar Signals, M. M. Gerdov. "Radiotek" #4. 1959. 5 pp. The paper studies the special features of recording radar signals in the system: panoramic radar receiver-operator. It is shown that the "average pulse duty ratio" for the noise is less than unity and that the computation of the probability of detecting the useful signal in the noise should be performed according to the formula for joint events. When the size of the image is greater than "critical," the operator perceives the noise peaks as discrete pips, and the main part in the signal detection is played by the signal energy which accumulates during the sampling time rather than by the signal power. (U.S.S.R.)

On the Theory of a Radio Range Finder with Frequency Modulation, B. V. Malanov. "Radiotek" #4. 1959. 11 pp. A detailed analysis is made of the output from the detector of an FM radio range finder. It is shown that the readings of a unit using an output device consisting of a pulse counter-limiter arrangement are practically independent of the type of frequency modulation. A detailed study is made of the widely used simplified analysis, and the limits of applicability for the method are determined. (U.S.S.R.)

The Influence of Certain Typical Nonlinearities on Autopilot Adjustment, M. E. Salukvadze. "Avto i Tel." May 1959. 11 pp. The power balance method is used to analyze the influence of control element nonlinearity on autopilot adjustment; the nonlinearity is due to restriction of the aileron angle when investigating the stability of the list. There is also analyzed the influence of the drive essential nonlinearity and quasi-nonlinearity of the autopilot mixer relay when investigating the airplane longitudinal stability. (U.S.S.R.)

Analysis of Linear Pulse Systems Using Simulation, G. P. Tartakovsky. "Avto i Tel." May 1959. 8 pp. Simulation of variable linear pulse systems is considered to get applicable pulse response. It is shown that pulse response may be obtained in the form of function of pulses application moments by simulation of pulse system adjoint as to the initial system. The way of forming structural diagrams of adjoint pulse systems models is described for two ways of simulating initial systems. (U.S.S.R.)

Radar Data Transmission, T. E. Schilizzi. "AWA Tech." #4, 1958. 32 pp. Information generated by a radar station is often required to be used at a distance. A.R.A.A.F. specification has led to a joint engineering developmental project with industry on this problem. This paper presents an estimate of the theoretical information required to be transmitted in a typical case. Practical methods of achieving a remote display over wide and narrow-bandwidth circuits are reviewed. (Australia.)

A Low-Drain Distress Beacon for a Crash Position Indicator, D. M. Makow, et al. "J. BIRE." March 1959. 13 pp. A new, light, simple and inexpensive radio distress beacon has been developed to survive airplane crashes. A special long-life pulsed transmitter with trickle-charged batteries and an internal capacitor antenna is potted in shock-absorbing foam which is transparent to radio waves and formed to a high-lift wing section. (England.)

The Place of V. H. F. Direction Finders in Air Traffic Control, S. A. W. Jolliffe. "Brit. C. & E." April 1959. 6 pp. Collaboration on a broad front between the Government Research Establishments and Industry has resulted in direction finders of steadily improved accuracy and flexibility. (England.)

The Place of V.H.F. Direction Finders in Air Traffic Control, Part 2, Applications, S. A. W. Jolliffe. "Brit. C. & E." May 1959. 6 pp. The practical application of the modern direction fiinder to the problems of air navigation are considered in this article and where possible systems are compared in terms of technical performance and capital and operating cost-factors in which the user is vitally interested. (England.)

SEMICONDUCTORS

Computing the Frequency Response of a Transistorized Amplifier, L. P. Kozintsova. "Radiotek" #4. 1959. 6 pp. Based on an analysis of the equivalent output circuit for a transistor, formulas are derived for computing the frequency and phase responses for a RC-coupled transistor amplifier with a common-base circuit. (U.S.S.R.)

Transistor Comparison Devices, V. M. Poljakov. "Avto i Tel." May 1959. 3 pp. Transistor comparison devices of null-element type are considered. The comparison devices in question are of high reliability, small sizes and of low required supply power. (U.S.S.R.)

Analysis of a Direct Coupled Astable Transistor Multivibrator, T. S. K. V. Iyer. "J. ITE." March 1959. 5 pp. Two grounded-emitter transistor amplifiers coupled capacitatively to each other work as an astable multivibrator which is similar to the free running plate coupled vacuum tube multivibrator. If one of the couplings is direct, under certain conditions, the system works as an astable multivibrator. (India, in English.)

Avalanche Transistors an Appraisal of Their Properties and Uses, R. C. V. Macario. "El. Eng." May 1959. 6 pp. The results from an investigation of the properties of some experimental alloyed junction avalanche transistors enables a review of their characteristics to be made. (England.)

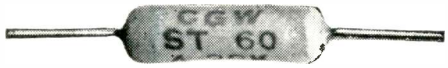
The Charge Storage in a Junction Transistor During Turn-Off in the Active Region, R. S. C. Cobbold. "El. Eng." May 1959. 3 pp. Through the solution of the one dimensional diffusion equation for a junction transistor, equations are derived for the emitter and collector currents that exist under conditions of minimum turn-off time. (England.)

TELEVISION

Television Coverage in the Service Area of the Ochsenkopf Transmitting Station, Erhard Graff. "Rundfunk." February 1959. 3 pp. After giving a brief historical survey of the possibilities of television coverage in northeast Bavaria, such as have existed in that area since the start of television, the author describes the efforts made to obtain a channel for the Ochsenkopf transmitting station. (Germany.)

High-Power Television Transmitting Station for Bands IV/V, A. Kolarz and A. Schweisthal. "Rundfunk." February 1959. 11 pp. At present two different methods are used for the amplification of the outputs of UHF television transmitters of 10 KW or more operating in bands IV and V. With frequencies of 400 Mc/s, in addition to amplifiers with grid-modulated valves, amplifiers with velocity-modulated valves (klystrons) are of interest. (Germany.)

The Technical Equipment of the Television Tower on the Ochsenkopf, Ernst Angermuller. "Rundfunk." February 1959. 10 pp. An introduction gives a summary of the layout of the technical equipment within the tower building. This is followed by a description of the



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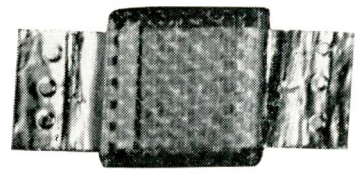

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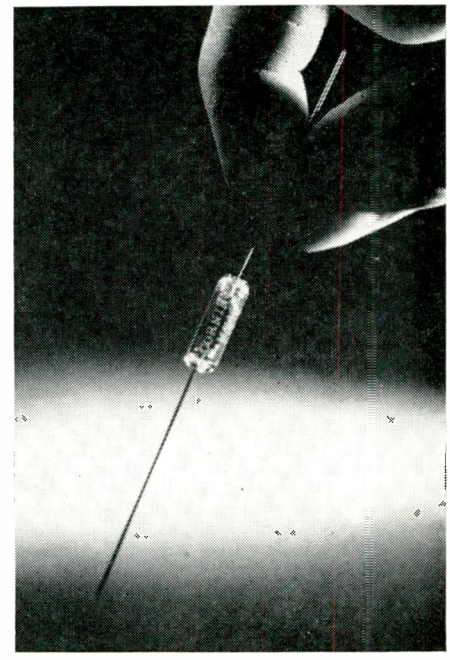

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CORNING ELECTRONIC COMPONENTS

design of the television transmitter, the control desk and the television transmitting aerial. (Germany.)

The State of Development and Possible Fields of Application of the Ampex System of Recording Television Signals on Magnetic Tape, Hans Joachim v. Braunmuhl. "Rundfunk." April 1959. 5 pp. The paper discusses in quantitative terms the performance of the Ampex system, after modification for the European 625 line standards, and compares them as far as possible with the corresponding figures for 16 mm-film. (Germany.)

The Deduction of Data for a Television Noise Evaluation Filter, J. Miller and E. Demus. "Nach. Z." April 1959. 6 pp. A visual acuity curve for the 625-line TV system has been derived from detailed human measurements. The result is compared with results obtained from other sources. Furthermore, it has been possible to give data for a practical noise evaluation filter which has the advantage of great simplicity and the attenuation response of which remains within ± db of the measured visual acuity curve. (Germany.)

The Re-Equipment of the Austrian Television Studios, Franz Brunner. "Rundfunk." April 1959. 10 pp. The operational accommodation of the Austrian television service was obtained by rebuilding and extending existing sections of buildings, and a description is given of the new construction and equipment. Three studios and their control rooms are equipped for producing live programmes, and there are also an announcer's studio and a control position for a transit programme. (Germany.)

Television Distributor, G. Dureau. "Cab. & Trans." April 1959. 6 pp. This paper relates to a distribution system for television signals installed at the long-distance line main station at MEUDON, which provides interconnection between Paris and various provincial centres according to television program requirements. (France.)

Subjective Impairment of Television Pictures, Effect of Signal-to-Random Noise Ration, L. E. Weaver. "E. & R. Eng." May 1959. 10 pp. The paper describes a series of tests which were undertaken by the B.B.C. in order to determine the statistical spread of opinion among viewers on the degree of impairment introduced into a television picture by known levels of wideband random fluctuation noise. (England.)

A Vidicon Camera for Industrial Colour Television, L. J. P. James. "J. BIRE." March 1959. 18 pp. The choice of systems, i. e. field-sequential or simultaneous, is discussed, and the conclusion is reached that it would be expedient to exploit the simultaneous colour camera using three vidicons. The main features of the camera and its associated control equipment are described. (England.)

TRANSMISSION

A Rectangular Waveguide with Longitudinal Irises, E. G. Solovei. "Radiotek" #4. 1959. 6 pp. The waves propagated in a rectangular waveguide with longitudinal irises of finite thickness can be separated structurally in the waveguide cross-section into symmetrical and anti-symmetrical waves. In turn, the symmetrical and anti-symmetrical waves can be separated into "fast" waves and "surface waves with a periodic structure." Among the infinite set of "surface waves," a portion has normal dispersion and a portion has anomalous dispersion. Any space harmonic can be taken as the "zero" space harmonic in the conditional sense. Increasing the thickness of the irises leads to an increase in the lag of the waves with normal dispersion, and to a decrease in the lag of the waves with anomalous dispersion. Increasing the thickness of the irises leads to a displacement of the pass bands toward longer wavelengths. (U.S.S.R.)

TUBES

A Proposed Ferrite-Tuned Magnetron, Amarjit Singh. "J. ITE." March 1959. 5 pp. General considerations are given for tuning a magnetron by suitably placing a ferrite material in the resonator and varying its effective permeability by means of a biasing magnetic field. It is shown that an inverted interdigital magnetron with a coaxial line coupled to the region enclosed by the fingers is well suited for this purpose. The ferrite can be placed near the shorted end of the line and can be biased by a radial field. The ferrite material thus located can be kept out of the main magnetic field of the magnetron; so that the interference of one with the other is avoided. (India, in English.)

Stass Electrolysis in Electronic Tubes, Fritz Engel. "Vak. Tech." March 1959. 4 pp. If stray electrons reach the glass envelope of an electronic high vacuum tube, secondary emission can take place, producing a positive electric charge on the inner wall of the envelope. The resulting electric field between the positive charged wall and the negative leads through the base of the valve, causes electrolytic effects in the glass. (Germany.)

Design and Performance of Backward Wave Oscillators, G. Bolz. "Nach. Z." March 1959. 8 pp. The paper includes a report of experiences made during the manufacture of backward wave oscillators with inter-digital lines. After a short summary of the operation of these tubes, the design date for a 4-8cm tube, obtained from calculations and test results, are given. (Germany.)

The Reason for Differences Between the Theoretical and Practical Values of the Shot Noise in High Gain VHF Triodes, R. Thielert. "Nach. Z." April 1959. 4 pp. Modern VHF triodes occasionally exhibit considerable deviations of the space-charge reduced shot noise from the theoretical value. The reasons for these deviations are investigated by means of experiments. The measurements have revealed, that the noise in valves exhibiting such deviations is composed of a portion without frequency sensitivity and one portion with a frequency characteristic. (Germany.)

Remarks Relating to the Theory of Backward Wave Tubes, K. H. Locherer. "Nach. Z." April 1959. 6 pp. The slow-wave structure tube theory given by Gundlach is applied to a mismatched backward wave tube with an inter-digital line (O-type carcinotron). The conclusions of this theory in the case of effects from reflections on the frequency characteristic and in the case of transient state currents are discussed. The results are in reasonable agreement with the experiment. (Germany.)

Measurement of a New Valve for Picture Presentation, W. Dillenburger. "El. Rund." April 1959. 4 pp. The depth of modulation of a new picture valve of 28 kV anode voltage was measured in the horizontal direction. At 5 mc/s it decreases to about 64% of that measured at 1 mc/s. Contrast and halo have almost no influence on the measured value. (Germany.)

On the Reduction of the Reolution of Image-Orthicons by Crosstalk of the Scanning Fields into the Picture Conversion Section, H. Fix and W. Habermann. "Rundfunk." April 1959. 5 pp. Several improvements in the picture quality of image-orthicons have become known in the past few years. Nevertheless, the resolution of this camera tube is still inferior for the 3 inch-type, than, for example, that of the super-iconoscope. (Germany.)

Cathode Compensation, Use with Pentode Video Stage, H. D. Kitchin. "E & R Eng." April 1959. 7 pp. (England.)

The Principles and Applications of Storage Tubes, E. B. Callick and J. C. Firmin. "Brit. C. & E." May 1959. 5 pp. Many of the problems of data recording, conversion and transmission can today be solved by means of storage tubes. This article surveys developments in these tubes and describes the principles of operation and applications of the various types. (England.)

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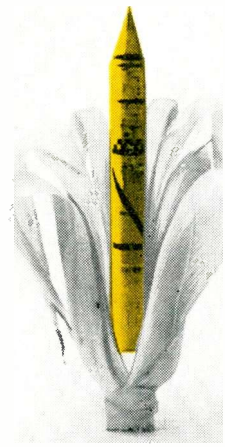

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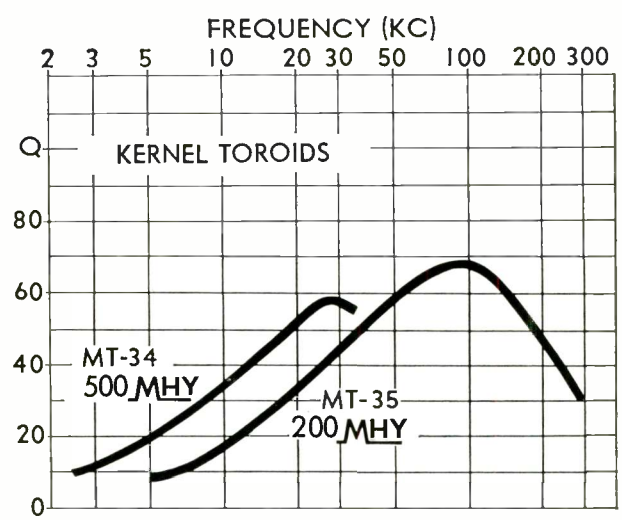

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PACIFIC DIVISION
DEPT. I-20
720 MISSION ST.
SOUTH PASADENA, CAL.
RYAN 1-2841
TELETYPE: PASACAL 7578

Circle 77 on Inquiry Card

Parametric Amplifier Diode

(*Continued from page* 100)

ure is about as low as can be effectively utilized with associated microwave equipment.

Many configurations exist for the diode amplifier, some of which appear more promising than others. To date none of these have met all requirements for an optimum device and much in the way of theoretical analysis and development remains to be accomplished.

Also under investigation are pump sources for the diode paramp, with development of a compact, lightweight all solid state pump as the ultimate objective.

This family of parametric amplifiers includes the tiny units which can double the range of ground and aircraft radar.

Examples of diode paramps which have been developed or are presently in the development stage include the following:

1. Signal Frequency; 1 KMC.
   Pump; 10 mw at 2.6 KMC.
   Gain; 20 db.
   Bandwidth; 1 MC.
   Noise Figures; 2.5–3.5 db.
2. Signal Frequency; 2.6 KMC.
   Pump; 20 mw at 6.2 KMC.
   Gain; 17 db.
   Bandwidth; 3 MC.
   Noise Figures; 3.5 db.
3. Signal Frequency; X-Band.
   Pump; 50–100 mω atK μ band.
   Gain; 17–20 db.
   Bandwidth; As yet unknown.
   Noise Figure; 9 to 15 db.

Railroad Electronics

(*Continued from page* 98)

A. B. Dick Co. The Videograph is a high-speed duplicator which uses television methods.

A camera, specially designed to transmit a sharp, clear signal, looks at the material to be reproduced. It then sends its signal by coaxial cable or microwave to the printing equipment. Here the signal deposits electrical charges on a continuous paper tape, and these charges correspond to the dark areas of the image.

The tape is dusted with black powder, which clings to the charged portions of the surface, and the powder is heated and pressed into the paper to make a permanent record. The entire system is extremely high-speed—for example, it can duplicate and print out 17,000 characters of elite typewriter-sized type per second.

Basically, the Videograph system works for the railroads this way: An unattended television camera is set up beside the railroad tracks at the outlying station. When a train passes, floodlights are automatically turned on, and the camera begins recording the cars' image as they pass by. The picture is flashed by coaxial cable or microwave relays to the desired point. There, the Videograph printout immediately turns out a clear, printed picture of the train on a running two-inch paper tape. From study of the permanent picture, the yardmaster knows both the car numbers and their sequence in the incoming train and can plan accordingly.

Other Applications

Because of the Videograph's flexibilities, the same equipment could be used for communication between the various elements of a large railroad system. And communication represents an extremely vital activity to running a railroad.

Moreover, another study—which was done for the A. B. Dick Company at the request of the Denver & Rio Grande Western Railroad—shows that the high-speed Videograph system can be used to transmit printed material, such as waybills, much more quickly and efficiently.

Electron Tube News —from SYLVANIA

Designing for extra reliability—everywhere in Electronics

TELEVISION...

New bonded-shield picture tube squares away the TV screen, increases viewing area, reduces reflection, improves light output and picture clarity

TV design engineers can now take advantage of one of the first major improvements in television faceplate design since the rectangular screen . . . the Sylvania bonded-shield picture tube. It incorporates a built-on panel of safety glass that makes the traditional separate safety glass unnecessary and opens the way to exciting new possibilities in TV cabinet design. It allows substantial reductions in both cabinet dimensions and cost. And because it reduces reflection, increased light output and clearer TV pictures result.

The squared away corners of the new bonded-shield picture tubes add approximately 20 square inches to the viewing area of a 21-inch screen. The 23-inch tube presents more of the picture as the camera sees it. The new bonded-shield picture tubes are available in 18″ and 23″ sizes (diagonal measurement) with conventional or Sylvania tripotential focus electron guns.

New Sylvania bonded-shield picture tube shows more picture than the conventional 21″ tube

INDUSTRIAL & MILITARY CATHODE-RAY TUBES...

New Sylvania high resolution CRT, type SC2782

Sylvania develops ultrahigh definition CRT for photo video recording in aerial reconnaissance and other applications where high resolution is necessary

All of the precision qualities of specialized fine spot CRT's are now available to design engineers in a new 5-inch CRT with a definition range of 3,000 lines. Through rigid selection techniques, greater accuracy controls, new fine grain phosphors and optical quality faceplate, Sylvania CRT engineers have been able to achieve this extremely fine definition using standard CRT auxiliary components and design. The new tube has an operating voltage of 20 to 25 KV. It incorporates an anode lead that is potted on the side of the tube to prevent corona and permit high-altitude applications. The tube has standard basing and a 6.3 V standard heater. It is available now for sampling through your Sylvania equipment representative or government office.

Sylvania is actively engineering CRT's with even greater resolutions —up to 6,000 lines—to meet the ever increasing needs of the armed forces and industry. We will welcome the opportunity to discuss your specific applications problems with you and to explore custom design possibilities to meet your needs. Contact your Sylvania representative or the factory directly today.

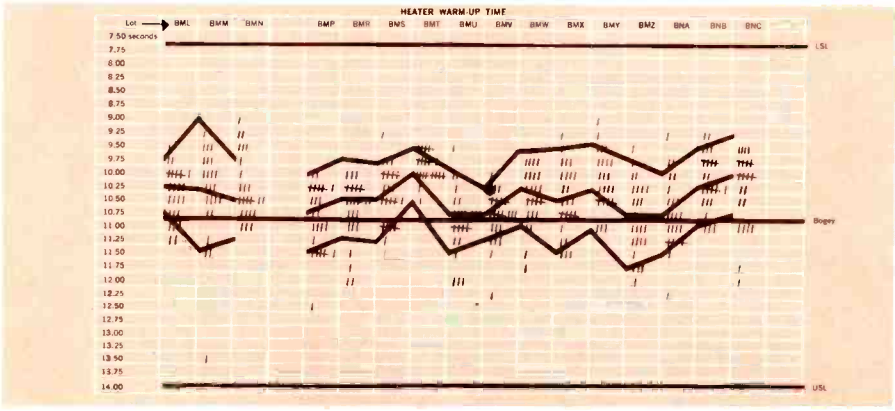
New design of standard 3-inch oscilloscope tube

Improved Sylvania oscilloscope CRT, type 3ASP1

Oscilloscope designers can obtain all the advantages of present 3-inch oscilloscope CRT's plus these added features with the new 3ASP1:

- **Improved faceplate—**
  Flat pressed type gives greater clarity —less distortion.
- **Better Insulation—**
  Anode connection located on side to prevent possible arcing.
- **Conventional basing—**
  Standard CRT stem and base is used.

Sylvania sets a new GOLD



Picture of Reliability—Actual graph of mixed variable-attribute inspection shows how individual tube lots meet a particular specification

New variables inspection procedure gives a quantitative picture of the reliability of each important characteristic in Gold Brand Tubes

A new measure of reliability is being extended to Sylvania Gold Brand Tubes. Developed by the Sylvania quality control department, it provides the design engineer with a true, measurable profile of the operating dependability of individual tube lots.

The new testing procedure—known as Mixed Variables—Attributes Inspection involves the recording of each characteristic reading, as opposed to ordinary go no-go testing by attributes. If the readings fall within the closely established acceptance limits, the tube passes the new testing procedure, otherwise it is rejected.

The new procedure not only provides Sylvania tube-design engineers with invaluable data for product improvement but allows Sylvania to provide the design engineer with tubes that more exactly fit his application needs.

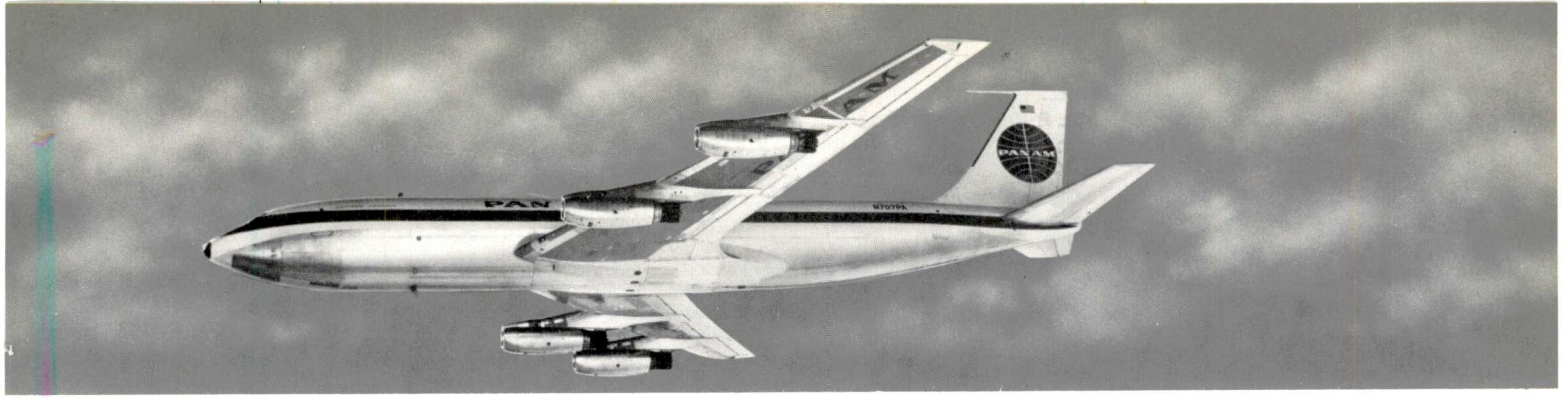
Sylvania develops new specifications for Gold Brand Industrial and Commercial Types to meet the specialized needs of jet airliners, commercial prop-driven aircraft, executive aircraft, mobile radio, marine radio and industrial control equipment

Now designers of electronic equipment for commercial and industrial applications can specify tubes that are tailored to meet their specific requirements. Sylvania has developed a line of 47 commercial industrial Gold Brand types, that are identified with a GB prefix. This is the mark of a Gold Brand tube specifically designed to meet commercial and industrial application requirements. Specialized specifications are already written for more than half of the GB line and eventually all 47 will be covered. These new GB specifications tailor military standards to the individualized requirements of commercial and industrial equipment. In many cases, the GB specifications exceed previously known requirements.

In every case, specification of Gold Brand Types provides the very highest degree of reliability and performance.

For example, type GB5751, a high mu double triode (9 pin miniature) meets a tougher AC Gain Test than the comparable military type. While the military type is tested to a 100 V supply, the supply for GB5751 is only 65 V. This provides extra assurance that the tube will operate effectively with a low voltage supply such as is used in fuel gauge circuits—the GB5751 also meets life test conditions that are more severe than the military.

Another example of a Gold Brand Industrial and Commercial type with specifications that exceed comparable military requirements is type GB5749. This semi-remote cutoff pentode (7-pin miniature) can withstand a 165°C maximum bulb temperature and is tested to lower grid emission minimums. This again is extra assurance the tube will perform reliably under high temperature conditions that may exist in today's high speed industrial and commercial electronic equipment.



Jet Age Choice—Sylvania Gold Brand tubes—Over 27 Sylvania types are in use in Pan American Boeing 707 Jet Airliners

GOLD BRAND standard

Sylvania Gold Brand Industrial and Commercial tubes have become one of the fastest growing tube lines in the electronics industry. Today every major airline uses Sylvania Gold Brand tubes. And in the new jet airliners, where the demand for top performance and reliability is more than ever a critical necessity, Sylvania Gold Brand types are becoming the leading choice. On Pan American's Boeing Jet 707 Airliners over 27 Sylvania types are in daily use.

Here are some of the tests that every Gold Brand tube must pass: Multiple Life Tests ranging from 500 to 1000 hours, Impact Shock Tests of up to 500 G, Fatigue Tests of 96 hours at 2.5 G, Vibration Tests, Glass Strain Tests, Variable Control Tests and Special Interface Control Tests are underway. And Gold Brand tubes must meet stringent electrical test requirements. Shorts and continuity are controlled to a 0.4% AQL and major electrical characteristics are controlled to a 0.65% AQL.

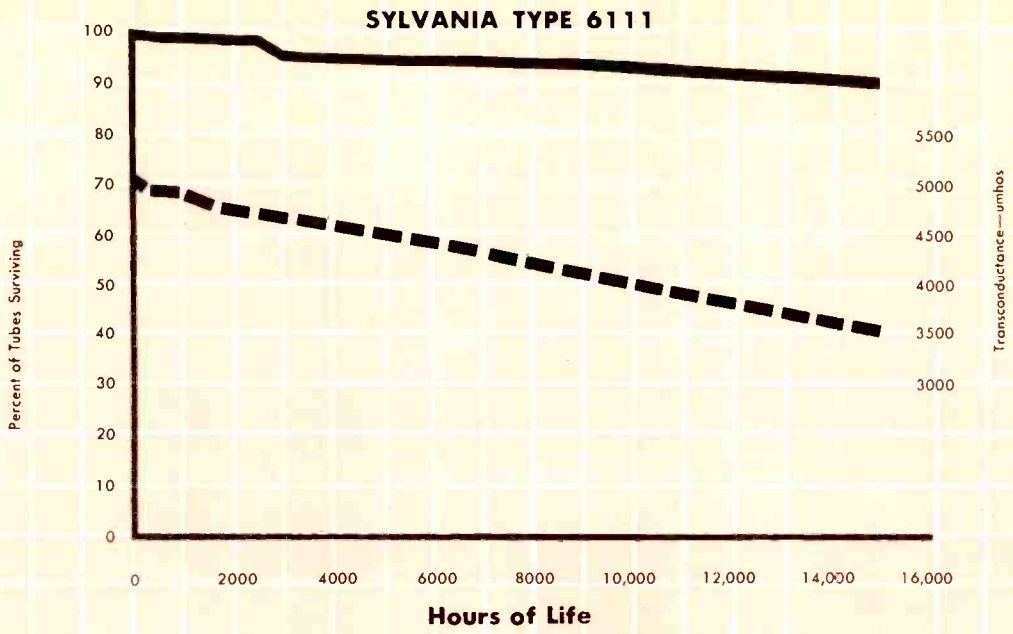
GOLD BRAND Guided Missile Types— Reliability in the Atomic Age

The electronic equipment in today's missiles, drones and aircraft must have the capability to withstand some degree of nuclear radiation if it is to meet realistic military operational requirements. Preliminary tests have already indicated Sylvania Gold Brand Guided Missile tubes have an immunity to radiation that solid-state devices tested do not exhibit.

The reliability of Sylvania's Gold Brand Guided Missile Line is outstanding because of the way it is manufactured and tested. The entire line undergoes Sylvania's exclusive White Noise Test which subjects each type to a vibrational spectrum covering the frequency band of 100 to 5,000 cps. The rms G-level is 2-3 G's per octave with peak G-level of 15 G's. The tubes are also tested for rms and peak vibrational output and limits are established on each.

SYLVANIA GOLD BRAND
Reliable Commercial and Industrial Types

Type	Description	Use
GB-OA2WA	Cold cathode diode	Voltage regulator
GB-OB2WA	Cold cathade diode	Voltage regulator
GB-5Y3WGTA	Double diade	Rectifier
GB-6AU6WB	Sharp cutoff pentode	Amplifier
GB-6J4WA	Hi mu triode	Grounded grid amplifier
GB-6SJ7WGT	Sharp cutoff pentode	Amplifier
GB-6SL7WGT	Hi mu double triode	Amplifier
GB-6SN7WGT	Medium mu double triode	Amplifier
GB-6X4WA	Double diode	Rectifier
GB-6X5WGT	Double diode	Rectifier
GB-7AK7	Dual control pentode	Computer
GB-7F8W	High mu double triode	Amplifier
GB-2BD7W	Double beam pentode	Power amplifier
GB-407A	Medium mu double triode	Amplifier
GB-408A	Sharp cutoff pentode	Amplifier
GB-1216	Medium mu double triode	Computer
GB-1217	Dual control pentode	Computer
GB-5654	Sharp cutoff pentode	Amplifier
GB-5670	Medium mu double triode	Amplifier
GB-5725	Dual control pentode	Gated amplifier, converter
GB-5726	Double diode	Detector
GB-5727	Tetrode thyratron	Relay, grid controlled rectifier
GB-5749	Semi-remote cutoff pentode	Amplifier
GB-5750	Dual control heptode	Gated amplifier converter
GB-5751	High mu double triode	Amplifier
GB-5814A	Medium mu double triode	Amplifier
GB-5930	Low mu triode	Power amplifier
GB-5931	Double diode	Rectifier
GB-5932	Beam pentode	Power amplifier
GB-5933	Beam pentode	Power amplifier
GB-5963	Medium mu double triode	Computer
GB-5964	Medium mu double triode	Computer
GB-5965	Medium mu double triode	Computer
GB-6005	Beam Pentode	Power amplifier
GB-6101	Medium mu double triode	Oscillator-amplifier
GB-6135	Medium mu triode	Oscillator-amplifier
GB-6145	Dual control pentode	Computer
GB-6186	Sharp cutoff pentode	Amplifier
GB-6189	Medium mu double triode	Oscillator-amplifier
GB-6201	High mu double triode	Amplifier
GB-6211	Medium mu double triode	Computer
GB-6350	Medium mu double triode	Computer
GB-6814	Triode	Computer
GB-6888 (Mil)	Duol control pentode	Computer
GB-7044	Medium mu double triode	Computer
GB-7137	Medium mu triode	Grounded grid amplifier
GB-7327	Medium mu double triode	Pulse Applicotions



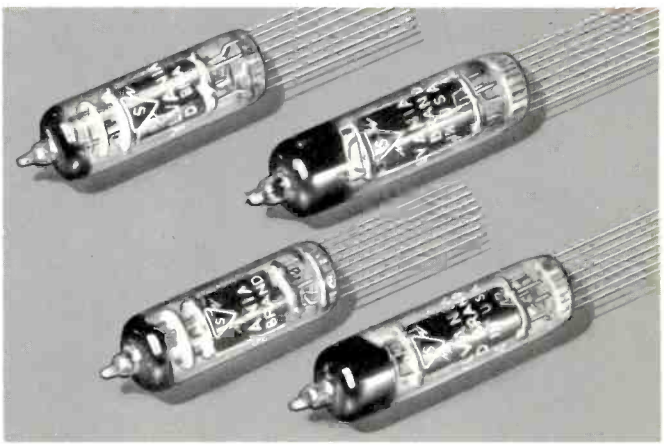
New test results show the outstanding capability of premium Gold Brand subminiature tubes

SYLVANIA TYPE 6111
Observed Survival Curve For Inoperatives Thru 15,000 Hours
Median For Transconductance Thru 15,000 Hours

GOLD BRAND Subminiatures—Reliability Plus

Life tests on Gold Brand premium subminiature tubes set new records of reliability

Unprecedented testimonial to the reliability of Sylvania Gold Brand Subminiatures is indicated by the results of new life tests on the tubes. They exhibit a mean time between inoperative failure of 133,000 hours. Life tests conducted for 15,000 hours on twenty lots of tubes show an average decline in Gm of only 2.4% per 1,000 hours. Inoperatives in these life tests exhibited a failure rate of 0.66% per 1,000 hours during the first 3,000 hours of operation and 0.75% per 1,000 hours during the following 12,000 hours.



SYLVANIA

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
P. O. Box 1190, Station "O," Montreal 9

electronic industries'

1959 DIRECTORY

of western electronic manufacturers

This directory is an alphabetical listing of Western electronic manufacturers and their principal products. Address, person to contact and telephone number are included to speed contacts. Triangle signifies WESCON exhibitors; an asterisk signifies Eastern and Mid-western firms with Western manufacturing facilities.

A

ACDC Electronics Inc 2979 N Ontario St Burbank Calif—R Hyder—App 125 Employees—VI 9-2414—Transformers, Power Supplies, Delay Lines

△AC Electronics Inc 11725 Mississippi Ave Los Angeles 25 Calif—Edwin L Almo

△*Acoustica Associates Inc 10400 Aviation Blvd Los Angeles 45 Calif—D S MacGregor—180 Employees—Ultrasonic Cleaning & Degreasing Systems, Liquid Level Gauging Switches & Continuous Liquid Level Sensing Gauges

△Advanced Electronics Mfg Corp 2116 S Sepulveda Blvd Los Angeles 25 Calif—B F Ambrosio—30 Employees—GR 8-9220—Oscilloscopes, Digital Computers, Data Display Devices

Advanced Instrument Corp 1740 University Ave Berkeley 3 Calif—R E Krueger—8 Employees—TH 5-4409—Digital Recorders, Hydrometers, Digital Memory Systems

*Advanced Relays/Electronics Div Elgin Nat'l Watch Co 2435 N Naomi St Burbank Calif — Eric Firth — 500 Employees—VI 9-1446—Relays

*Acme Electric Corp 12822 Yukon Ave Hawthorne Calif — Jack Hall — 35 Employees — OR 8-1238 — Transformer Winding Bobbins, Chokes, Power Supplies

Aero Electronics Corp 1745 W 134th St Gardena Calif—Steve Taylor—25 Employees—FA 1-2196—Trimming Potentiometers (High Reliability)

*Aeronautical & Instrument Div Robertshaw-Fulton Controls Co Santa Ana Freeway at Euclid Ave Anaheim Calif—Fred H Weisel—488 Employees—KE 5-8151—Crystal Ovens, Computers, Data Transmission Systems

△Aeronutronic Systems Inc 1234 Air Way Glendale Calif Richard P Lytle

△*Aerovox Corp 1100 Chestnut St Burbank Calif—James Fouch—Amplifiers, Capacitors, Filters

AiResearch Mfg Co of Arizona 402 S 36th St Phoenix Ariz—3400 Employees—Gas Turbine Engines, Constant Speed Drives, Pneumatic Controls

△*Air-Marine Motors Inc 2221 Barry Ave Los Angeles 64 Calif—D H Thomas—40 Employees—GR 9-8818—Motors, Blowers, Fans

△*Airtron Inc Div Litton Industries 336 N Foothill Rd Beverly Hills Calif—M Richard Williams

Alac Inc 365 W Arden St Glendale Calif—Milton Terkla—85 Employees—CI 4-7261 — Electronic Hardware (Standard & Custom)

△Aladdin Electronics Div Aladdin Ind Inc 380 Green St Pasadena 1 Calif—Chas L Freel

△Alfred Electronics 897 Commercial Palo Alto Calif—Paul N Fulton—47 Employees—DA 6-6496 Traveling Wave Tube Amplifiers, Electronically Swept Microwave Oscillators, Microwave Power Supplies

Allen Mfg Co 927 Industrial Ave Palo Alto Calif—Steve Allen—5 Employees — DA 1-4050 — Amplifiers, Chokes, Delay Lines

*Allied Control Co Inc/Pacific Coast Div 1326 Flower St Glendale 1 Calif—E Bachorik—100 Employees—CI 4-8103—Controls, Relays, Switches

△Allison Laboratories Inc 14185 Skyline Dr La Puente Calif—D E O'Donnell—6 Employees—OX 4-4056—Filters, Noise Generators

Alpar Mfg Co 220 Demeter St Palo Alto Calif—R V Laustrup—9 Employees—DA 6-8105—Towers, Parabolic Reflectors, Passive Reflectors

△Altec Lansing Corp 1515 S Manchester Ave Anaheim Calif—E F Grigsby—187 Employees—PR 4-2900—High Fidelity & Stereophonic Home Sound Systems, Public Address Systems, Microphone & Telephone Products

Alto Fonic Corp 981 Commercial St Palo Alto Calif—E W Shafer—19 Employees—DA 6-5280—Magnetic Tape Reproducers

Alto Instrument Corp 1357 E 14th St Oakland 6 Calif—Remy L Hudson—10 Employees—KE 4-4297—Amplifiers, Assemblies, Power Supplies

Alto Scientific Co Inc 855 Commercial St Palo Alto Calif—David D Cherry 45 Employees — DA 1-3434—Switches, Power Supplies & Switches, Time Delay Relays

AMECO-Div of Antennavision 2949 W Osborn Rd Phoenix Ariz—Malcolm Edwards—40 Employees—AL 4-5511—Distribution System Equipment, Community & Closed-Circuit Television

Amelco Inc 2040 Colorado Ave Santa Monica Calif—Remy L Hudson—EX 3-7281—Amplifiers, Cable Assemblies, Printed Circuits

American Avionics Inc 11513 W Washington Blvd Los Angeles 66 Calif—Harold Moss—30 Employees—EX 1-5749—Test Equipment, Power Supplies, Cables

American Concertone 9449 W Jefferson Blvd Culver City Calif—Howard P Ladd—150 Employees—TE 0-7245—Magnetic Tape Recorders, Recording Heads, Audio Amplifiers

△American Electrical Heater Co 2018½ S Beverly Glen Blvd Los Angeles 25 Calif—O Fred Nats

△American Electronics Inc 9503 W Jefferson Blvd Culver City Calif—Albert Izuel—300 Employees—UP 0-5581—Servo Motors, Synchros, Resolvers

△American Electronics Inc/Electric Machinery & Equipment Div 2112 N Chico Ave El Monte Calif—W W Neubauer—375 Employees—CU 3-7151—High Frequency Rotary & Static Power Supplies, Electrical & Pneumatic Ground Support Equipment, Magnetic Amplifier Type Voltage Regulators

△American Electronics Inc 1025 W 7th St Los Angeles 17 Calif—William Moffett Jr—1450 Employees—MA 4-9241—Accelerometers, Amplifiers, Converters

American MARC Inc 1601 W Florence Ave Inglewood Calif—Frank S Hill—258 Employees — OR 7-7149—Diesel Engines, Generators, Generator Sets

△*American Super Temperature Wires Inc 3440 Overland Ave Los Angeles 34 Calif—John M Cooner

American Thermo-Electric Co 1023 N Fuller Ave Los Angeles 46 Calif—A Levy—12 Employees—HO 4-1632—Vacuum Thermocouples

Ampex Audio Inc 1020 Kifer Rd Sunnyvale Calif—C A Foy—325 Employees—RE 6-2110 — Tape Recorders, Home Music Consoles

△AMPEX Corp/Instrumentation Div 934 Charter St Redwood City Calif—Robinette E McCabe—3250 Employees — EM 9-1481 — Mobile & Laboratory Magnetic Tape Recorders for Instrumentation Applications

Anadex Instruments Inc 14734 Arminta St (PO Box 4720) Van Nuys Calif—R M Flygare—ST 0-7911—Automatic Data Handling Equipment, Strain Gage Bridge Balance Units & Power Supplies, Transistorized Power Toggles & Static Relays

△Anchor Plating & Tinning Co Inc 9536 Rush St El Monte Calif—J Cranor Richter

△*Andrew Calif Corp 941 E Marylind Ave Claremont Calif—J D Montgomery Jr—35 Employees—NA 6-3505—Antenna Systems, Coaxial Transmission Lines, Waveguides & Components

△Appleton Co Inc Harry 136 San Fernando Rd Los Angeles 31 Calif—John B Miller—40 Employees—CA 5-5513—Antennas, Materials (Metal), Wire & Cable

△Applied Electronics Co Inc 213 E Grand Ave S San Francisco Calif—B H Ballard Jr—150 Employees—PL 6-4100 — Marine Electronic Equipment, Radio Telephones, Depth Sounders & Direction Finders

Applied Magnetics Corp Santa Barbara A/P Bldg 304 Santa Barbara Calif—H R Frank—11 Employees—WO 7-2016—Magnetic Recording Heads for Instrumentation Use, Special Magnetic Recording Devices

Applied Physics Corp 2724 S Peck Rd Monrovia Calif—R W Moulton—200 Employees—HI 6-7181—Vibrating Reed Electrometers, Ionization Chambers, Recording Spectrophotometers

Applied Radiation Corp 2404 N Main St Walnut Creek Calif—A S Klein—93 Employees — YE 5-2250 — Electron Linear & Positive Ion Accelerators, High Voltage dc Power Supplies, Custom Precision Electromagnet Systems

*Applied Research Labs Inc P O Box 1710 Glendale Calif—Wm E Davis—150 Employees — CH 5-5524—Spectrochemical Analyzers, Denistometers, Power Source Units

Applied Technology Inc 930 Industrial Ave Palo Alto Calif—V Barker—6 Employees—DA 1-5135—Research, Development & Custom Fabrication

*A R F Products Inc Gardener Rd Raton N M—Dave Joseph—100 Employees—995—Electronic Test Equipment, Remote Controls, Printed Circuits

Arizona Telemetering Corp 2923 E McDowell Rd Phoenix Ariz—Floyd F Lewis Jr—8 Employees—BR 5-3822—Voltage Controlled Oscillators, Sub-Contract Assembly

△Armour Electronics Div Cardinal Instrumentation Corp 4201 Redwood Ave Los Angeles 66 Calif—Jerry S Frank

Arnoux Corp 11924 W Washington Blvd Los Angeles 66 Calif—Lester Cole—75 Employees—TE 0-5371—Telemetering Decommutation Systems, Power Supplies, Temperature-Measurement Equipment

△Ash M Wood Co P O Box 1158 Arcadia Calif—Ash Wood

Asquith Co S A 427 W Chevy Chase Dr Glendale 4 Calif—James V Keith—25 Employees — CI 3-2878 — Accelerometers, Metal Bonding, Multiturn Counting Dials

△Astra Technical Instrument Corp 1132 Mission St South Pasadena Calif—W MacPherson

Atkinson Laboratory Inc 7070 Santa Monica Blvd Hollywood 38 Calif—R W Reed—10 Employees—HO 9-8374—Photographic Chemicals

△Atlas E-E Corp 577 S Fairfax Ave Los Angeles Calif—Clyde B Rush

△Atojm Electronics 7648 San Fernando Rd Sun Valley Calif—G H Elliott

1959 Directory of Western Electronic Manufacturers

Atomic Research Laboratory 10717 Venice Blvd Los Angeles 34 Calif—R D Finkle — TE 0-1161 — Radioactive Isotopes

△*Audio Devices Inc/Rectifier Div 620 E Dyer Rd Santa Ana Calif—A J Romano — 114 Employees — KI 5-8241—Silicon Rectifiers

Automation Service Co 2123 Outpost Dr Hollywood 28 Calif—A E Kipps—HO 7-3844—Electronic Analog Computers, Function Generators, Oscilloscopes

△Autonetics/Div North American Aviation Inc 9150 E Imperial Hwy Downey Calif—C R Raftery—7000 Employees — SP 3-2233 — Inertial Navigation Systems, Flight & Armament Control Systems

Aviation Developments Inc 210 S Victory Blvd Burbank Calif—James D Santacroce—100 Employees—VI 9-4631—Specialty Fasteners

△*Avnet Corp 5877 Rodeo Rd Los Angeles 16 Calif—M G Newberger—100 Employees—UP 0-6141—Connectors, Fasteners

B

Babcock Radio Eng'g Inc 1640 Monrovia Ave Costa Mesa Calif—Norman E Cime—400 Employees—LI 8-7705—Remote Control Transmitters, Remote Control Receivers, Test Equipment

Barry Controls Inc/Western Div 2821 N Naomi St Burbank Calif—A S Chivers—25 Employees—VI 9-2256—Shock & Vibration Isolators, Shock & Vibration Mounting Bases

Barwood Electronics Inc 921 E Broadway Glendale Calif—John Mutschler—10 Employees—CH 5-4063—Transformers, Footswitches, Power Supplies

Bauer Electronic Mfg Co 3728 Southwood Ave San Mateo Calif—Fritz Bauer—4 Employees—FI 5-0897—Transmitters

Baughman Co E J 1914 N Cogswell Rd El Monte Calif—E J Baughman—4 Employees—GI 4-7586—Remote Pan & Tilts, Explosion Proof Pan & Tilts, Mike Booms

△Bearing Inspection Inc 3311 E Gage Ave Huntington Park Calif—Charles McKnight

Beattie-Colman Inc 1000 N Olive St Anaheim Calif—T B Olsson—90 Employees — PR 4-4503 — Oscilloscope Recording Cameras "Oscillotron" Type Programers, Electrically Operated Pulse Cameras

△Becker Co Herb 1140 Crenshaw Blvd Los Angeles 19 Calif—Herb Becker

△Beckman/Berkeley Div 2200 Wright Ave Richmond Calif—John Scheck App 425 Employees—LA 6-7730—Digital Frequency Meters, Time Interval Meters, Preset Counter-controllers

Beckman & Whitley Inc 993 E San Carlos Ave San Carlos Calif—Myron B Baldwin — 108 Employees — LY 3-7824—High Speed Cameras, Meterological Instruments, Missile Products

△Behlman Eng'g Co 2911 Winona Ave Burbank Calif—J M Schroeder—100 Employees—VI 9-5733—Electronic ac Power Supply

Belleville-Hexem Corp 638 University Ave Los Gatos Calif—Logan M Belleville—6 Employees—EL 4-1379—D-C Amplifiers, Electric Measuring Instruments, Kilovoltmeters

Benchmaster Mfg Co 1835 W Rosecrans Ave Gardena Calif—Arch C Shafer—65 Employees — FA 1-0411—Milling Machines, Punch Press, Various types of Feeding Machines

△*Bendix Computer Div Bendix Aviation Corp 5630 Arbor Vitae St Los Angeles 45 Calif—450 Employees—SP 6-2220—General Purpose Digital Computers, Data Processing Systems, Flight Control Systems Simulators

△*Bendix-Pacific Div Bendix Aviation Corp 11600 Sherman Way N Hollywood Calif — Herbert Wilkinson—3500 Employees—ST 7-2881—Telemetering, Radar, Missile Guidance, Sonar & Underwater Ordnance

Benson-Lehner Corp 11930 W Olympic Blvd Los Angeles 64 Calif—Don Press—13 Employees—GR 9-3723—Film & Oscillogram Record Readers, Automatic Plotting Machines, Photo Instrument

Bently Scientific Co 2811 7th St Berkeley 10 Calif—D E Bently—5 Employees—TH 3-6303—Distance Detector, Energizer, Angular Accelerometer

B-H Electronics 2022 S Sepulveda Los Angeles Calif—Dudley Cassard—2 Employees — BR 2-3757 — Trimmer Potentiometers

Biggs Co Inc Carl H 1547 14th St Santa Monica Calif—D B Lott—11 Employees — TE 0-4910 — Bonding Agents, Potting Compounds, Circuit Board Coatings

△Birtcher Corp 4371 Valley Blvd Los Angeles 32 Calif—Charles F Booher—75 Employees—CA 2-9101—Tube & Component Retaining & Cooling Devices, Transistor Retaining & Cooling Devices, Medical Electronic Instruments

BJ Electronics Borg-Warner Corp 3300 Newport Blvd Santa Ana Calif—Herbert G Ayers—363 Employees—KI 5-5581—Vibrotron Transducer, Miniature Tape Recorders, Nuclear Instrumentation

Blaine Electronetics Inc 14757 Keswick St Van Nuys Calif—Robert F Blaine—20 Employees—ST 2-6303—Antenna Pattern Laboratory Equipment, Scale Models for Antenna Study, Scale Models for Technical Sales Purposes

Bodde Screen & Projector Co 11541 Bradley Ave (P O Box 711) Pacoima Calif—B M Bodde Jr—6 Employees—EM 5-2551—Translucent & Front Projection Screens, Slide Projectors

Booth Co Arthur E 265 So Alexandria Ave Los Angeles 4 Calif—Arthur F Booth—7 Employees—DU 1-2161—Power Supplies for Calibrating Electrical Instruments, Relay Test Sets for Testing, Calibrating Power System Network Protective Relays

△Borden Chemical Co 436 E Gutierrez St Santa Barbara Calif—Allen W Schmidt—75 Employees—WO 3134—Specification Grade & Commercial Grade Vinyl Insulation Sleeving, Tapes, Lacing Cord, Cable Jacketing & Cable Fillers

△Bourns Inc P O Box 2112 Riverside Calif—D P Vaughan—530 Employees — OV 4-1700 — Leadscrew Actuated Potentiometers, Transducers-Pressure. Position, Accelerometers

△Brand & Co Inc William 3030 Nebraska St Santa Monica Calif—Barney Sutton

△*Branson Ultrasonic Corp 12438 Ventura Blvd Studio City Calif—Kenneth P Hayes

Braun-Knecht-Heimann Co Glass Eng'g Dept 601 O'Neil Ave Belmont Calif—Hugh Hutchings—20 Employees—LY 3-8276—Special Glass Apparatus, Flat Glass Fabrication

Brubaker Electronics Inc 3642 Eastham Drive Culver City Calif—E Fredericks—220 Employees—TE 0-6441—Radar Test Equipment, IFF Equipment, Air Traffic Control Equipment

*Brush Instrument/Div Clevite Corp 1960 So La Cienega Blvd Los Angeles 34 Calif—Cole D Bacon—18 Employees—TE 0-7517—Oscillographs, Amplifiers, Operations Monitors

△Burnell & Co Inc 720 Mission St S Pasadena Calif—Frank Edmonds—2 Employees — RY 1-2841 — Delay Lines, Filters, Toroidal Coils

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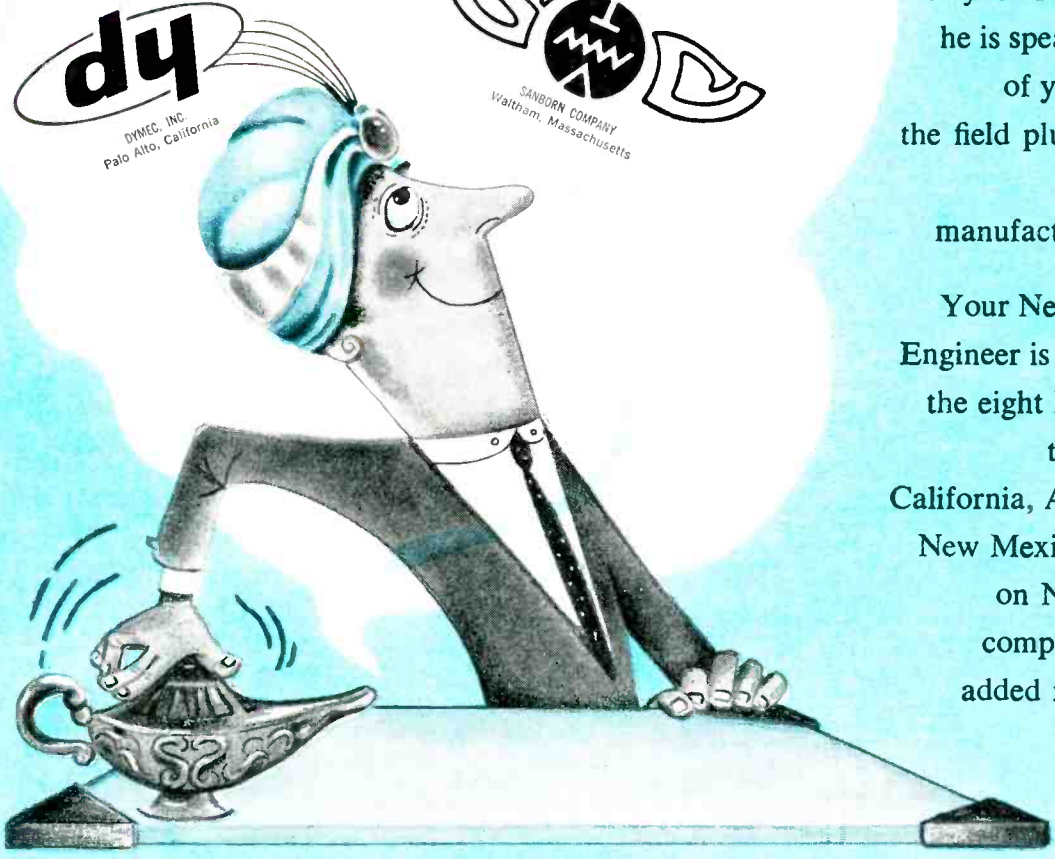

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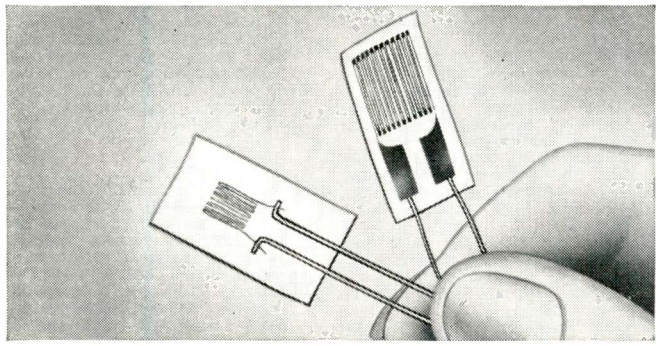

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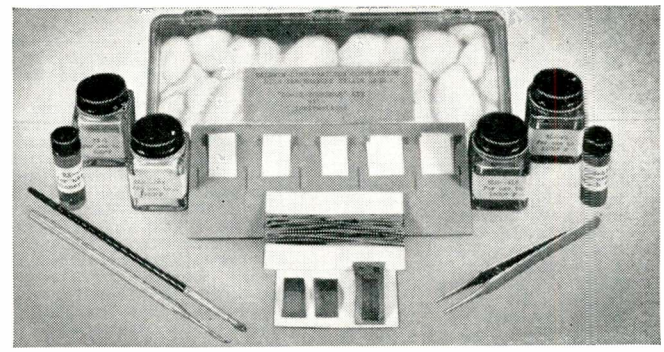

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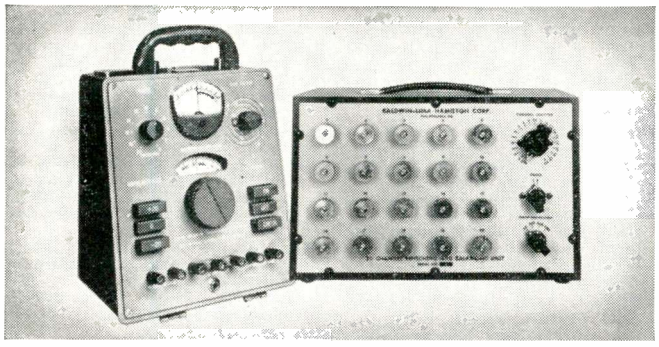

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△*Fairchild Semiconductor Corp 844 Charleston Rd Palo Alto Calif—David A Beadling—320 Employees—DA 6-6695—Diffused Silicon Mesa Transistors

△Featherstone & Salisbury Inc 1355 Market St #431 San Francisco 22 Calif—C M Salisbury

Feay Co Neal 133 La Patera Ave Goleta Calif—Neal F Rasmussen—24 Employees—WO 7-4521—Hardware Components for Electronics

Federal Equipment Co 38 Brady St San Francisco 3 Calif—R W Randolph—approx 25—UN 3-3607—Photoelectric Traffic Counting Equipment, Printing Counter Recorder Units

Federated Metals Div/American Smelting & Refining Co 4010 E 26th St Los Angeles 23 Calif—L A Blum—150 Employees—AN 8-4291—Tin-Lead, Acid Core & Rosin Core Solders

△Ferro-Magnetics Co 989 Commercial St Palo Alto Calif—S J Henke—11 Employees—DA 1-5141—Chokes, Delay Lines, Filters

△Filtron Co Inc 10023 W Jefferson Blvd Culver City Calif—Wm M Lana—75 Employees—VE 9-2206—Capacitors, Chokes, Filters

Fisher Berkeley Corp 4224 Holden St Emerilla 8 Calif—R S Fisher—20 Employees — OL 5-9696 — Wired & Wireless Loudspeaking Intercom Systems, Market Hospital & Industrial Sound Systems

Fisher Research Lab Inc 1975 University Ave Palo Alto Calif—E A Feichtmeir—48 Employees—DA 2-4646—AC & DC Millivoltmeters, Pipe & Cable Finders, Leak Detectors

△Fluke Mfg Co Inc John 1111 W Nickerson St Seattle 99 Wash—R E Florence—92 Employees—AT 2-5700—Voltmeters, Power Supplies, Electronic Wattmeters

△*Franklin Electronics Inc/Communications & Control Div Van Nuys Calif—Dr Martin L Klein—Precision Data Systems, Language Translators, Data Logging Systems

Friden Inc 2350 Washington Ave San Leandro Calif—George Beeken—3000 Employees—NE 8-0700—Calculators, Adding Machines, Data Processing Equipment

△Furane Plastics Inc 4516 Brazil St Los Angeles 39 Calif—80 Employees—Plastic Resins, Adhesives, Coatings

G

△Garrett Corp/Airesearch Mfg Div 9851 Sepulveda Blvd Los Angeles 45 Calif—Charles Hansen—8700 Employees—SP 6-1010—Central Air Data Systems, Electronic Cooling Equipment, Aircraft Temperature Controls

Garrett Corp/Airesearch Mfg Div 402 S 36th St Phoenix Ariz—Charles Hansen—BR 5-6311—Central Air Data Systems, Electronic Cooling Equipment, Aircraft Temperature Controls

*Gavitt Wire & Cable Co 455 N Quince St P O Box 336 Escondido Calif—John T Hall—40 Employees—SH 5-3181—Insulated Electronic Hook-up Wire, Cables & Cable Assemblies

△GB Components Inc 14621 Arminta St Van Nuys Calif—G R Geiger

General-American Valve Co 413 Poinsettia St P O Box 444 Corona del Mar Calif—Eugene C Greenwood—4 Employees—OR 3-2326—Precision Metering Valves

△Geist Co W K 3177 Glendale Blvd Los Angeles 39 Calif—W K Geist

△General Controls Co 801 Allen Ave Glendale 1 Calif—John E Flickinger—1800 Employees — VI 9-2181—Potentiometers, Electronic Systems, Hi-g Valves for Missile, Aircraft & Radar Application

General Electric Microwave Lab 601 California Ave Palo Alto Calif—Alden H Ryan—425 Employees—DA 4-1661—Amplifiers, Microwave Equipment, Tubes

△*General Electric Co Computer Dept 13430 N Black Canyon Hwy P O Drawer 270 Phoenix Ariz—G A Hagerty—1000 Employees—WI 3-2351—Electronic Computers

△*General Precision Laboratory Inc 180 N Vinedo Ave Pasadena Calif—T C Le Vay—20 Employees—MU 1-5669—Military & Commercial Aircraft Navigation Equipment, Closed Circuit Television Equipment, Special Test Equipment

△*General Transistor Western Corp Magne-Head Div 6110 W Venice Blvd Los Angeles 34 Calif—Martin Braude 50 Employees—WE 3-5867—Tape Head, (Magnetic Computer & Audio) Drum Heads

△Genisco Inc 2233 Federal Ave Los Angeles 64 Calif—W R Esser—197 Employees—GR 9-4331—Test Equipment, Instruments, Electric Motors & DC Motors

△Gertsch Products Inc 3211 So La Cienega Blvd Los Angeles 16 Calif—Edward W Watts—140 Employees—VE 9-2201—Electronic Test Equipment, AC Voltage Dividers, Special Instrument Transformers

△Giannini Controls Corp 918 E Green St Pasadena 1 Calif—R L Lawrence—40 Employees—RY 1-7152—Air Data Instruments, Inertial Instruments, Avionic Subsystems

Giannini Controls Corp Systems Div 1902 W Chestnut St Santa Ana Calif—C R Hodges—65 Employees—KI 7-5485—Avionic Subsystems, Ground Support Test Equipment, Instrumentation

△Girard-Hopkins 1000 40th Ave Oakland 1 Calif—A R Stack—25 Employees—KE 2-8477—Fixed Capacitors, Resistors

△Globe Electrical Mfg Co 1729-45 134th St Gardena Calif—Joe A Gamache—140 Employees—FA 1-3311—Relays, Potentiometers, Printed Circuits

△Goe Engineering Co 219 S Mednik Los Angeles 22 Calif—Jack Goerg—8 Employees—AN 1-2183—Terminals, Standoffs, Handles & Ferrules

*Gonset Div/Young Spring & Wire Corp 801 S Main St Burbank Calif—W E Hunter—255 Employees—VI 9-2222—Radio Communications Equipment

△Granger Assoc 966 Commercial St Palo Alto Calif—C A Walter—46 Employees—DA 1-4175—Amplifiers, Antennas, Power Supplies

Graphik-Circuits/Div of Cinch Mfg Co 200 S Turnbull Canyon Rd—City of Industry Calif—S L Glaspell—123 Employees—ED 3-1201—Printed Circuit & Terminal Boards, Flexible Printed Cables

Gudeman Co 2669 S Myrtle Ave Monrovia Calif—K R Clark—60 Employees—HI 6-3101—Delay Lines, Transformers

Gudeman Co of Calif 190 Commercial St Sunnyvale Calif — Mary Gudeman—200 Employees—RE 6-5471—Capacitors, Condensers

G W Associates P O Box 363 El Segundo Calif — 10 Employees — Calorimetric Wattmeter, Power Supplies

H

Hadley Co Inc Robert M 750 W 51st St Los Angeles 37 Calif—Arthur H Hadley—90 Employees—AD 4-9091—Transformers

△Hallamore Electronics Co 714 N Brookhurst St Anaheim Calif—John R Frost—700 Employees—PR 4-1010—Ground Support Systems & Equipment, Space Communication Systems & Equipment, Instrumentation Systems

Hallett Mfg Co 5910 Bowcroft St Los Angeles 16 Calif—Stanley E Estes—50 Employees—TE 0-7094—Radio Interference Shielding, Flexible Conduit Assemblies, Coaxial Connectors

△Halliburton Inc Mfg Div 4724 S Boyle Ave Los Angeles 58 Calif—J W Murphy

Hamilton Watch Co/Hathaway Instrument Div 5800 E Jewell Av Denver 22 Colo—R A Miller—500 Employees—SK 6-8301—Airborne Recorder, Automatic Oscillographs, Tuning Fork Frequency Standards

Handley Inc 14758 Keswick St Van Nuys Calif—James Hudson—20 Employees—ST 2-5840—Precision Potentiometers, Trimmer Pots (Custom & Special), Temperature Indicator

△Handy & Harman 330 N Gibson Rd El Monte Calif—Philip G Deuchler—50 Employees — CU 3-8181 — Alloys (Precious Metals, Silver & Gold, Silver Brazing)

Harder Co Donald C 3710 Midway Dr San Diego 10 Calif—Donald C Harder—20 Employees—AC 2-5240—Linear & Non-Linear, Magnetic Devices, Toroidal Coil Winders

Harworth Mfg Co 409 El Camino Real Menlo Park Calif—Keith Harworth—2 Employees—DA 3-9965—Detectors, Counters

△*Hayden Div General Time Corp 1213 N Highland Ave Los Angeles 38 Calif—Carl W Cummings

Heiland Div/Minneapols-Honeywell 5200 E Evans Ave Denver 22 Colo—Lloyd J Moyer—App 400 Employees—SK 6-3681—Direct-Recording Oscillographs, Carrier & Linear/Integrate Amplifiers, Bridge Balance Units

△Helipot Div/Beckman Instruments Inc 2500 Fullerton Rd Fullerton Calif—Michael York—700 Employees—TR 1-4848 — Precision Potentiometers, Monitoring & Control Components, Rotating Components

△*Hermetic Pacific Corp 4232 Temple City Blvd Rosemead Calif—Donald R Heins—85 Employees—GI 3-1757—Hermetic Seals, Hermetic Sealed Terminals

△Herrmann Associates Carl P O Box 1179 Palo Alto Calif—Carl W Herrman

△Hetherington Inc 139 Illinois St El Segundo Calif

△Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif—Peter N Sherrill—1800 Employees — DA 5-4451—Oscilloscopes, Digital Voltmeters, Frequency Counters & Recorders

△Hickok Electrical Inst Co 2585 Shattuck Ave Berkeley 4 Calif—G Ksander

△Hill Co J T 420 S Pine St San Gabriel Calif—John T Hill

Hi-Shear Rivet Tool Co 2600 W 247th St Torrance Calif—Guy Nach—DA 6-8110—Hi-Shear Rivets & Tools, Hi-Torque Bolts & Tools, Hi-Lok Fasteners & Tools

△*Hoffman Laboratories Div/Hoffman Electronics Corp 3740 S Grand Ave Los Angeles 7 Calif—R A Maher—2000 Employees—RI 7-4488—Navigation Equipment & Communications Equipment, Countermeasures Systems

Holex Inc 2751 San Juan Rd Hollister Calif—J W Jones—18 Employees—ME 7-5306—Explosive Cartridge, Electric Initiated Explosive Valves, Switches, Thrusters & Ignition Primers

Hoover Electric Co 2100 S Stoner Ave Los Angeles 25 Calif—H W Shaffer—300 Employees—BR 2-3125—Linear & Rotary Actuators, AC & DC Motors, Mechanical Drive & Control Components

△Hopkins Eng'g Co 12900 Foothill Blvd San Fernando Calif—John Schlenker—125 Employees—EM 1-8691—Fixed Capacitors, Condensers, Filters

Horkey-Moore Assoc 24660 S Crenshaw Blvd Torrance Calif—E J Horkey—DA 6-0733—Force Ejection Devices Ground Support Equipment, Heat Exchangers

Houston Fearless Corp 11801 W Olympic Blvd Los Angeles 64 Calif—A J Kjontvedt—315 Employees—BR 2-4331—Motion Picture Film Processing Equipment, TV & Motion Picture Studio Equipment—Astrodomes

Hufco Industries 2815 W Olive Ave Burbank Calif—O F Huffman—26 Employees—VI 9-2118—Relays

△Huggins Laboratories Inc 999 E Arques Ave Sunnyvale Calif—V D Varenhorst—210 Employees—RE 6-9330—Traveling Wave Tube Amplifiers, Backward Wave Oscillators

△Hughes Aircraft Co/Airborne Systems Div Florence & Teale Sts Culver City, Calif—32,168 Employees—RE 6-9330—Diodes, Radar Systems, Semiconductors

Hughes Aircraft Co Ground Systems Group 1901 Malvern P O Box 2097 Fullerton Calif—R M Sweeney—TR 1-3232—Radar Systems, Data Processing, Display & Computer Systems

Hughes Products/Industrial Systems Div Imperial Hwy Los Angeles 45 Calif—C C Roberts—165 Employees—OR 0-1515 — Crystal Filters, Memo-Scope (Storage Oscilloscopes)

△Hughes Aircraft Co/Hughes Products Div International Airport Sta P O Box 90427 Los Angeles Calif—OR 8-0361 — Airborne Flight, Control Systems & Digital Computers

Hughey & Phillips 3200 N San Fernando Blvd Burbank Calif—J H Ganzenhuber—16 Employees—VI 9-1104—Obstruction Lighting Equipment, Obstruction Lighting Control & Lamp Failure Alarm Units, Tower Lighting Isolation Transformers

Humphrey Castings Inc 3944 Riley St San Diego 10 Calif—George P Wilson—35 Employees—CY 6-6173—Investment Castings (Ferrous & Non-Ferrous)

Humphrey Inc 2805 Canon St San Diego Calif—J H Bender—AC 3-1654—Accelerometers, Gyroscopes, Missile Guidance Systems & Controls

Hunter Tools 9851 Alburtis Ave Sante Fe Springs Calif—R N Hunter Jr—50 Employees—OX 2-7231—Folding Hex Wrench Sets, Screwholding Screwdrivers, Color Coded Nut Drivers

△Hysol of Calif Div Houghton Labs Inc 1706 Potrero South El Monte Calif—Lloyd A Dixon

I

Ideal-Aerosmith Inc 3913 Evans Ave Cheyenne Wyo—Ronald G Popelka—59 Employees—7-7715—Manometers, Test Tables & Pressure Chambers, Needle Valves (sensitive)

Illumitronic Eng Co 680 E Taylor Ave Sunnyvale Calif—Joe D Givlie—20 Employees—RE 9-2395—Airdux Air Wound Inductors, Automatic Weigher, Spiral Wrap

△*Induction Motors of Calif/Div of IMC Magnetics Corp N Y 6058 Walker Ave Maywood Calif—C B Pearson—149 Employees—LU 3-4785—Solenoids, Synchro Components, Step-Servo Motors

Industrial Electronic Engineers Inc 3973 Lankershim Blvd N Hollywood Calif—John J Bylo—20 Employees—ST 7-0328—Control Equipment, Indicators

△*Instron Eng Corp 1271 S Boyle Ave Los Angeles 23 Calif—A E Cozens

*Int'l Business Machines Corp Monterey & Cottle Rds San Jose 14 Calif—2400 Employees—CY 7-2950—Date Processing Equipment

△Int'l Electronics Research Corp 145 W Magnolia Blvd Burbank Calif—John E Markley Jr—100 Employees—VI 9-2481 — Heat Dissipating Tube Shields for Subminiature, Miniature, Octal & Power Electron Tubes

△Int'l Rectifier Corp 233 Kansas St El Segundo Calif — Gar Goodson — 670 Employees—OR 8-6281—Silicon & Selenium Rectifiers & Diodes, Germanium Rectifiers

*Int'l Tel & Tel Labs/Div Int'l Tel & Tel 937 Commercial St Palo Alto Calif—H Busignies—41 Employees—DA 1-0211—Amplifiers, Chokes, Communication Systems

△Interstate Electronics Corp 707 E Vermont Ave Anaheim Calif—Charles T Cosser—407 Employees—PR 2-2222—Missile Range Instrumentation, Closed Circuit Television, Custom Cable

△Iron Fireman Mfg Co Electronics Div 2838 S E 9th Ave Portland 2 Ore—Henry DesGeorges—425 Employees—BE 4-6551—Miniature & Microminiature Hermetically Sealed Relays, Vertical & Free Gyroscopes, Slipring & Brush Assemblies

ITT Components Div 815 San Antonio Rd Palo Alto Calif—Robert Olander—50 Employees—DA 6-9900—Capacitors, Seals, Plug

ITT Industrial Products Div ITT Corp 15191 Bledsoe St San Fernando Calif—EM 7-6161—Power Supplies

J

Jack Scientific Instrument Co Bill 143 S Cedros St Solana Beach Calif—Richard T Johnson—150 Employees—SK 5-1551—Servo Amplifiers, Assemblies, Control Equipment

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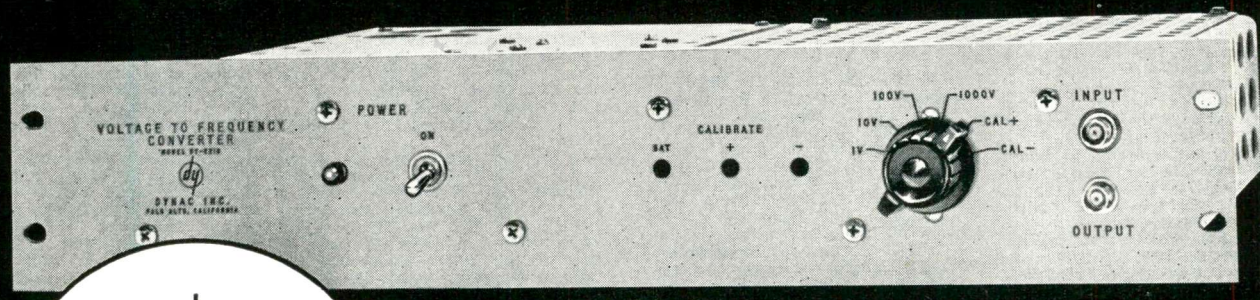

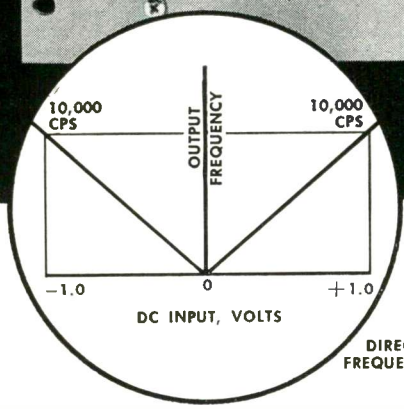

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Kaar Engineering Corp 2995 Middlefield Rd Palo Alto Calif—Harry Copelan—101 Employees—DA 6-5050— Marine Radiotelephones, Industrial Radiotelephones, Custom Transmitters

Kaiser Aircraft & Electronics/Div Kaiser Industries Corp P O Box 1828 Oakland 4 Calif—R M Watt Jr—750 Employees—LA 6-4688—Missile Preflight Testers, Contact Analog Display Systems, Thin Cathode-Ray Tubes

Kalbfell Electronix 3434 Midway Dr San Diego 10 Calif—D C Kalbfell—5 Employees — AC 3-7156 — Magnetic Amplifiers

Kartron P O Box 472 7882 Kartron St Huntington Beach Calif—Tom B Linton—5 Employees—JE 4-1161—Electronic Instruments

Kauke & Co Inc 1632 Euclid St Santa Monica Calif—John R Kauke—16 Employees—EX 5-5246—Transistorized PDM Telemetering Equipment, Signal Conditioners, Sub-Carrier Oscillators

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Kelvin Electric Co 5907 Noble Ave Van Nuys Calif—Boyd Barton—128 Employees—ST 3-2666—Precision Wire Wound Resistors, Subminiature Toroidal Coils, Uncased, Plastic Encapsulated Hermetic Sealed Magnetic Amplifiers

△Key Resistor Corp 321 W Redondo Beach Blvd Gardena Calif—W Peddie—45 Employees—DA 3-5000—Precision Film & Precision Wire Wound Resistors, Encapsulated Power Supplies & Special Circuits

K-F Development Co 2606 Spring St Redwood City Calif—Paul Keeler—8 Employees—EM 8-5670 — Precision Wire-wound Resistors, Potentiometers, Black Boxes, Components, etc

KFR Corp 6006 W Washington Blvd Culver City Calif—Thurman D Brooms—13 Employees—VE 8-3763—Cathode Ray Tubes & Special Purpose Tubes

Kinetics Corp 410 S Cedros Solana Beach Calif—F E Matthews—90 Employees—SK 5-1181—Power Changeover Switches, Static Commutators & Inverters, Voltage Testers

△King Eng'g Co 5321½ Hollywood Blvd Los Angeles 27 Calif—Robert E King Jr

△Kingsley Machine Co Electronic Div 850 Cahuenga Blvd Hollywood 38 Calif—John M Butler

△Kin Tel Div Cohu Electronics Inc 5725 Kearny Villa Rd San Diego 11 Calif E C Titcomb—400 Employees—BR 7-6700—Digital Voltmeters, Single-ended & Differential DC Amplifiers, Closed Circuit Industrial Television Equipment

Knapic Electro-Physics Inc 936-38 Industrial Ave Palo Alto Calif—George M MacLeod—65 Employees—DA 1-5544—Silicon Single Crystal Material, Silicon Infrared Large Diameter Material for Optical Purposes

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Lake Mfg Co 2323 Chestnut St Oakland 7 Calif—W E Howe—26 Employees—TE 2-2498—Audio Amplifiers & Equipment, Communications Systems

*Lambda-Pacific Engr Inc 14725 Armita St Van Nuys Calif—L W Mallach—52 Employees—ST 2-1980—Microwave Relay Systems, Microwave Test Equipment, UHF Translators

Laminair Inc 18530 So Broadway Gardena Calif—I W Love—app 20 Employees—FA 1-0545 — Radomes, Antenna Structure, Structural Airborne Components of Fiberglas Reinforced Plastic

La Moree C D 2433 Birkdale Los Angeles 31 Calif—Ben Ley—12 Employees—CA 5-5666—Dielectrics, Engraving, Insulating Compounds

Lance Antenna Mfg Co 1730-1802 1st St San Fernando Calif—Milton Mann—35 Employees—EM 1-8645—Outdoor Antennas, FM Antennas, Fringe Area Antennas

Land-Air Inc/Instrument & Electronics Div 2133 Adams Ave San Leandro Calif—B Pat Moore—80 Employees—LO 9-5841—Sub-Miniature Receivers, Radioactive Gas Monitors, Alpha Particle Converters

*Land-Air Inc P O Box 2327 Airport Sta Cheyenne Wyo—J T Shelton—232 Employees—2-6481—Missile Ground Support Equipment, Engineering & Fabrication of Aircraft Retrofit Kits for modification of aircraft

Lane Electronics Mfg Corp 7254 Atoll Ave N Hollywood Calif—John T Chase—22 Employees—PO 5-2413—Engineering & Production Prototypes of Electronic Units, Custom Radio Control Panels, Modification & Overhaul of Airborne Electronic Equipment

Lansing Sound Inc James B 3249 Casitas Ave Los Angeles 39 Calif—200 Employees—NO 5-4101 — Loudspeakers (High Fidelity), Loudspeaker Systems & Enclosures

Larson Electronic Glass P O Box 371 2426 El Camino Real Redwood City Calif—J Palmer Larson—4 Employees—EM 8-7228—Metal to Glass Seals, Electronic Components, Sealing

L & B Welding Equipment Inc 2424 6th St Berkeley 10 Calif—C F Leader—40 Employees—TH 3-5734—Controls, Testing & Welding Equipment

△Leach Corp Leach Relay Div 5915 Avalon Blvd Los Angeles 3 Calif—G F Rosewell—app 484 Employees—AD 2-8221—Relays (Over-voltage and Under-Voltage Relays and Contactors)

Lear Inc/LearCal Div 3171 S Bundy Dr Santa Monica Calif — Paul O Momenteller—587 Employees—EX 8-6211 — Accelerometers, Amplifiers, Special Antennas

Lee Electric & Mfg Co 2806 Clearwater St Los Angeles 39 Calif—Louis P Tuttle—NO 3-1295—Magnetic Amplifiers, Cable Assemblies, Magnetic Equipment

△Lenkurt Electric Co Inc 1105 County Road San Carlos Calif—W C Fisher—1359 Employees—LY 1-8461—Mobile Telephone & Microwave Radio Systems

△Lerco Electronics Inc 501 S Varney St Burbank Calif—Hugh P Moore—70 Employees—VI 9-5556—Terminals, Insulated Terminals, Instrument Control Knobs

△*Levinthal Electronic Products Inc 3180 Hanover St Stanford Industrial Park Palo Alto Calif—Albert J Morris—80 Employees—DA 6-1640—Transmitters, Modulators, Power Supplies

Lewis & Kaufman Ltd P O Box 337 Los Gatos Calif——Alfred Thompson—60 Employees—EL 4-3540—Transmitting Electron Tubes

*Librascope Inc Commercial Div 100 E Tujunga Ave Burbank Calif—A L Munzig Jr—250 Employees—VI-6061—Shaft-Position to Digital Encoders, X-Y Plotters LGP-30 General Purpose Digital Computer

△*Librascope Inc 808 Western Ave Glendale 8 Calif—Kenneth J Slee—2250 Employees — CI 4-6541 — Abalog/Digital Encoders, X Y Plotter, Minimal Airborne Computers

Librascope Inc/Precision Technology Dept 66 S "P" St Livermore Calif—Kenneth A Johnson—90 Employees—HI 7-3343—Exploding Bridgewire Ordnance Components, Proximity Scoring Devices, Image Converter Cameras

△Ling Electronics 1515 S Manchester Ave Anaheim Calif—W S Northridge—300 Employees—TE 0-7711—Vibration Test Systems, High Fidelity & High Intensity Sound Systems, High Power Transmitting & Industrial Tubes

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Litton Eng'g Labs P O Box 949 Grass Valley Calif—F L Towne—70 Employees — GR 1730 — Glassworking Lathes & Accessories, Vacuum Pumps, Hydrogen Furnaces

△Litton Industries Inc 336 N Foothill Rd Beverly Hills Calif—Crosby M Kelly—1100 Employees—CR 4-7411—Electronic Components, Equipment & Systems

△Litton Industries/Components Div Rodeo Rd Culver City Calif—Richard Williamson—12000 Employees—CR 4-7411—Printed Circuits, Computers, Radar Systems

Litton Industries 1476 66 St Emeryville Calif—Robert H Dolbear—30 Employees—OL 8-3831—High Definition & Special Cathode Ray Tubes, Computer & Image Storage Type Cathode Ray Tubes, Color Tubes

Litton Industries/Electron Tube Div 960 Industrial Rd San Carlos Calif—Norman H Moore—1350 Employees LY 1-8411—Carcinatrons, Filters, Tubes

Litton Industries U S Eng'g Co Div 13536 Saticoy St Van Nuys Calif—Paul J Robichaud—app 100 Employees — TR 3-3520 — Electronic Hardware, Printed Circuits, Terminals & Terminal Boards

Lockheed Electronics & Avionics Div Lockheed Aircraft Corp 6201 E Randolph St Los Angeles 22 Calif—S J Jatras—495 Employees—RA 3-8896—Telemetry Systems, Magnetic Tape Recorders (Airborne), Miniaturized Television System

△Lockheed Missile & Space Div 1122 Jagels Rd Sunnyvale Calif—L E Root—15000 Employees — RE 9-9611—Electronic Equipment Components & Systems

Loge J M 2171 W Washington Blvd Los Angeles 18 Calif—J M Loge—29 Employees—RE 4-9178 Inter-office Communication Systems, Audio Amplifiers, Portable Public Address Systems

△Luscombe Eng'g Co 1129 S Fair Oaks Ave Pasadena Calif—B K Brackman

Lynch Carrier Systems Inc 695 Bryant St San Francisco 7 Calif—E B Stone—200 Employees—EX 7-1471—Carrier Telephone & Telegraph Equip, Components, Remote Control & Telemetering Systems

Lyn-Tron Inc 5350 Riverton Ave N Hollywood Calif—Jack R Snyder—8 Employees—ST 7-9023—Printed Circuit Hardware, Molded Products, Connectors

M

△McCarthy Assoc 1055 E Walnut St Pasadena Calif—Edward R McCarthy

McKenna Labs 2503 Main St Santa Monica Calif—A G McKenna—10 Employees—EX 9-8846—Ultrasonic Equipment

△MacDonald & Co 1324 Etherl St Glendale 7 Calif—D G MacDonald—4 Employees—SY 0-1615—Sleeving Cutter, Jiffy Connector & Plug Holders, Circuit Board Holders

MacKay Research Labs P O Box 738 Benson Ariz—S H MacKay—11 Employees—Lead Sulphide Tubes, Magnetrons, Miscellaneous Type Photoconductive Tubes

MacKenzie Electronics Inc 145 W Hazel St Inglewood 3 Calif—Louis G MacKenzie—15 Employees—OR 8-9335—Audio Equipment, P. A. Systems, Audio Recorders

Magnasync Mfg Co Ltd 5546 Satsuma Ave N Hollywood Calif—Howard V Auchstetter—45 Employees—ST 7-5493—Amplifiers, Consoles, Control Equipment

*Magnavox Research Labs 2255 Carmelina Ave Los Angeles 64 Calif—J J Slattery—220 Employees—GR 9-7796—Digital Data Processers, Telemetry Commutators & Switches, Digital Communication Equipment

△*Magnecraft Electric Co 1157 N Western Ave Los Angeles 27 Calif—Richard A Strassner

*MagneTec Corp 7232 Eton St Canoga Park Calif—Vern Johnson—15 Employees — DI 7-4642 — Magnetic Brakes, Controls, Magnetic Clutches

△*Magnetic Amplifiers Inc 136 Washington St El Segundo Calif—Morris Beard—OR 8-2665—Magnetic Amplifiers, Variable Speed Drives, Motor Generator Controls & Systems

Magnetic Circuit Elements Inc 3722 Park Pl Montrose Calif—John S Conklin—15 Employees — CH 5-2012 — Magnetic Amplifier, Transformers, Instrument Sensors

Magnetic Research Corp 3160 W El Segundo Blvd Hawthorne Calif—John L Boethling—157 Employees—OS 5-1171—Magnetic Components & Subassemblies, Signal Conditioning System, Universal Temperature Measuring Systems

Mandrel Industries Inc Burbank Div 2950 N Ontario St Burbank Calif—Edward J Stephens—280 Employees—VI 9-2341—Custom Cable, Sheet Metal Fabrication & Electronic Assemblies

Mandrel Industries Inc 800 Welch Rd Palo Alto Calif—W E Wilson—DA 1-2366—Seismic Exploration Equipment, Photoelectric Sorting Machines, Integrating Gyroscopes

Manufacturing Associates 1416 Westwood Blvd Los Angeles 24 Calif—Lloyd F Washburn

*Marman Div Aeroquip Corp 11214 Exposition Blvd Los Angeles 64 Calif—Myra Sparkman—GR 3-0932—Pneumatic & Hydraulic Systems

Marquardt Aircraft Co Pomona Div 2709 N Garey Ave Pomona Calif—U W Richardson—368 Employees—LY 3-1311—Trainers & Simulators, Ground Support Equipment, Data Processing & Display Equipment

△Marsh Co J W 4216 W Jefferson Blvd Los Angeles 16 Calif—Earl M Rush

Mason Electric Corp 3839 Verdugo Rd Los Angeles 65 Calif—L H Littlefield—50 Employees—CL 5-1431—Switches, Relays & Contactors

Master Mobile Mounts Inc 1306 Bond St Los Angeles 15 Calif—Walter Watt—27 Employees—RI 7-0638—Antennas, Radio-Tel Equipment

△Master Specialties Co 956 E 108th St Los Angeles 59 Calif—Art Graver

△Menlo Park Eng'g 711 Hamilton Ave Menlo Park Calif—Harold W Harrison—35 Employees—DA 6-9080—Traveling Wave Tube Amplifiers, Electronically Swept Oscillators, Microwave Test Consoles

△Meridan Metalcraft Inc 8739 S Millergrove Dr Whittier Calif—W G Sterns—103 Employees—OX 2-3761—Custom Designed Microwave Sub-systems, Rigid Waveguide Components, Microwave Connection Links

△Mesa Plastics 12270 Nebraska Los Angeles 25 Calif—F C Karas—40 Employees—GR 8-2310—Molding Compounds, Molded Parts, Molded Prototype Stock

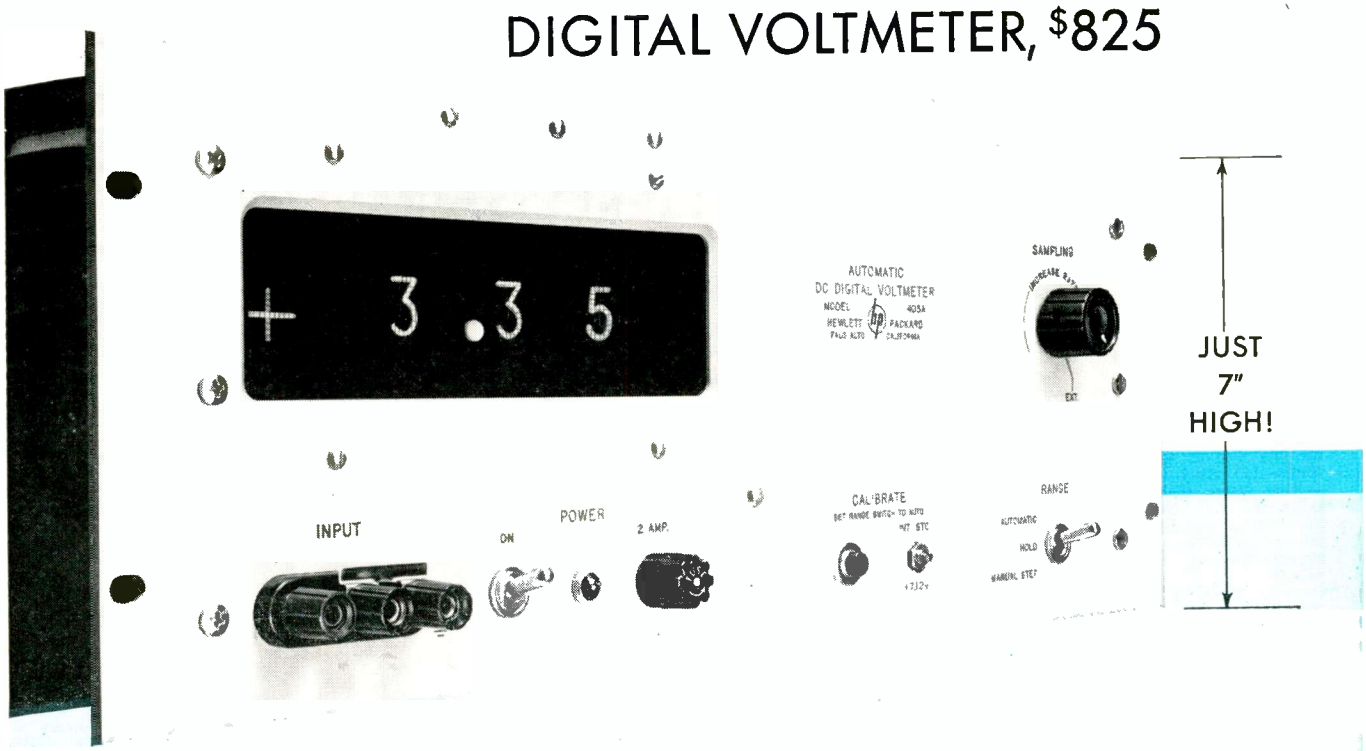
Metrolog Corp 160 N Halstead Pasadena Calif — Dale H DeMott — 22 Employees—MU 1-5194—Control System Instrumentation & Check-out Equipment, Power Supplies, Flight Control Components

Mica Corp 4031 Elenda St Culver City Calif—B Kessler—30 Employees—TE 0-6861 — Laminates, Epoxy Resin Glass Cloth (Unclad & Copper Clad)

△Michael Inc Claude 703 W Ivy St Glendale 4 Calif—Robert Michael

△Microdot Inc 220 Pasadena Ave S Pasadena Calif—Guy M Martin Jr—app 160 Employees—RY 1-3351—Ultramicrominiature & Microminiature Co-

DIGITAL VOLTMETER, $825



Automatic range and polarity selection. Just apply the probe and read voltage directly!

405AR DC DIGITAL VOLTMETER is a completely new instrument providing, literally, "touch-and-read" voltage measurements between 1 and 1,000 volts. *Range, even polarity, are automatically selected.* Readout is in-line, in bright, steady numerals.

New, novel circuitry provides a stability of readings virtually eliminating jitter in the last digit. This reduces operator fatigue and avoids uncertainty.

Special features include a floating input, electronic analog-to-digital conversion, digital recorder output and front-panel "hold" control permitting manual positioning of decimal. Voltage sampling rate is variable from 1 reading every 5 seconds to 5 per second; or can be controlled externally by a 20 v positive pulse.

BRIEF SPECIFICATIONS

Range: 0.001 to 999 v dc; 4 ranges.
Presentation: 3 significant figures, polarity indicator
Accuracy: ±0.2% full scale ± 1 count
Ranging time: ⅕ sec to 2 sec
Input impedance: 11 megohms to dc, all ranges
Response time: Less than 1 sec
AC rejection: 3 db at 0.7 cps; min. 50 db at 60 cps
Price: $825.00

Data subject to change without notice. Price f.o.b. factory.

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axial Cables & Connectors, Assemblies & Harnesses

△Micro Gee Products Inc 6319 W Slauson Ave P O Box 1005—B W McFadden—20 Employees—EX 1-1716—Flight Simulation Tables, Environmental Rate Tables, Servo & Operation Amplifiers

Microwave Electronics Corp 4061 Transport St Palo Alto Calif—Stanley F Kaisel—20 Employees—DA 1-1770—Amplifiers, Oscillators, Tubes

Microwave Eng'g Labs Inc 943 Industrial Ave Palo Alto Calif—James K Palmer—150 Employees—DA 6-9500—Frequency Meters, Microwave Receivers & Components, Signal Generators

Mid-Continent Mfg Inc/Datran Electronics Div 3613 Aviation Blvd Manhattan Beach Calif—Corwin D Denney—75 Employees — OS 5-7131 — Pressure Transducers, Resistance Bridge Indicators, Servo Converters

△Miller Co Gerald B 1550 N Highland Ave Hollywood 28 Calif—G B Miller

△Miller Co J W 5917 S Main St Los Angeles 3 Calif—J R Hummes—65 Employees—AD 3-4294—Chokes, Delay Lines, Filters

Miller Dial & Nameplate Co 4400 N Temple City Blvd El Monte Calif—Tom Moule—163 Employees—CU 3-5111—Name Plates, Dials, Foilcals

Miller-Robinson Co 7007 Avalon Blvd Los Angeles 3 Calif—James Robinson—60 Employees—PL 2-6141—Pressure Switches, Pneumatic & Hydraulic

△*Minnesota Mining & Mfg Co 11701 Mississippi Ave Los Angeles 25 Calif—Robert J Brown

△Mitchell Co G H 9015 Wilshire Blvd Beverly Hills Calif—C H Mitchell

Modern Communications Co Inc 605 Sunol St San Jose Calif—Arnold W Tiscornia—18 Employees—CY 7-4314—Audio Amplifiers, Assemblies, Audio Equipment

Modern Industries Inc 5755 Camille Ave Culver City Calif—J K Brose—20 Employees — UP 0-2020 — Transistorized Power Supplies

Monadnock Mills Sub United Carr Fastner 1977 1st Ave San Leandro Calif—G A Gianandres—175 Employees—EL 7-3700 — Connectors, Electronic Hardware, Wire Harnesses

△Monitor Products Co 815 Fremont Ave S Pasadena Calif—John W Blasier—65 Employees—RY 1-1174—Quartz Frequency Control Crystals, Crystal Ovens, Packaged Oscillators

Monogram Precision Industries Inc/Cascade Research Div 5245 San Fernando Rd W Los Angeles 39 Calif—Jerome S Jaffee—144 Employees—CH 5-8625—Microwave Components & Antenna Systems, Microwave Ferrite Modulator & Load Isolators, Microwave Circulators & Duplexors

Moore Associates Inc 2600 Spring St Redwood City Calif—James B Bullock—15 Employees—EM 9-0204—Remote Control, Telemetering & Alarm Systems, PDM Multiplexing Systems

Morrow Radio Mfg Co 2794 Market St Salem Ore—Fred Hart—30 Employees — EM 3-6952 — Communication Systems, Receivers, Transceivers

△Moseley Co F L 409 N Fair Oaks Ave Pasadena Calif—Myron Hunt

△*Motorola Inc Military Electronics Div 8201 McDowell Rd Phoenix Ariz—E E McLellan

△*Motorola Inc Semiconductor Products Div 5005 E McDowell Rd Phoenix Ariz—Charles S Granieri—760 Employees — BR 5-4411 — Transistors, Rectifiers, Diodes

*Motorola Inc 8330 Indiana Ave Riverside Calif—E D Jernigan—260 Employees—OV 9-3141—Radar Systems, Receivers

△Moxon Sales G E 489 S Robertson Blvd Beverly Hills Calif—G E Moxon

N

Nacimo Products 1090 Morena Blvd San Diego 10 Calif—William R Foster—25 Employees—BR 6-3020—Tachometer, AC-DC Converter, Temperature Transducers

NARMCO Resins & Coatings Co 600 Victoria St Costa Mesa Calif—W D Rainey—App 180 Employees—LI 8-1144—Structural Adhesive, Structural Laminating Materials, Epoxies, Resins & Putties

△National Cash Register Co/Electronics Div 1401 E El Segundo Blvd Hawthorne Calif—Wm Wright—204 Employees — PL 7-1811 — Computers Data Processing Systems, High Speed Printers

Neff Instrument Corp 2211 E Foothill Blvd Pasadena Calif—D B Schneider—20 Employees—Airborne & Ground DC, AC Amplifiers & Power Supplies

△Networks Electronic Corp 14806 Oxnard St Van Nuys Calif—Richard Ousley—123 Employees — St 3-2191—Amplifiers, Coils, Relays

Nevada Air Products Co P O Box 1090 Reno Nev—J W Baldecchi—230 Employees—FA 2-9421—Antenna Tuning Units, UHF Transmitter, Blower Units & Electromagnetic Speed Changers

Newcomb Audio Products Co 6824 Lexington Ave Hollywood 38 Calif—Robert Newcomb—85 Employees—HO 9-5381 — Sound Equipment, Photographs & Radios, Tape Recorders

New Hermes Engraving Machine Corp 1346 N Highland Ave Los Angeles 36 Calif—K J Flamm—5 Employees—HO 5-5414—Engraving Machines & Accessories

△Non-Linear Systems Inc Del Mar Airport Del Mar Calif—Peter J Van Benschoten—135 Employees—SK 5-1134—Indicators, Electronic Measuring Instruments, Measurement Equipment

Norgren-Stemac 5400 S Delaware Littleton Colo—Charles C Haney—App 100 Employees—PY 4-4271—Nameplates. Zinc Die Casting, Injection Molded Plastics

△Nortronics/Div Northrop Corp 222 N Prairie Ave Hawthorne Calif—R E Ringle—5108 Employees—OR 8-9111—Navigation & Guidance Equipment, Automatic Electronic Checkout Equipment, Mechanical Ground Support Equipment

Nucleonic Products Co Inc 1601 Grande Vista Ave Los Angeles 23 Calif—A J Jolles—50 Employees—AN 2-1187—Germanium Diodes, Photo Diodes, Thermistors

*Nutt-Shel Co 2701 S Harbor Blvd Santa Ana Calif—R C Poucher—150 Employees—KI 5-9311—Aircraft Self-Locking Nuts

NYT Electronics Inc 2979 N Ontario St Burbank Calif—R L Hyder—app 125 Employees—VI 9-5094—Transformers, Power Supplies, Delay Lines

△Nylok Corp 133 Penn St El Segundo Calif—B B Steele

O

△O'Halloran & Assoc John Francis 11636 Ventura Blvd N Hollywood Calif—John Francis O'Halloran

Olympic Instruments Inc Vashon Wash—Carlyle A Crecelius—4 Employees—HO 3-5641—Wire Length Meters, Reels

Olympic Plastics Co Inc 3471 S La Cienega Blvd Los Angeles 16 Calif—H M Rome—240 Employees—TE 0-1121 — Electrical Terminal Strips, Fiberglass Molded Parts, Plastic Packaging

△Optical Coating Lab Inc 977 Sebastopol Rd Santa Rosa Calif—L Vance Fisher—49 Employees—LI 5-6440—High Efficiency Dichroic Mirrors, Infrared Filters, Specialized Optical Thin Films

△Optron Corp 335 S Salinas St Santa Barbara Calif—G A Hotham

Orbitran Co Inc 11487 Woodside Ave Lakeside Calif—R J Price—10 Employees — HI 3-6832 — Pulse Delay Generators, Delay Lines, Electronic Weighing Systems

△Oregon Electronic Mfg Co 2105 S E 6th Ave Portland 14 Ore—H K Lawson—40 Employees—BE 6-9292—Power Supplies

△Osborne Electronic Sales Corp 712 S E Hawthorne Blvd Portland 14 Ore—T E Murphy—BE 2-0161—Transformers, Potentiometers

Owen Labs Inc 55 Beacon Pl Pasadena Calif—R P Owen—24 Employees—RY 1-6901—Power Supplies, Strain Gage Bridge Balance & Control Units, Transistor Test Set

P

Pace Eng'g Co 13035 Saticoy St N Hollywood Calif—Bernard Helfand—40 Employees—PO 5-0453—Thermocouple Reference Junctions, Pressure Transducers

△Pacific Automation Products Inc 1000 Air Way Glendale 1 Calif—E Regan—855 Employees—CI 6-2411—Special Cables & Cable Assemblies

Pacific Electricord Co 3217 Exposition Pl Los Angeles 18 Calif—Kurt Michael—AX 3-7025 — Cable Assemblies, Cables, Connectors

Pacific Mercury Electronics 8345 Hayvenhurst Ave Sepulveda Calif—Joel H Axe—1382 Employees—EC 2-3131—Television Receivers, Electronic Organs, Cable Assemblies

△Pacific Missile Range Pont Mugu Calif—CDR—R A Barracks

Pacific Relays Inc 13915 Saticoy St Van Nuys Calif—N F Leo—32 Employees—ST 2-2360—Relays

△Pacific Scientific Co 6280 Chalet Dr Los Angeles 22 Calif—Andre Reichol—300 Employees—SP 3-2020—Cable Tension Regulators, Aircraft Instruments, Furnaces for Electronics Industry

△Pacific Semiconductors Inc 10451 W Jefferson Blvd Culver City Calif—Frank E O'Brien—TE 0-4881—Capacitors, Rectifiers, Semiconductors

Pacific Technical Co 2047 Sawtelle Blvd Los Angeles 25 Calif—Louis G Fields—50 Employees—GR 7-0455—Two Phase Power Supply, Delta-Wye Isolation Box, Instrumentation

△Packard Bell Computer Corp 1905 Armacost Ave Los Angeles 25 Calif—Max Palevsky—90 Employees—GR 8-4247—Computers & Components, Converters, Digital Modules

△Packard Bell Electronics/Technical Products Div 12333 W Olympic Blvd Los Angeles 64 Calif—Hugh Vick—1100 Employees—Digital Computers, Missile Checkout & Launch Equipment, Airborne, Aircraft & Missile Electronic Equipment

Palmer Inc M V 4108 N W Fruit Valley Rd Vancouver Wash—Martin Palmer—OX 3-0590 — Telephone Switchboards, Radio Link Equipment, Infra-Red Communication Links

△Palo Alto Eng'g Co 620 Page Mill Rd Palo Alto Calif—E H Krueger—115 Employees—DA 6-5360—Magnetic Amplifiers, Chokes, Converters

Palomar Equipment Co 4254 Niagara Ave San Diego 7 Calif—Frank P Dane—40 Employees—AC 3-6796—Scatter Propagation Transmitters & Receivers

Palomar Research RT 1 Box 660 Escondido Calif—W F Collison—SH 5-1806—Digital Computers, Absolute Velocity & Altitude Systems, Non-Inertial Electronic "Space-Gyro"

*Parker Seal Co 10567 Jefferson Blvd Culver City Calif—W P Lester—250 Employees—UP 0-6821—Wave Guide Flange Seals, Flange Seals, Fastener Seals

Parks Lab Henry Francis 7544 23rd Ave N E Seattle 15 Wash—Henry F Parks—9 Employees—LA 3-4832—Moisture Gages, Regulated, Transistorized Power Supply Modules. Electrodes Professional Electronic Projects

PAR Products Corp 602 Colorado Ave Santa Monica Calif—C R Hallowell—7 Employees—EX 4-4219—Optical Read Heads for Electronic Punched Paper Tape Readers, Vector Cardiograph Recording Camera, Head Mount Visual Recording Camera

Parsons Co Ralph M/Electronics Div 151 S De Lacey Ave Pasadena Calif—Edson C Lee—161 Employees—RY 1-0461—Ground & Airborne Telemetry Equipments, Electronic Miss-Distance Indicator Systems, Ground Support Equipments

△PCA Electronics Inc 16799 Schoenborn St Sepulveda Calif—Paul Kliebert—App 125 Employees—EM 2-0761—Pulse Transformers, Delay Lines, Generators

Pearson Electronics Inc 707 Urban Lane Palo Alto Calif—Dr Paul A Pearson—9 Employees—DA 5-3147—High Voltage, High Power Pulse Transformer, Pulse Current Transformers, Voltage Dividers

Pee Cee Tape & Label Co 521 W La Brea Ave Los Angeles 36 Calif — Paula Miller—40 Employees—WE 8-2134—Pressure Sensitive Name Plates—Die Cut Masks, Pressure Sensitive Labels & Tapes

Pedersen Electronics Corp 3667A Mt Diablo Blvd Lafayette Calif—William T Wilkinson—40 Employees—AT 3-3434—Amplifiers, Analyzers, Electronic Counters

Peerless Electrical Products 6920 McKinley Ave Los Angeles Calif—Ercell B Harrison—124 Employees—PL 8-4175—Power, Input & Output & Impedance Matching Transformers

Peerless Electronics Inc 5338 Alhambra Ave Los Angeles 32 Calif—Robert Monroe—14 Employees—CA 1-5196—Clamps (Tube, Capacitor, Relays, etc)

Pendar Inc 14744 Arminta St Van Nuys Calif—R C Carter—65 Employees—TR 3-3136—Switches & Indicator Assemblies, Electronic Assemblies, Power Resistors

Penta Labs Inc 312 N Nopal St Santa Barbara Calif—R L Norton—104 Employees — WO 5-4581 — Electron Tubes

△Penwarden Co J G 7311 Van Nuys Blvd Van Nuys Calif—J "Pat" Houck

△Perkin Eng'g Corp 345 Kansas St El Segundo Calif—George W Mousel—170 Employees—OR 8-7215—Static DC Power Supplies, AC Line Voltage Regulators, Inverters-Converters (Static)

△Perlmuth Electronic Associates 5057 W Washington Blvd Los Angeles 16 Calif—J J Perlmuth—32 Employees—WE 1-1041 — Electronic Components & Instruments, Instrumentation for Guided Missile & Air Frames

Permoflux Products Co 4101 San Fernando Rd Glendale 4 Calif—L M Heineman—150 Employees—CH 5-5135 — Headsets, Speakers, Transformers

△Phaostron Instrument & Electronic Co 151 Pasadena Ave S Pasadena Calif—H J Veitch—380 Employees—CL 5-1471—Measurement Meters, Relays, Resistors

△Photo Chemical Products 1715 Berkeley St Santa Monica Calif—Henry G Renaud—175 Employees—EX 5-0919—Electronic Chemicals, Dials, Engraving

△Photocon Research Products 421 N Altadena Dr Pasadena Calif—(Mrs) P C Ganzell — SY 2-4131 — Amplifiers, Gages, Indicators

Photographic Analysis Inc 13273 Ventura Blvd N Hollywood Calif—T C Robinson—12 Employees—ST 3-3580—Electro Mechanical Programmer, Data Recording Camera, Contour Mapper

Pick Labs Sanborn Rd Saratoga Calif—Vernon J Pick—6 Employees—UN 7-3481—Data Display Systems, Control & Computing Systems

Pioneer Electronics Corp 2235 S Carmelina Ave Los Angeles 64 Calif—Zarmond Goodman—75 Employees—BR 2-8053—Relays, Switches, Tubes

Plastic Factors Inc 926 Broadway Redwood City Calif—Norman F Frost—9 Employees — EM 9-1764 — Wave Guide Flanges, Protective Covers, In-Plant Panel Protective Covers

Pomona Electronics Co Inc 1126 W Fifth Ave Pomona Calif—Carl Wm Nusarra—22 Employees—NA 9-9549—Patch Cords, Socket Savers, Surface Mounted Breadboard Sockets

△Precision Instrument Co 1011 Commercial St San Carlos Calif

Precision Technoloy Dept/Librascope Inc 66 S P St Livermore Calif—L W Imm—74 Employees—HI 7-3343—Electronic Cameras. Converters, Electronic Measuring Instruments

Prescott Television Co 7706 Melrose Ave Los Angeles 46 Calif—M Prescott—12 Employees—WE 3-7193—Video Recording Equipment. Custom Home Television Receivers

△Presin Co 2014 Broadway Santa Monica Calif—M D Teichner

Printed Electronic Research Inc 4212-4-16 Lankershim Blvd N Hollywood Calif—Jay H Praer—6 Employees—ST 7-3063—Power Amplifiers, Stero Equipment, Electronic Simulators

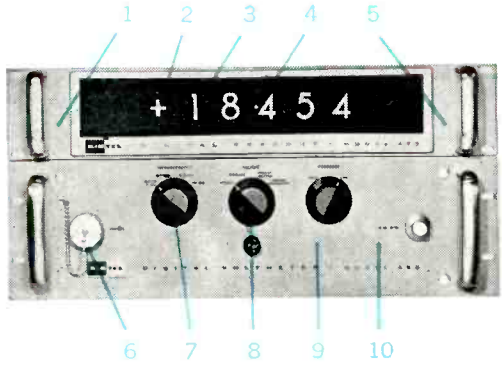
Printronics Corp 3127 El Camino Real Palo Alto Calif—J Coffron—60 Employees—Printed Circuit Boards

△*PSP Eng'g Co Div Induction Motors Corp 6058 Walker Ave Maywood Calif—C B Pearson—LU 3-4377—Coils, Control Equipment (Industrial), Industrial Electronic Equipment

Pulse Eng'g Inc 560 Robert Ave Santa Clara Calif—Hugh B Fleming—75 Employees — CH 8-6040 — Magnetic Amplifiers, Delay Lines, Filters

△Pyromet Co 429 S Canal St S San Francisco Calif—Robert L Ray

HERE'S WHY CALCULATING ENGINEERS USE KIN TEL DIGITAL VOLTMETERS

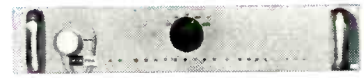


MODEL 501
DC DIGITAL VOLTMETER

1. **Single-Plane Readout**... no superimposed outlines of "off" digits... readout lamps have ten times longer life.
2. **Automatic Polarity Indication**... no lead switching.
3. **Ten Times Greater Resolution** at decade voltage points than other 4-digit voltmeters. A unique extra fifth digit in the left decade indicates "0" or "1" to provide 100% over-ranging.
4. **Automatic Ranging**... decimal point is automatically positioned for maximum resolution and accuracy.
5. **Remote Readout Mounting**... no electronic circuitry in readout allows easy remote mounting.
6. **Floating Input**... input may be floated above or below chassis ground... 10 megohms input impedance... input connectors on front and rear.
7. **Adjustable Sensitivity**... control permits decreasing sensitivity to allow reading of noisy signals... greatly increases instrument usefulness.
8. **Built-in Printer Drive** for parallel input printers... control permits either automatic operation when voltmeter reaches null, or remote operation by external contact closure.
9. **Reliability**... transistor drive circuits provide "cushioned" DC drive for stepping switches for long, trouble-free operation.
10. **Accuracy**... measures DC from ±0.0001 to ±1000.0 volts... continuous, automatic calibration against internal standard cell provides 0.01% ±1 digit (of reading) DC accuracy.

Price: $2995

These let you measure AC, increase sensitivity, measure ratios, scan multiple inputs



AC CONVERTER — Price: $850

The Model 452 AC converter can be added to the basic 501 DC digital voltmeter to permit 4-digit measurement of 0.001 to 999.9 volts AC, RMS, 30 to 10,000 cps. Accuracy is 0.2% of full scale and ranging is manual (auto-ranging models are available).

DC PREAMPLIFIER — Price: $1475

The Model 459 differential DC preamplifier has a gain of —100 which extends the DC sensitivity of KIN TEL digital voltmeters to 1 microvolt. Overall system accuracy when the 459 is used with a digital voltmeter is 0.15% ±5 microvolts. Input resistance is greater than 5 megohms, and input and output circuits are completely floating and isolated from each other and chassis ground. Common mode rejection is 180 db for DC and 130 db for 60 cps with up to 1000 ohms input unbalance. Input can be floated up to ±250 volts.

AC-DC PREAMPLIFIER — Price: $1225

The Model 458 is a single-ended preamplifier with a gain of —100 which extends the sensitivity of KIN TEL digital voltmeters to 1 microvolt DC, and 10 microvolts AC from 30 to 2000 cps. Overall system accuracy when the 458 is used with a digital voltmeter is 0.1% ±2 microvolts for DC, and 0.25% of full scale for AC.

DVM & RATIOMETER — Price: $3835

The Model 507A measures both DC voltages from ±0.0001 to ±1000.0 volts and DC/DC ratios from .0001:1 to 999.9:1. Ranging is automatic and accuracy is 0.01% ±1 digit both for ratios and voltage. Any external reference between 1 and 100 volts may be used for ratio measurements.

INPUT SCANNER

The Model 453M master scanner automatically or manually scans up to 400 1-wire, 200 2-wire, or 100 4-wire inputs. Addition of a slave scanner (453S) permits scanning up to 1000 data points.

5725 Kearny Villa Road, San Diego 11, Calif.
Phone: BRowning 7-6700
Representatives in all major cities

KIN TEL
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1959 Directory of Western Electric Manufacturers

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Radar Relay Inc 2322 Michigan Ave Santa Monica Calif—W C Arrasmith—25 Employees—EX 4-2230—Word Warning Systems, Electrical Relays, Mercury Pushbutton Switches

Radiatronics Inc 5956 Kester Ave Van Nuys Calif—George Hewitt—36 Employees—ST 2-1461—Missile, Aircraft & Communications Antennas, Antenna Components

△*Radio Corp of America West Coast Missile & Surface Radar Dept 11819 W Olympic Blvd Los Angeles 64 Calif—M E Collins—1000 Employees—GR 8-0251—Adapters, Amplifiers, Radar Antennas

Radiophone Co Inc 600 E Evergreen Ave Monrovia Calif—Frank E Hamilton—App 200 Employees—EL 8-2585—Telemetering Systems, Telemetering Components, Ground Support Equipment

Radioplane/Div Northrop Corp 8000 Woodley Ave Van Nuys Calif—W D McBride—ST 6-7020—Target & Surveillance Drone Systems

△Ramo-Wooldridge/Thompson Ramo Wooldridge Inc 5500 W El Segundo Blvd P O Box 90215 A/P Sta Los Angeles Calif—David T Traitel—Digital Control Computers

Ransom Research 323 W 7th St P O Box 269 San Pedro Calif—David H Ransome Jr—12 Employees—TE 2-6848—Computer Elements, Data Processing Systems, Analog to Digital or Digital to Analog Converters

△Rantec Corp 23999 Ventura Blvd Calabasas Calif—Jack Wills—85 Employees—DI 7-5446—Antennas, Multiplexers, Microwave Ferrite Devices

Ratel Inc 1 El Camino Ratel Goleta Calif—G E Archenbronn—100 Employees—WO 7-1214—Transformers, TV & Radio, Torroidal Transistor Coils & Transformers

*Raytheon Co Research & Development Lab P O Box 636 Santa Barbara Calif—Charles F Adams—300 Employees — WO 7-2381 — Magnetic Amplifiers & Servomechanisms, Portable Transceivers, Telephone Power Supplies

△Raytherm Corp-Rayclad Tubes Inc Oakside at Northside Redwood City Calif—Robert M Halperin—App 75 Employees — EM 9-3376 — Hook-up Wire, Terminax Miniature Coaxial Cable, Thermofit Tubing

Red Point Corp 1907 Riverside Dr Glendale 1 Calif—Ralph P Craig—12 Employees—TH 2-4895 — Processing Machinery, Automatic Encapsulating Machines, Dual & Single Impregnators

△*Reeves Soundcraft Corp 342 N La Brea Los Angeles 36 Calif—Bruce MacPherson

Reiter Co F 3340 Bonnie Hill Dr Hollywood 28 Calif—F Reiter—3 Employees—HO 2-2913 — Professional Splicer

△Remanco Inc 1630 Euclid Santa Monica Calif—R W Ryall—35 Employees—EX 3-7184 — Reticles, Optical Comparator Charts & Accessories, Collimators

Remler Co 2101 Bryant St San Francisco 10 Calif—Andrew B Hart—App 100 Employees—VA 4-3435 — Intercommunication Equipment, Marine & Air Microphones, Speakers & Amplifiers

△Resin Formulators Inc 8956 National Blvd Los Angeles 34 Calif—P A Van Amburgh

Repath Pacific Div/Arnold Eng'g Co 641 E 61st St Los Angeles 1 Calif—P R Repath—75 Employees—AD 3-7262—Laminations, Cans & Shields, End Bell

Resdel Eng'g Corp 330 S Fair Oaks Ave Pasadena Calif—A J Siegmeth—80 Employees—SY 5-5197—Ground Support Equipment, Wideband Amplifiers, Receiver Multicouplers

Research Specialties Co 200 S Garrard Blvd Richmond Calif—James M Felts—60 Employees—BE 5-9110—Chromatography & Electrophoresis Systems, Zone Melting Apparatus, Temperature Controlled Water Bath Shakers & Tube Heaters

△Rheem Mfg Co Defense & Technical Products Div 1711 Woodruff Ave Downey Calif—John H Titley—2500 Employees—TO 1-9711—Accelerometers, Amplifiers, Communication Systems

△Rheem Semiconductor Corp 327 Moffett Blvd Mountain View Calif—J D Hurley—App 102 Employees—YO 8-8391 — Silicon Transistors, Fast Switching & High Current Silicon Diodes, High Voltage Subminiature Silicon Rectifiers

RHO Eng'g Co 2242 Sepulveda Blvd Los Angeles 64 Calif—Muriel E Gorden—40 Employees—GR 7-4741—D-C Amplifiers, Plug-in Circuits, Encapsulation Service

△Riedel & Co M W 316 E Valley Blvd Alhambra Calif—M W Riedel

Riggs Nucleonics Corp 717 N Victory Blvd Burbank Calif—John E Markley Jr—12 Employees—VI 9-2481—Nuclear Radiation Area Monitoring Detector, Single & Multi-Channel

△Rimak Inc 10929 Vanowen St N Hollywood Calif—James H Flint—90 Employees — TR 7-5526 — Electronic Components

△Rinco Inc 7962 S E Powell Portland 6 Ore—F M Brown—24 Employees—PR 4-3259 — Impedance Bridges, Decade Precision Potentiometers, Single Turn Precision Potentiometers

Robbins Aviation Inc 2350 E 38th St Los Angeles 58 Calif—H N Mabery—20 Employees—LU 9-5221—Meterin Valves, Dehydration Equipment

△Roberts & Assoc E V 5068 W Washinton Blvd Los Aneles 16 Calif—Ernest V Roberts

△Robertshaw-Fulton Controls Co/Aeronautical & Instrument Div Santa Ana Freeway at Euclid Ave Anaheim Calif—R H Heller—618 Employees—KE 5-8151—Transistor Amplifiers, Cable Assemblies

△Rosan Inc 2901 W Coast Hwy Newport Beach Calif—James D Magner

Rototest Labs Inc 2803 Los Flores Blvd Lynwood Calif—J R Duncan—60 Employees—NE 6-9238—Environmental—& Performance Testing of Electronic, Electro-Mechanical Assemblies & Sub-Assemblies

Royce Instruments Inc 847 Fabian Way Palo Alto Calif—Henry Fondiller—5 Employees—DA 5-2277—Surface Temperature Measuring Instruments

△RS Electronics Corp 435 Portage Ave Palo Alto Calif—Albert B Worch—36 Employees—DA 1-1130—Amplifiers, Converters, Filters

Rucker Co 4700 San Pablo Ave Oakland 8 Calif—Centrifuges

Rue Products 1628 Venice Blvd Venice Calif—Herman D Rue—20 Employees—EX 8-2241—Test Equipment, Encapsulated Components, Automotive Electrical Accessories

△Rush & Associates C B 3757 Wilshire Blvd Los Angeles 5 Calif—Clyde B Rush

△Rutherford Electronics Co 8944 Lindblade St Culver City Calif—N T Holzer—50 Employees—TE 9-7393—Pulse Generators & Systems, Time Delay Generators

Ryan Aeronautical Co/Ryan Electronics Div 5650 Kearny Mesa Rd San Diego 12 Calif—T Claude Ryan—1300 Employees—BR 7-6450—Missile Guidance Systems & Controls, Navigation Equipment, Radar Systems

S

Saine Equipment Lab Harry T Rt 2 Box 407 E Main Ave Morgan Hill Calif—Harry T Saine—2 Employees—MO 9-0066 — Oscillotron, Oscilloclast, Depolatherm

△San Fernando Electric Mfg Co 1509 First St San Fernando Calif—Lyle R Smith—175 Employees—EM 1-8681—Capacitors, Potentiometers, Filters

*Santa Barbara Div/Curtiss-Wright Corp P O Box 689 Santa Barbara Calif—D E Trumbull — 350 Employees—WO 7-3411 — Automatic Checkout Equipment, Missiles & Radomes

Sargent-Rayment Co 4926 E 12th St Oakland 1 Calif—Will Rayment—35 Employees—KE 6-5277—Tuners, Pre-Amp Amplifiers, Amplifiers

*Satellite-Kennety Inc of California P O Box 1711 (Rancho Laguna Seca) Monterey Calif—Dr J T de Bettencourt—8 Employees—FR 3-2461—Research & Development, Antennas & Antenna Systems

Scala Radio Co 2814 19th St San Francisco 10 Calif—Bruno Zucconi—VA 6-2898—Antennas (UHF & VHF)

Scantlin Electronics Inc 2215 Colby Ave Los Angeles 64 Calif—Edmund J Canning—41 Employees—GR 8-8251—Digital Computers (Special Purpose)

△Schmit Eng'g Co 862 Fabian Way Palo Alto Calif—Robert D Rhodes

△Scientific Eng'g Labs 1510 6th St Berkeley 10 Calif—George C McFarland—24 Employees—LA 6-2772—Vacuum Pumping Systems, Altitude Simulators & Controlled Atmosphere Chambers, Vacuum Furnaces

△*Sealectro Corp 1557 N Western Ave Los Angeles 27 Calif—Richard A Strassner

Secode Corp 555 Minnesota St San Francisco 7 Calif—Robert Blodget—100 Employeess—MA 1-2643—Signaling & Remote Control Equipment

Seeley Electronics 1060 S La Brea Ave Los Angeles 19 Calif—Warren M Seeley—2 Employees—WE 3-1183—Fixed Frequency Mobile Receivers

*Sequoia Wire & Cable Co 2201 Bay Rd Redwood City Calif—Jordan E Beyer—177 Employees—EM 9-0331—Wire & Cable, Communication Cables

Servomechanisms Inc 12500 Aviation Blvd Hawthorne Calif—R J Gray—750 Employees—OR 8-7841—Central Air Data & True Airspeed Computers, Missile Fuel Management Systems

Schrader Co F W 11623 S Broadway Los Angeles 61 Calif—Virgle Hernbloom—12 Employees—PL 6-9166—Magnets Electro & Permanent, Laboratory Magnets, Rectifiers

Shamban & Co W S 11617 W Jefferson Blvd Culver City Calif—Matt Kennedy—App 150 Employees—TE 0-6877—Fabricating of Insulators, Copper Laminates, Spaghetti & Sleeving

Sheltered Workshops Inc 2521 5th St Santa Monica Calif — Joseph E Anthony—37 Employees—EX 9-7741—Assembly Services

△Shinkyo Trading Co 1680 N Vine St Los Angeles 17 Calif—George H Nakaki

△Shockley Transistor Corp 1117 California Ave Palo Alto Calif—Frank Newman—75 Employees—DA 6-1907—Silicon Diodes, Transistor Diodes

△Shoemaker & Associates H M 1127 Wilshire Blvd Los Angeles 17 Calif—H M Shoemaker

Sidco Inc/Sid Ungar Co Inc 1729 W Washington Blvd Box 312 Venice Calif—EX 9-0228—Soldering Irons

△*Sierra Electronic Corp 3885 Bohannon Dr Menlo Park Calif—C M Volkland—130 Employees—DA 6-2060—Wave Analyzers, RF Test Equipment, Oscilloscopes

Slideways Mfg Co 8075 Woodley Ave Van Nuys Calif—William H Johnson—35 Employees—ST 2-3393—Chassis

Slip Ring Co of America 5456 W Washington Blvd Los Angeles 16, Calif—C Gehrke—125 Employees—WE 1-8156—Slip Ring & Brush Assemblies, Commutators, Rotary Switches, Precision Molded Plastic Parts & Terminal Boards

△Snitzer Co T Louis 5354 W Pico Blvd Los Angeles 19 Calif—Christopher D Sloan

Soderberg Mfg Co Inc 628 S Palm Ave Alhambra Calif—H M Gibbons—50 Employees—CU 3-3382—Aircraft & Marine Lights, Landing Gear Control Panels

Solar Mfg Corp 4553 Seville Ave Los Angeles 58 Calif—C A Swanson—500 Employees—LU 3-1411—Capacitors, Condensers, Crystals

Soltronics Inc 14712 Raymer St Van Nuys Calif—Hugh Mitchell—5 Employees—ST 6-4528—Ultrasonic Bond Inspection Systems, Ultrasonic Flaw Recorders

△Southern Electronics Corp 150 W Cypress Ave Burbank Calif—Geo E Gansell—65 Employees—VI 9-3193—Capacitors, Film

Spaulding Fibre Co Inc 1325 San Julian St Los Angeles 15 Calif—E S Rinehart—26 Employees—RI 8-7341—Laminated Thermosetting Plastic, Hard Vulcanized Fibre & Fishpaper, Transformer Boards

△Specific Plating Co Inc 3002 Downey Rd Los Angeles 23 Calif—D Golbert

Spectralab Instruments 608 Fig Ave Monrovia Calif—Franklin R Goodman—23 Employees—RY 1-7044—UHF Power Amplifiers, Oscillators, Frequency Multipliers

Spectra-Strip Wire & Cable Corp 10052 Larson Ave P O Box 415 Garden Grove Calif—Donald D Lang—20 Employees — JE 7-4530 — Wire & Cable Assemblies, Vinyl Adhesives & Marking Inks, Flat & Spiral Bonded Cables

△*Spectrol Electronics Corp 1704 S Del Mar Ave San Gabriel Calif—Robert K Burtner—350 Employees—AT 7-9761—Precision Potentiometers, Precision Mechanisms, Transistorized Power Supplies

Sprague Electric Co 12870 Panama St Los Angeles 66 Calif—40 Employees—TE 0-7531—Capacitors, Magnetic Components, High Speed Switching Transistors

△Standard Wire & Cable Co 3440 Overland Ave Los Angeles 34 Calif—I M Harris—App 40 Employees—TE 0-4647—Insulated Wire, Cable & Cord

Stanford Research Institute Engineering Div Menlo Park Calif—E Finley Carter—425 Employees—DA 6-6200—Contract Research & Development, Electronic Components & Systems, Mechanics

Stanley Aviation Corp 2501 Dallas St Denver 8 Colo—R H Frost—425 Employees—EM 6-3581 — Electronic Breadboard, Radiation Detector, Emergency Escape Devices

△Staham Development Corp 1845 Pontius Ave Los Angeles 25 Calif—C L Vaughn

Statham Instruments Inc 12401 W Olympic Blvd Los Angeles 64 Calif—T M Crandall—520 Employees—BR 2-0371—Pressure Transducers, Accelerometers, Strain Gage Signal Amplifiers

Stephens Trusonic Inc 8538 Warner Dr Culver City Calif—E J Petre—75 Employees—TE 0-6671 — HiFidelity Speakers & Enclosures, Condensor Microphones, Wireless Microphones

△Stepper Motors Co Div Land-Air Inc 1732 W Slauson Ave Los Angeles 47 Calif—Clarence Adams

Sterling Electric Motors 5401 Telegraph Rd Los Angeles Calif—Peter G Arnovick—300 Employees—RA 3-6211—Variable Speed Drives, Slo-Speed Gearmotors, AC Squirrel Cage Motors

Stewart Eng'g Co P O Box 727 Soquel Calif—Ken Baker—GR 5-4790—Backward Wave Oscillators, Controlled Atmosphere Furnaces, Precision Spot Welders

△Stoddart Aircraft Radio Co Inc 6644 Santa Monica Blvd Hollywood 38 Calif—J H Hanrahan—135 Employees—HO 4-9292—Radio Interference-Field Intensity Meters, Attenuators, Current Probes

△Strassner Ellard E 1865 N Western Ave Los Angeles 27 Calif

Stromberg-Carlson Co/Div General Dynamics Corp 1895 Hancock St P O Box 2449 San Diego Calif—H M Taylor—500 Employees—CY 8-8331—Analog Computers, Digital Computers, Cathode Ray Tubes

Sunnyvale Development Center of Sperry Gyroscope Co 294 Commercial St Sunnyvale Calif—E B Hammond—200 Employees—RE 9-2344—Accelerometers, Analog Computers, Gyroscopes

Superscope Inc 8520 Tujunga Ave Sun Valley Calif—Fred C. Luchinsky—35 Employees—TR 7-1313—Sterecorder, Condenser & Wireless Microphones

△Sylvania Electric Products Inc 6505 E Gayhart Los Angeles 54 Calif—Don Hughes—app 75 Employees—Cathode Ray & Receiving Tubes, Microwave Tubes, Semi-Conductor Products

△*Sylvania Electric Products Inc/Special Tube Operations 500 Evelyn Ave Mountain View, Calif—David H Simon—742 Employees—YO 8-6211—Microwave Tubes & Components, Counter & Trigger Tubes

*Systems Development Corp 2428 Colorado Ave Santa Monica Calif—David Green—Electronic Systems

△Systron Corp 950 Galindo St Concord Calif—Ralph L Manildi—70 Employees — MU 2-3650 — Electronic Counters-Timers-Converters, Custom Instrumentation, Data Processing & Checkout Systems

T

Talkmaster Inc 534 Laurel St San Carlos Calif—E D Melligan Jr—2 Employees—LY 3-9515—Intercommunication Equipment

Tally Register Corp 5300 14th Ave N W Seattle 7 Wash—M R Dilling—40 Employees—SU 4-5500—Digital X-Y Plotter, Paper Tape Reader & Punch, Pulse Delay Logic Switches

△Tamar Electronics Inc 1805 Colorado Ave Santa Monica Calif—J C LaFlash

TA Mfg Corp 4607 Alger St Los Angeles 39 Calif—Jay N Thraves—130 Employees—CH 5-3748—Wire Harness

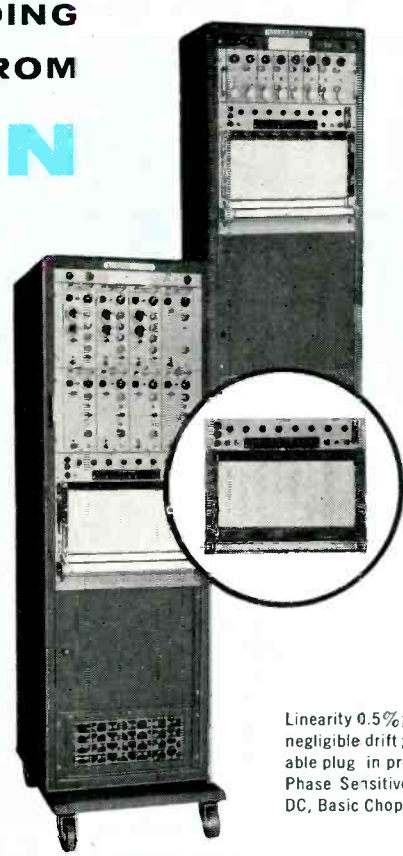
VERSATILE, RELIABLE

OSCILLOGRAPHIC RECORDING INSTRUMENTATION FROM

SANBORN

MINIMUM PANEL SPACE, SIMPLER PREAMPS — 6 or 8 channels, DC to 150 cps — "850" Series

Comparable performance to "350" System; uses same Recorder-Power Amplifier unit; modules of up to 8 plug-in preamps occupy 7" of panel space; total panel space only 24½"; cabinet 60" high. Available preamps include Carrier (separate MOPA required), Phase Sensitive Demodulator, DC Coupling, Basic Chopper (MOPA required), with others in development.



BASIC "350"/"850" 6- and 8-CHANNEL RECORDER-AMPLIFIER UNIT

Integral recorder package has transistorized, current feedback Power Amplifiers and voltage regulated power supply; nine electrically controlled pushbutton chart speeds, with provision for remote control; automatic over-all and individual stylus heat control; time-code marker; low impedance, low voltage galvanometers with enclosed construction; true velocity feedback damping at all times, limiting ahead of output circuit; inkless, rectangular coordinate recording on Permapaper charts, easily loaded from the front.

VERSATILE, ECONOMICAL — 1 to 8 channels DC to 100 cps — "150" Series

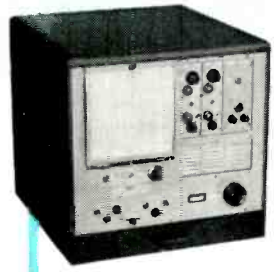
Over-all linearity better than 1%; basic sensitivity from 10 uv/div. to 0.1 volt/div., depending on preamplifier. Current feedback driver amplifier and regulated power supply for each channel; amplifiers, recorder available in individual portable cases. Front ends include AC-DC, Carrier, Servo Monitor (demodulator), DC Coupling, Log-Audio, Low Level Stabilized DC, AC Wattmeter, RMS Volt/Ammeter, 400 Cycle Frequency Deviation, Frequency Meter, and Triplexer 3-channel electronic switch.

MAXIMUM PERFORMANCE VERSATILITY — 6 or 8 channels, DC to 150 cps — "350" Series

Linearity 0.5%; improved current feedback power amplifiers, negligible drift; total panel space only 38½"; interchangeable plug in preamplifier types include Carrier, DC Coupling, Phase Sensitive Demodulator, True Differential Wide Band DC, Basic Chopper, with more to follow.

SIMPLIFIED 6- or 8-CHANNEL SYSTEM — 5 volts full-scale

Model 358-5480 system for computer readout, telemetry recording, DC voltage monitoring and similar applications requiring no preamplification. Uses 350 system recorder providing moderate sensitivity, good linearity and gain stability.



HIGH SPEED OPTICAL X-Y RECORDER — flat response to 100 cps, writing speeds to 2500"/sec.

Can record such rapidly changing variables as acceleration and vibration of mechanical elements, transistor characteristics, etc. Mirror-galvanometers and a light beam produce recording traces on ultraviolet-sensitive 8" x 8" direct-print paper that develops immediately by exposure to normal room light. Interchangeable "850" system preamplifiers are used for each axis; new preamps and time base generator now in development allow a wide variety of applications.

LINEAR MOTION TRANSDUCERS

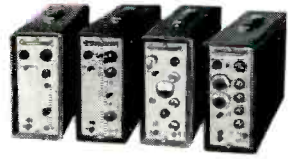
. . . to measure displacement

"PROBE" STYLE — complete, for 150, 350 or 850 Series Carrier Amplifiers; linearity 0.5%; stroke range ±0.050"; sensitivity 50 chart div deflection/0.001" displacement.

LINEARSYN — differential transformer; strokes from ±0.005" to ±10.000"; high sensitivities. Six standard series, five models in each series.

. . . to measure velocity

LVsyn — strokes to 9"; output sensitivities from 35 to 650 mv/inch/sec. Twelve standard Models, with regular or unbreakable cores.



SELF-CONTAINED "450" UNIT AMPLIFIERS

Versatile "350" Series preamplifiers with individual power supplies in portable cases; for driving 'scopes, optical oscillographs, tape recorders, etc. Available in "450" cases or four-unit modules in 19" frame for rack mounting. One "450" case and power supply can serve any "350" preamp.

For complete descriptive information on these and other Sanborn precision instruments, write to the Industrial Division in Waltham or contact your local Sanborn Sales-Engineering representative.

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Tape-Athon 523 Hindry Ave Inglewood Calif—George M Anthony—13 Employees—OR 8-5359—Tape

△*Tapco Group of Thompson Ramo Wooldridge Inc P O Box 90215 5500 W El Segundo Blvd Los Angeles 45 Calif—David Traitel

Taylor Fibre Co 1400 Palomares Ave LaVerne Calif—Milton F Chapel—85 Employees—LY 3-1341—Laminated Plastics, Vulcanized Fibre, Copper Clad Laminates for Printed Circuits

△TDK Electronics Co Ltd 606 South Hill St Los Angeles 14 Calif—K Suzuki

△Technibilt Corp 905 Air Way Glendale 1 Calif—Ray Cairnes

△Technical Devices Co 2340 Centinela Ave Los Angeles Calif—Melvin K Allen

Technical Oil Tool Corp 1057 N LaBrea Ave Los Angeles 38 Calif—John P Davis—100 Employees—OL 4-1763—Accelerometers, Assemblies, Attenuators

△Technical Products Instrument Div 6670 Lexington Ave Los Angeles 38 Calif—J H Krebs

△Technology Instrument Corp of Calif 7229 Atoll Ave N Hollywood Calif—J M Looney Jr—85 Employees—PO 5-8620—Accelerometers. Potentiometers, Transducers

△Tektronix Inc 9450 S W Barnes Rd Portland Ore—Howard Vollum—2400 Employees—CY 2-2611—D-C Amplifiers, Differential Amplifiers, Generators

△Telecomputing Corp 915 N Citrus Ave Los Angeles Calif—Peter L Bealer—HO 4-3171 — Amplifiers, Aviation Auxiliary Electronic Equipment, Batteries, Charges & Accessories

△Telemeter Magnetics Inc 2245 Pontius Ave Los Angeles 64 Calif—Erwin Tomash—BR 2-0991—Ceramics, Digital Computers, Cores

Telemetering Corp of America 8345 Hayvenhurst Ave Sepulveda Calif—Joel H Axe—14 Employees—Telemetry Systems (FM/FM & PCM) Miniaturized Voltage Controlled Oscillators

Telepix Corp & Film Recorders 1515 N Western Ave Hollywood 27 Calif—Robert P Newman—14 Employees—HO 4-7391—Industrial Motion Pictures, Slide Films, Sound Recording Services

Tevco Insulated Wire 108 E Prospect Ave Burbank Calif—Peter S Wald—40 Employees — VI 9-5574 — Insulated Wire, Special Cables, TV Parts & Accessories

△Thermador Electrical Mfg Co 715 S Raymond Ave Alhambra Calif—M B Sawyer Jr—60 Employees—CU 3-8831 — Precision Magnetic Components, Power Supplies, Special Transformers

△Thermocal Inc 1631 Colorado Ave Santa Monica Calif—N J Kennedy—30 Employees — EX 3-9841 — Current Sensitive Switch, Heat Sensitive Switch, Pressure Switches

△Thomas & Betts Co Inc 645 Philips St San Francisco 24 Calif—Donald J Frear

△Thompson Ramo Wooldridge Inc P O Box 90215 Airport Sta Los Angeles 45 Calif—D E Wooldridge—OS 5-4651—Missile & Aircraft Auxiliary Power Systems, Ground Support & Fuel Systems, Pumps

△Thorson Co 7361 Melrose Ave Los Angeles 46 Calif—T Macklin

Tipco Mfg Co 14734 Calvert Van Nuys Calif—J W Gage—5 Employees—ST 6-7881 — Self Adjusting Wrench, Safety Wire Tools

△Topatron Inc 942 E Ojai Ave Ojai Calif—Lee Appleman—20 Employees—MI 6-1600—Shielded Rooms, Anechoic Microwave Test Chambers & Electronic Test Consoles

Touch-Plate Mfg Corp 16530 Garfield Ave Paramount 1 Calif—K P Cronk—30 Employees—ME 3-0207—Low Voltage Switch Systems, Relays, Momentary Contact Switches

Trans Electronics Inc 7349 Canoga Ave Canoga Park Calif—William J Miller—30 Employees—DI 0-3334—Power Supplies, Transistor & Diode Testers

△Transformer Engineers 285 N Halstead Ave Pasadena Calif—J M Gallagher—170 Employees — RY 1-6906—Transformers, Chokes, Filters

Trans-Tel Corp 910 N Orange Dr Los Angeles 38 Calif—Ben Williams—23 Employees — HO 2-7304 — Audio & Transistor Amplifiers, Baffles Speaker, Cable Assemblies

△Triad Transformer Corp 4055 Redwood Ave Venice Calif—L W Howard—475 Employees—TE 0-5381 — Electronic Transformers, Filters & Toroidal Coils, Reactors

Tri-Dex Co P O Box 1207 Lindsay Calif—K B Howard—3 Employees—LI 2-4051—Terminal Boards, Turret Lug Type, Coils, Special Types, Assemblies (All Contract Mfg)

Tri-Ex Tower Corp 127 E Inyo St Tulare Calif—Louis V Tistao—18 Employees—MU 6-3411—Microwave & Communications & Accessories, Telescoping Crank Up Towers

Triplett Electrical Instrument Corp 202 Via Del Monte Oceanside Calif—V A Neeper—40 Employees—SA 2-9779—Electrical Indicating Meters

△Tri-State Supply Corp 554 Bryant St San Francisco 7 Calif—G M Eickmeyer

Trutone Electronics Inc 6912 Santa Monica Blvd Los Angeles 38 Calif—P H Tartak—22 Employees—HO 4-8118—AM FM & FM Tuners, Pre-Amplifiers, Amplifiers & Monaural Loud Speaker Systems & Cabinets

T T Electronics Inc P O Box 180 Culver City Calif—J F Sodaro—10 Employees—TE 0-3213—Twin-T Rejection & Highpass, Lowpass & Bandpass Filters, Active Bandpass Filters

△Tung-Sol Electric Inc 8575 Washington Blvd Culver City Calif—Charles Silver

△Tur-Bo Jet Products Co Inc 424 S San Gabriel Calif—Charles A Sprowl—85 Employees — CU 3-5191 — Coils for Relays, Solenoids & Chokes

△Twin Lock Inc 1024 W Hillcrest Blvd Inglewood Calif—C Parke Masterson—20 Employees — OR 3-0911—Adapters, Assemblies, Circuit Breakers

U

Ultradyne Inc 2624 San Mateo N E P O Box 3308 Albuquerque N M—Edward L Amonette—50 Employees—AM 8-2431—Pressure Transducers, Pressure to Voltage Systems, Pressure to Frequency Systems

Ultra-Fidelity Labs Inc 643 W 17th St Costa Mesa Calif—A Badmaieff—16 Employees—LI 8-1381—Amplifiers, Audio Equipment, Complete Sound Systems

Ultra-Violet Products Inc 5114 Walnut Grove Ave San Gabriel Calif—Thomas S. Warren—32 Employees—CU 3-3193 — Ultra-Violet Lamps, Black Light Lamps, Fluorescent Materials

△Ultronix Inc 111 E 20 Ave San Mateo Calif—David Persen—100 Employees—FI 5-7921 — Wire Wound Resistors, Networks, Trimming Potentiometers

△Ungar Electric Tools Inc 4101 Redwood Ave Los Angeles 66 Calif—William L Nehrenz—100 Employees—EX 8-5718—Electrical Soldering Tools

United Electrodynamics Inc 200 Allendale Rd Pasadena Calif—Frank A Fleck—300 Employees—MU 2-1134—Telemetering Systems & Components, Stepping Switches

△*United Electronics Inc 9937 Jefferson Blvd Culver City Calif—Ralph B Austrian

United States Chemical Milling Corp 1700 Rosecrans Ave Manhattan Beach Calif—R S Stevens—500 Employees—OR 8-4041 — Printed Circuit, Cables, Connectors

United Transformer Corp 4008 W Jefferson Blvd Los Angeles 16 Calif—John Borg—125 Employees—RE 1-6313—Transformers, Reactors, Filters

△Universal Electronics Co 1720 22nd St Santa Monica Calif—Edward Lacey

△Universal Match Corp Armament Div 6850 Van Nuys Blvd Van Nuys Calif—I A Waterstreet Jr

△U S Dept of Commerce Electronics Div 555 Battery St San Francisco 11 Calif—Merrill F Woodruff

△U S Department of Commerce Nat'l Bureau of Standards Boulder Labs Boulder Colo—Charles L Bragaw

△U S Dept of Commerce Technical Services 555 Battery St San Francisco 11 Calif—Merrill F Woodruff

U S Electrical Motors Inc 200 E Slauson Ave Los Angeles 54 Calif—R E Goodman—AD 3-3131—Electric Motors, Power Transmissions, Fractional HP Aircraft Motors

△U S Naval Ordnance Test Station China Lake Calif—Ray A Sinnott

△U S Naval Ordnance Lab Corona Calif—A W Card

△U S Navy Electronics Lab San Diego 52 Calif—Charles M Hatcher

U S Relay Co The Electronics Div A S R Products Corp 717 N Coney Ave Azusa Calif—Lyle D Bunce—197 Employees — ED 4-8206 — Relays, Solenoids & Packaged Controls

△U S Semiconductor Products Inc 3540 W Osborn Rd Phoenix Ariz—J C Worth—150 Employees—AP 8-5591—Voltage Regulating Diodes, Low Medium & High Power Zener Diodes & Rectifiers, Dry Solid Tantalytic Capacitors

U S Semiconductor Products Inc 3536 W Osborn Rd Phoenix Ariz—J C Worth Jr—86 Employees—AP 8-5591—Silicon Voltage Regulator Diodes, Silicon Rectifiers, Silicon Zener Diodes

△*Utica Drop Forge & Tool Div Kelsey-Hayes Co 1348 Venice Blvd Los Angeles 6 Calif—John Arnett

V

△Vacuum Tube Products/Div Hughes Aircraft Co 2020 Short St Oceanside Calif—J J Sutherland—80 Employees—SA 2-7648—Special Cathode Ray Tubes, High Vacuum Rectifiers & Xenon Thyratrons, Spot & Seam Welders

△Van Groos Co 21051 Costanso St Woodland Hills Calif—J C Van Groos

Vanguard Electronics Co 3384 Motor Ave Los Angeles 34 Calif—Simon A Golbert—20 Employees—TE 0-7344—Coils, Chokes, Variable Inductors

△Varian Associates 611 Hansen Way Palo Alto Calif—W M Silhavy—2400 Employees — DA 6-4000 — Microwave Tubes, High Vacuum Equipment, RF Spectrometers

△Vaughn Co G H 2366 E Foothill Blvd Pasadena Calif—George Vaughn

△Vector Electronic Co 1100 Flower St Glendale 1 Calif—R R Scoville—CH 5-1076—Chassis, Accessories, Fuses, Shielding

△Vicon Corp Div Insul-8-Corp 1369 Industrial Rd San Carlos Calif—H Johnston

Video Instruments Co Inc 3002 Pennsylvania Ave Santa Monica Calif—Peter Pohl—app 30 Employees—EX 3-1244—Solid State DC Amplifiers & Power Supplies, Strain Gage Control Units (Transistorized)

△Viking Industries Inc 21343 Roscoe Blvd Canoga Park Calif—F V Criswell—125 Employees—DI 7-8500—Miniature Circular Connectors, Printed Circuit Connectors, Compression & Transfer Molded Plastics

Vinson Co E R 1401 Middle Harbor Rd Oakland Calif—William Fleming—8 Employees—GL 1-2357—Industrial Automation Equipment, Photoelectric Control Devices, Short Run Electronic Assemblies

Voltron Products 1010 Mission St S Pasadena Calif—Arnold Raines—30 Employees — RY 1-3377 — Expanded Scale Voltmeters, Frequency Meters, Wattmeters

Vought Co P O Box 1350 Beverly Hills Calif—A D Fraser—25 Employees—CR 6-1131—Electrically Operated Photographic Data Recorders, Film Viewers & Printers, Test Panels for Photographic Data Recording Equipment

W

△Walkirt Co 141 Hazel St Inglewood Calif—Wes L Kirchoff—25 Employees—OR 8-4814—Plug-in & Modular Circuits

△Walsco Electronics Mfg Co 3225 Exposition Pl Los Angeles 18 Calif—Arnold Kloman

Walton Tool & Die Co Inc 2707 Empire Ave Burbank Calif—Walton Emmick—35 Employees—TH 6-5252—Sheet Metal Fabrication & Machining of Component Parts for Radar, Electronics & Guided Missiles

△Warren Wire Co 1601 Chestnut Alhambra Calif—R A Rahe

Watkins-Johnson Co 3333 Hillview Ave Palo Alto Calif—H Richard Johnson—38 Employees — DA 6-8830—Traveling-Wave Tubes, Backward-Wave Oscillators, Helitrons

Waugh Eng'g Co 7842 Burnet Ave Van Nuys Calif—Reuel H Smitter—90 Employees — ST 3-1055 — Turbine Type Flowmeters, Frequency Converters, Delay Relay Timers

Waveguide Inc 1769 Placentia Costa Mesa Calif—John J Bodley—20 Employees—MA 8-7786—Fiberglass Antennas, Waveguide Assemblies & Components

△Weightman & Associates 4029 Burbank Blvd Burbank Calif—H G Weightman

△Weldmatic Div/Unitek Corp 380 N Halstead Ave Pasadena Calif—Gerald E Woods—100 Employees—SY 5-5995—Precision Stored Energy Welders

△Wesrep Corp 2022 S Sepulveda Blvd Los Angeles 25 Calif—Dudley V Cassard

△Western Control Equipment Co 14615 Ventura Blvd Sherman Oaks Calif—Howard L Miller

△Western Devices Inc 600 W Florence Ave Inglewood Calif—W C Strumpell

Western Electronic Co 717 Dexter Ave Seattle 9 Wash—H Tory—22 Employees — AT 4-0200 — Electronic Analog Computer

△Western Fishing Line Co 4680 San Fernando Rd Glendale 4 Calif—John Howard

△Western Gear Corp/Electro Products Div 132 W Colorado St Pasadena Calif—R B Abott—140 Employees—SY 6-4395—AC and DC Fractional HP Motors, Mil Spec Fans & Blowers, Aircraft Heaters

△*Western Gold & Platinum Co 525 Harbor Blvd Belmont Calif—Walter Hack—85 Employees—LY 3-3121—Hi-Temperature, Hi-Purity Alumina Geramics, Low Vapor Pressure Brazing Alloys, Molybdenum Ribbon

Western Radiation Lab—1107 W 24th St Los Angeles 7 Calif—G L Locher—4 Employees — RI 7-8355 — Radioisotope Sources & Nucleonic Instruments, Light Receivers, Medical GM Counter Tubes

△Westline Products Div/Western Litho Co 600 E 2nd St Los Angeles 54 Calif—Ben Birken—app 400 Employees—MA 7-2641—Wire Markers, Tubing & Sleeving, Special Labels & Markers

△Westron Sales & Eng'g 7407 Melrose Ave Los Angeles 46 Calif—Charles R Fetty

△White Dental Mfg Co S S 1839 W Pico Blvd Los Angeles 6 Calif—Paul S Rohrig

Whittaker Gyro 16217 Lindbergh St Van Nuys Calif—D Rammage—480 Employees — ST 3-1950 — Electrically Operated Gyros

△Wiancko Eng'g Co 255 N Halstead Ave Pasadena Calif—R Major—280 Employees — EL 5-7186 — Transducers, AM & FM Systems, Commutators

△Wiggins Oil Tool Co E B 3224 E Olympic Blvd Los Angeles 23 Calif—Robert A Wolfe

Wirco Electronics Inc 11680 McBean Drive El Monte Calif—Vincent Wirth—11 Employees—GI 3-1433—Electronic Windings

△Wright Eng'g Co 180 E California St Pasadena Calif—Jack Mott

Wyco Metal Products 6918 Beck Ave N Hollywood Calif—Forrest N Weiss—50 Employees—TR 7-5579—Relay Racks, Chassis, Cases

Wyle Laboratories 128 Maryland St El Segundo Calif—Elmer R Easton—300 Employees — OR 8-4251 — Environmental, Functional & Combined Testing of Missile & Aircraft Components & Systems

Wyle Mfg Corp 133 Center St El Segundo Calif—J A Sneller—35 Employees—EA 2-0659 — Environmental Test Chambers, Liquid Storage Vessels, High-Force Vibration Test Systems

Z

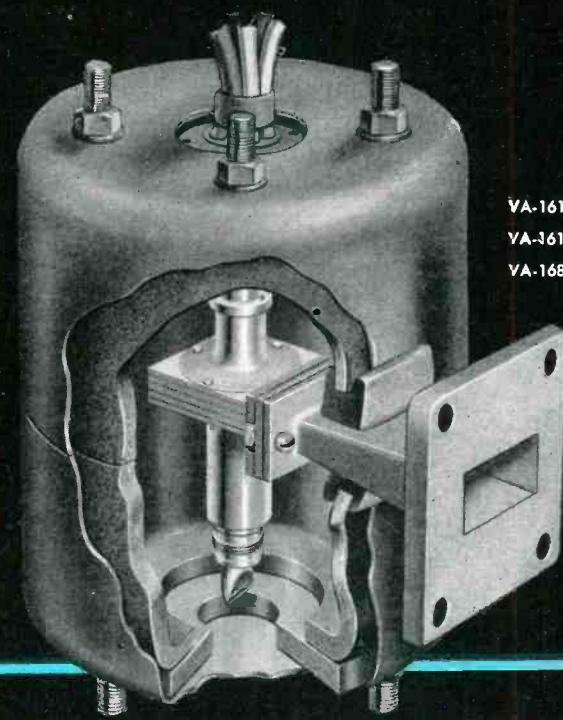
△*Zero Mfg Co 1121 Chestnut St Burbank Calif—Raymond A Harper—200 Employees—TH 6-4191—Container, Cases & Aluminum Fabrication

Zeus Eng'g Co Inc 635 S Kenmore Ave Los Angeles 5 Calif—H Patrusky—app 10 Employees—DU 7-7175—Transistor Index

△Zimmerman W E 407 N Maple Dr Beverly Hills Calif—W E Zimmerman

△Zippertubing Co 752 S San Pedro St Los Angeles 14 Calif—H Robert Edwards—25 Employees—MA 4-6664—Automatic Cable Making Machine & Plastic Cable Jackets

FOR
WIDEBAND
SYSTEM USE



VA-161
VA-161B
VA-168

VARIAN

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Features:

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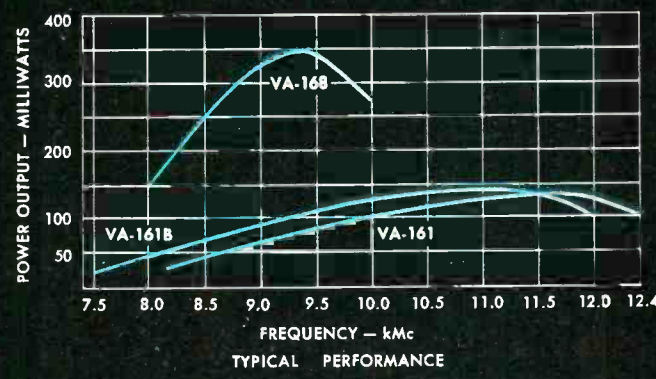
- RUGGED CONSTRUCTION



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Varian X-band BWO's are now the standard of the industry for systems requiring long life, low voltage operation, and small size. Characteristic of Varian BWO's is a uniform power output and helix voltage relationship with frequency. The metal and ceramic construction offers the most reliable tube at the lowest cost and assures dependability in severe environments.

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Phone: TRiangle 7-0721	Phone: LY 1-2626	Phone: GI 2-8901	Phone: AC 3-8106	Phone: AL 5-5586	Phone: JA 6-2486	Phone: CR 4-5431	Phone: MA 3-2564
TWX: N-HOL 7133	TWX: San Carlos—Belmont CAL 94	TWX: SC 124	TWX: SD 6315	TWX: AQ 172	TWX: Las Cruces NM 5851	TWX: PX 483	TWX: TS 5981

Circle 84 on Inquiry Card

POWER RECTIFIERS

The following survey of power rectifiers covers devices rated at 1 a. and over. It completes the data in "1959 Semiconductor Diode Specifications" which appeared in El's June 1959 All-Reference Issue

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C

AUDIO DEVICES, INC., Rectifier Div., 620 E. Dyer Rd., Santa Ana, Calif.

1N1450	D Si	100	5	100			5				100
1N1451	D Si	200	5	200			5				100
1N1452	D Si	300	5	300			5				100
1N1453	D Si	400	5	400			5				100
1N1454	E Si	100	25	100			25				100
1N1455	E Si	200	25	200			25				100
1N1456	E Si	300	25	300			25				100
1N1457	E Si	400	25	400			25				100
1N1458	E Si	100	25	100			35				100
1N1459	E Si	200	25	200			35				100
1N1460	E Si	300	25	300			35				100
1N1461	E Si	400	25	400			35				100
1N1462	F Si	100	50	100			50				100
1N1463	F Si	200	50	200			50				100
1N1464	F Si	300	50	300			50				100
1N1465	F Si	400	50	400			50				100
1N1466	F Si	100	50	100			75				100
1N1467	F Si	200	50	200			75				100
1N1468	F Si	300	50	300			75				100
1N1469	F Si	400	50	400			75				100
1N1470	G Si	100	100	100			100				100
1N1471	G Si	200	100	200			100				100
1N1472	G Si	300	100	300			100				100
1N1473	G Si	400	100	400			100				100
1N1474	G Si	100	100	100			150				100
1N1475	G Si	200	100	200			150				100
1N1476	G Si	300	100	300			150				100
1N1477	G Si	400	100	400			150				100
1N1478	G Si	100	100	100			200				100
1N1479	G Si	200	100	200			200				100
1N1480	G Si	300	100	300			200				100
1N1481	G Si	400	100	400			200				100

AUTOMATIC MANUFACTURING DIV., General Instrument Corp., 65 Gouveneur St. Newark 4, N. J

1N248	C Si		50	5	50	150		10			150
1N248A	C Si		50	5	50	150		20			150
1N249	C Si		100	5	100	150		10			150
1N249A	C Si		100	5	100	150		20			150
1N250	C Si		200	5	200	150		10			150
1N250A	C Si		200	5	200	150		20			150
AM7	B Si	50	50	0.5	50	150	40	3			150
AM17	B Si	100	100	0.5	100	150	40	3			150
AM27	B Si	200	200	0.5	200	150	40	3			150
AM37	B Si	300	300	0.5	300	150	40	3			150
AM47	B Si	400	400	0.5	400	150	40	3			150
AM57	B Si	500	500	0.5	500	150	40	3	1.25		150
AM67	B Si	600	600	0.5	600	150	40	3	1.25		150
AM0505	C Si	50		5	50	150	75	5	1.25		150
AM0510	C Si	50		5	50	150	150	10	1.25		150
AM0520	C Si	50		5	50	150	300	20	1.25		150
AM1005	C Si	100		5	100	150	75	5	1.25		150
AM1010	C Si	100		5	100	150	150	10	1.25		150
AM1020	C Si	100		5	100	150	300	20	1.25		150
AM1505	C Si	150		5	150	150	75	5	1.25		150
AM1510	C Si	150		5	150	150	150	10	1.25		150
AM1520	C Si	150		5	150	150	200	20	1.25		150
AM2005	C Si	200		5	200	150	75	5	1.25		150
AM2010	C Si	200		5	200	150	150	10	1.25		150
AM2020	C Si	200		5	200	150	300	20	1.25		150
AM2505	C Si	250		5	250	150	75	5	1.25		150
AM2510	C Si	250		5	250	150	150	10	1.25		150
AM2520	C Si	250		5	250	150	300	20	1.25		150
AM3005	C Si	300		5	300	150	75	5	1.25		150
AM3010	C Si	300		5	300	150	150	10	1.25		150
AM3020	C Si	300		5	300	150	300	20	1.25		150
AM3505	C Si	350		5	350	150	75	5	1.25		150
AM3510	C Si	350		5	350	150	150	10	1.25		150
AM3520	C Si	350		5	350	150	300	20	1.25		150
AM4005	C Si	400		5	400	150	75	5	1.25		150
AM4010	C Si	400		5	400	150	150	10	1.25		150
AM4020	C Si	400		5	400	150	300	20	1.25		150
AG0512	B Si	50		1.0	50	150	150	12	1.5		
AG1012	B Si	100		1.0	100	150	150	12	1.5		
AG1512	B Si	150		1.0	150	150	150	12	1.5		
AG2012	B Si	200		1.0	200	150	150	12	1.5		
AG2512	B Si	250		1.0	250	150	150	12	1.5		
AG3012	B Si	300		1.0	300	150	150	12	1.5		150
AG3512	B Si	350		1.0	350	150	150	12	1.5		150
AG4012	B Si	400		1.0	400	150	150	12	1.5		150
AG5012	B Si	500		1.0	500	150	150	12	1.5		150
AG6012	B Si	600		1.0	600	150	150	12	1.5		150
AD05H1A1	Z Si	35						1.5			150
AD10H1A1	Z Si	70						1.5			150
AD20H1A1	Z Si	140						1.5			150
AD30H1A1	Z Si	210						1.5			150
AD40H1A1	Z Si	280						1.5			150
AD50H1A1	Z Si	350						1.5			150
AD60H1A1	Z Si	420						1.5			150

BRADLEY SEMICONDUCTOR CORP., 275 Welton St., New Haven 11, Conn.

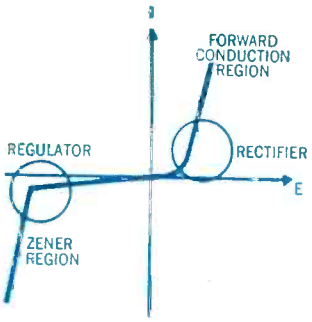
BY501	Si	60		5	50	150	60	12	1.5		150
BY502	Si	120		5	100	150	60	12	1.5		150
BY503	Si	240		5	200	150	60	12	1.5		150
BY504	Si	360		5	300	150	60	12	1.5		150
BY505	Si	475		5	400	150	60	12	1.5		150
BY506	Si	600		5	500	150	60	12	1.5		150
BY507	Si	720		5	600	150	60	12	1.5		150
BY511	Si	60		.05	50	25	60	12	1.5		150
BY512	Si	120		.05	100	25	60	12	1.5		150
BY513	Si	240		.05	200	25	60	12	1.5		150
BY514	Si	360		.05	300	25	60	12	1.5		150
BY515	Si	375		.05	400	25	60	12	1.5		150
BY-401	A Si		50				15	6	1.5		150
BY-402	A Si		100				15	6	1.5		150

BRADLEY SEMICONDUCTOR CORP., 275 Welton St., New Haven 11, Conn. *(continued)*

BY-403	A Si	200					15	6	1.5		150
BY-404	A Si	300					15	6	1.5		150
BY-405	A Si	400					15	6	1.5		150
BY-406	A Si	500					15	6	1.5		150
BY-407	A Si	600					15	6	1.5		150
BY-411	A Si	50	.005		25		15	6	1.5		150
BY-412	A Si	100	.005		25		15	6	1.5		150
BY-413	A Si	200	.005		25		15	6	1.5		150
BY-414	A Si	300	.005		25		15	6	1.5		150
BY-415	A Si	400	.005		25		15	6	1.5		150
BY-416	A Si	500	.005		25		15	6	1.5		150
BY-417	A Si	600	.005		25		15	6	1.5		150

COLUMBUS ELECTRONICS CORP., 1010 Saw Mill River Rd., Yonkers, N. Y.

1N248	B Si	50	5	150			10	1.5			
1N248A	B Si	50	5	150			20	1.5			
1N249	B Si	100	5	150			10	1.5			
1N249A	B Si	100	5	150			20	1.5			
1N250	B Si	200	5	150			10	1.5			
1N250A	B Si	200	5	150			20	1.5			
1N607	A Si	50	.025	100			1.0	1.5			
1N607A	A Si	50	.001	100			1.0	1.5			
1N608	A Si	100	.025	100			1.0	1.5			
1N608A	A Si	100	.001	100			1.0	1.5			
1N609	A Si	150	.025	100			1.0	1.5			
1N609A	A Si	150	.001	100			1.0	1.5			
1N610	A Si	200	.025	100			1.0	1.5			
1N610A	A Si	200	.001	100			1.0	1.5			
1N611	A Si	300	.025	100			1.0	1.5			
1N611A	A Si	300	.001	100			1.0	1.5			
1N612	A Si	400	.025	100			1.0	1.5			
1N612A	A Si	400	.001	100			1.0	1.5			
1N613	A Si	500	.025	100			1.0	1.5			
1N613A	A Si	500	.002	100			1.0	1.5			
1N614	A Si	600	.025	100			1.0	1.5			
1N614A	A Si	600	.002	100			1.0	1.5			
1N2218	A Si	500	.003	25			1.5	1.2			
1N2220	A Si	600	.003	25			1.5	1.2			
1N2222	A Si	800	.003	25			1.0	1.2			
1N2222A	A Si	800	.003	25			1.0	1.2			
1N2224	A Si	1000	.003	25			1.0	1.2			
1N2224A	A Si	1000	.003	25			1.0	1.2			
1N2226	A Si	1200	.003	25			1.0	1.2			
1N2226A	A Si	1200	.003	25			1.0	1.2			
1N2228	A Si	50	.003	25			5.0	1.2			
1N2228A	A Si	50	.003	25			5.0	1.2			
1N2230	A Si	200	.003	25			5.0	1.2			
1N2230A	A Si	200	.003	25			5.0	1.2			
1N2232	A Si	300	.003	25			5.0	1.2			
1N2232A	A Si	300	.003	25			5.0	1.2			
1N2234	A Si	400	.003	25			5.0	1.2			
1N2234A	A Si	400	.003	25			5.0	1.2			
1N2236	A Si	500	.003	25			5.0	1.2			
1N2236A	A Si	500	.003	25			5.0	1.2			
1N2238	A Si	600	.003	25			5.0	1.2			
1N2238A	A Si	600	.003	25			5.0	1.2			
1N2240	A Si	800	.003	25			5.0	1.2			
1N2240A	A Si	800	.003	25			5.0	1.2			
1N2242	A Si	1000	.003	25			5.0	1.2			
1N2242A	A Si	1000	.003	25			5.0	1.2			
1N2244	A Si	1200	.003	25			5.0	1.2			
1N2244A	A Si	1200	.003	25			5.0	1.2			
1N2246	A Si	50	.005	25			10	1.2			
1N2246A	A Si	50	.003	25			10	1.2			
1N2248	A Si	100	.005	25			10	1.2			
1N2248A	A Si	100	.003	25			10	1.2			
1N2250	A Si	200	.005	25			10	1.2			
1N2250A	A Si	200	.003	25			10	1.2			
1N2252	A Si	300	.005	25			10	1.2			
1N2252A	A Si	300	.003	25			10	1.2			
1N2254	A Si	400	.005	25			10	1.2			
1N2254A	A Si	400	.003	25			10	1.2			
1N2256	A Si	500	.005	25			10	1.2			
1N2256A	A Si	500	.003	25			10	1.2			
1N2258	A Si	600	.005	25			10	1.2			
1N2258A	A Si	600	.003	25			10	1.2			
1N2260	A Si	800	.010	25			10	1.2			
1N2260A	A Si	800	.005	25			10	1.2			
1N2262	A Si	1000	.010	25			10	1.2			
1N2262A	A Si	1000	.005	25			10	1.2			
1N2264	A Si	1200	.010	25			10	1.2			
1N2264A	A Si	1200	.005	25			10	1.2			
1N2266	A Si	50	.001	25			1.0	1.2			
1N2268	A Si	500	.003	25			1.0	1.2			
1N2270	A Si	600	.003	25			1.0	1.2			
1N2272	B Si	50	1	150			6	1.2			
1N2273	B Si	100	1	150			6	1.2			
1N2274	B Si	200	1	150			6	1.2			
1N2275	B Si	300	1	150			6	1.2			
1N2276	B Si	400	1	150			6	1.2			
1N2277	B Si	500	1	150			6	1.2			
1N2278	B Si	600	1	150			6	1.2			
1N2279	B Si	800	1	150			6	1.2			
1N2280	B Si	1000	1	150			6	1.2			
1N2281	B Si	1200	1	150			6	1.2			
1N2282	B Si	300	5	150			20	1.2			
1N2283	B Si	400	5	150			20	1.2			
1N2284	B Si	500	5	150			20	1.2			
1N2285	B Si	600	5	150			20	1.2			
1N2286	B Si	800	5	150			20	1.2			
1N2287	B Si	1000	5	150			20	1.2			
1N2288	B Si	1200	5	150			20	1.2			
1N2362	A Si	1400	1	25			1.0	2.0			
1N2362A	A Si	1400	1	25			5.0	2.0			
1N2362B	A Si	1400	1	25			10	2.0			



typical I-E characteristic curve for Hoffman Silicon Diodes

Hoffman

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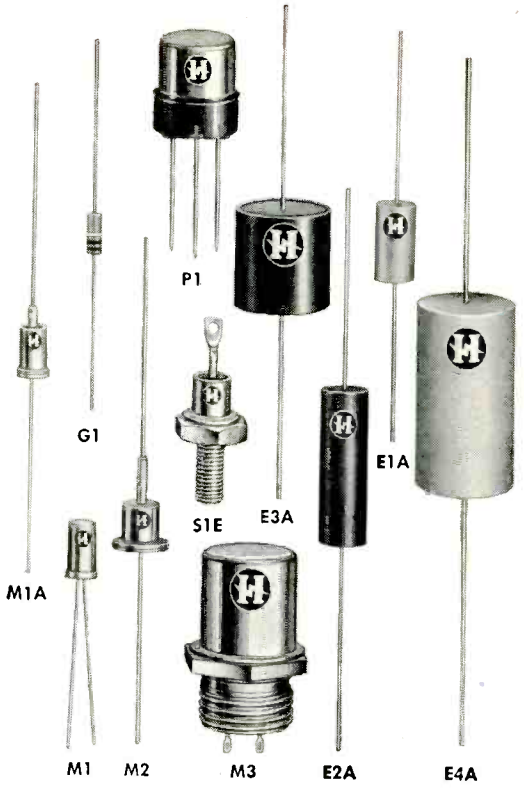
VISIT BOOTHS # 2222, 2223, 2224 and 2225 at the WESCON SHOW.



180 Zener Devices

	6	6	5	15	9	6	4	15	38	38	38
	ZENER LOW VOLTAGE DIODES • 200mW • Zener Voltage Range: 2.0V — 8.0V	ZENER MICRO-MINIATURE GLASS LOW VOLTAGE DIODES • 250mw • Zener Voltage Range: 2.0V — 8.0V	ZENER "DOUBLE ANODE" LOW VOLTAGE DIODES • 200mW • Zener Voltage Range: 3.0V — 8.0V	ZENER "SINGLE ANODE" MEDIUM VOLTAGE • 150mW • Zener Voltage Range: 7.5V — 145V	ZENER "DOUBLE ANODE" MEDIUM VOLTAGE DIODES • 150mW • Zener Voltage Range: 7.5V — 45V	ZENER REFERENCE DIODES & ELEMENTS • Operating Zener Voltage: 1N429:6.2V ±5% 1N430, 1N430A, 1N430B, 1N1530, 1N1530A: 8.4V ±5% • Dyn. Imp.: 1N429:20 ohms Others: 15 ohms	ZENER REFERENCE MICRO-MINIATURE DIODES • Operating Zener Voltage: 5.9V to 6.5V • Dyn. Imp.: 15 ohms	ZENER REFERENCE STRINGS • Operating Zener Voltage: 6.2V thru 49.6V ±5% • Dyn. Imp.: 20 ohms to 180 ohms (over the entire line)	ZENER VOLTAGE REGULATORS 10 WATT • Zener Voltage Range: 5.6V to 200V ±10% • Dyn. Imp.: 1 ohm to 140 ohms (over the entire line)	ZENER VOLTAGE REGULATORS 1 WATT • Zener Voltage Range: 5.6V to 200V ±10% • Dyn. Imp.: 1.2 ohms to 1100 ohms (over the entire line)	ZENER VOLTAGE REGULATORS 1/4 WATT • Zener Voltage Range: 5.6V to 200V ±10% • Dyn. Imp.: 3.5 ohms to 1400 ohms
Case Type	M1	G1	M1	M1	M1	M1, M3, P1	G1	E1A, E2A, E3A, E4A	S1E	M1A	G1

45 Diodes

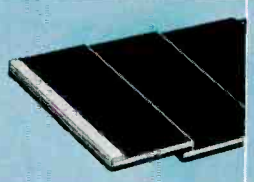
	26	6	8	5
	GENERAL PURPOSE SILICON DIODES • 150mW • PIV Range: 6.8V thru 470V	HB GENERAL PURPOSE SILICON DIODES • 150mW • PIV Range: 6.8V thru 270V	GLASS GENERAL PURPOSE DIODES • 200mW • PIV Range: 25V to 175V	GLASS FAST RECOVERY SILICON DIODES • 200mW • PIV Range: 25V to 175V
Case Type	M1	M1	G1	G1

26 Rectifiers

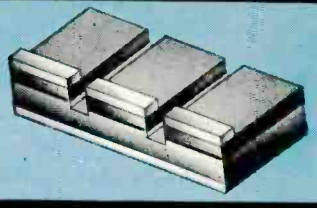
	11	7	8
	SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 50V to 1000V	SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 50V to 500 V	SILICON DIFFUSED JUNCTION MEDIUM POWER RECTIFIERS • PIV Range: 95V to 570V
Case Type	M1A	M2	S1E

17 Solar Cells

9
SILICON SOLAR CELLS
• Typical Power Output Range: .072mW to 34.0mW (at 10,000 ft. candles—sunlight)
• Spectral Response: Range: 4000 to 11,500 angstroms; Peak: 8500 angstroms



8
PHOTO-VOLTAIC READOUT CELLS
• Number of readout positions: from 4 to 10
• Spectral Response: Range: 4000 to 11,500 angstroms; Peak: 8500 angstroms



Design Parameter Data Available On All Above Items Upon Request.

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MAdison 6-8063, TWX: IA 188

Middle West Reg'l. & Export Office
930 Pitner Avenue, Evanston, Illinois
UNiversity 9-9850, TWX: Evanston, Ill. 398

Eastern Regional Office
710 Mattison Avenue, Asbury Park, N. J.
PRospect 4-7877, TWX: APK 634

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C

COLUMBUS ELECTRONICS CORP., 1010 Saw Mill River Rd., Yonkers, N. Y. *(continued)*

1N2364	A Si		1500	1	25		1.0	2.0			
1N2364A	A Si		1500	1	25		5.0	2.0			
1N2364B	A Si		1500	1	25		10	2.0			
1N2366	A Si		1600	1	25		1.0	2.0			
1N2366A	A Si		1600	1	25		5.0	2.0			
1N2366B	A Si		1600	1	25		10	2.0			
1N2368	A Si		1800	1	25		1.0	2.0			
1N2368A	A Si		1800	1	25		5.0	2.0			
1N2368B	A Si		1800	1	25		10	2.0			
1N2370	A Si		2000	1	25		1.0	2.0			
1N2370A	A Si		2000	1	25		5.0	2.0			
1N2370B	A Si		2000	1	25		10	2.0			
CEC310	B Si		300	5	150		10	1.2			
CEC410	B Si		400	5	150		10	1.2			
CEC510	B Si		500	5	150		10	1.2			
CEC610	B Si		600	5	150		10	1.2			
CEC810	B Si		800	5	150		10	1.2			
CEC1010	B Si		1000	5	150		10	1.2			
CEC1210	B Si		1200	5	150		10	1.2			

FANSTEEL METALLURGICAL CORP., North Chicago, Illinois

1N2294	Si	50	50	1	25	160	22A			165
1N2295	Si	100	100	1	25	160	22A			165
1N2296	Si	150	150	1	25	160	22A			165
1N2297	Si	200	200	1	25	160	22A			165
1N2298	Si	250	250	1	25	160	22A			165
1N2299	Si	300	300	1	25	160	22A			165
1N2300	Si	350	350	1	25	160	22A			165
1N2301	Si	400	400	1	25	160	22A			165
1N2302	Si	50	50	1	25	160	22A			165
1N2303	Si	100	100	1	25	160	22A			165
1N2304	Si	150	150	1	25	160	22A			165
1N2305	Si	200	200	1	25	160	22A			165
1N2306	Si	250	250	1	25	160	22A			165
1N2307	Si	300	300	1	25	160	22A			165
1N2308	Si	350	350	1	25	160	22A			165
1N2309	Si	400	400	1	25	160	22A			165
1N2310	Si	50	50	1	25	300	35			165
1N2311	Si	100	100	1	25	300	35			165
1N2312	Si	150	150	1	25	300	35			165
1N2313	Si	200	200	1	25	300	35			165
1N2314	Si	250	250	1	25	300	35			165
1N2315	Si	300	300	1	25	300	35			165
1N2316	Si	350	350	1	25	300	35			165
1N2317	Si	400	400	1	25	300	35			165
1N2318	Si	50	50	1	25	300	35			165
1N2319	Si	100	100	1	25	300	35			165
1N2320	Si	150	150	1	25	300	35			165
1N2321	Si	200	200	1	25	300	35			165
1N2322	Si	250	250	1	25	300	35			165
1N2323	Si	300	300	1	25	300	35			165
1N2324	Si	350	350	1	25	300	35			165
1N2325	Si	400	400	1	25	300	35			165
6A	Si		400				22			165

GENERAL ELECTRIC CO., Semiconductor Dept., Syracuse, N. Y.

1N151 AH1AC1	I G	70	100				1.2			55
1N152 BH1AC1	I G	140	200				1.0			55
1N153 CH1AC1	I G	210	300				.75			55
1N158 BH2AC1	J G	280	200				1.0			55
1N1301	H Si	50	50	15	150	300	17.5	0.63		200
1N1302	H Si	100	100	5	150	300	17.5	0.63		200
1N1304	H Si	200	200	5	150	300	17.5	0.63		200
1N1306	H Si	300	300	5	150	300	17.5	0.63		200
4JA211 FH1AC1	I G	35	50				1.3			55
4JA211 DH1AC1	I G	280	400				.4			55
4JA211 CH2AC1	J G	420	300				.75			55
4JA211 DH2AC1	J G	565	400				.4			55
4JA211 CH3AC1	K G	635	300				.75			55
4JA411 FH1AD1	I Si	35	50				1.5			150
4JA411 AH1AD1	I Si	70	100				1.5			150
4JA411 BH1AD1	I Si	140	200				1.5			150
4JA411 CH1AD1	I Si	210	300				1.5			150
4JA411 DH1AD1	I Si	280	400				1.5			150
4JA411 EH1AD1	I Si	350	500				1.5			150
4JA411 MH1AD1	I Si		600				1.5			150
4JA3011 AH1AC1	I G	70	100				5			55
4JA3011 BH1AC1	I G	140	200				5			175
4JA3011 CH1AC1	I G	210	300				2.25			175
4JA3511 FH1AD1	L Si	35	50				10			175
4JA3511 FH1AD2	L Si	35	50				18			175
4JA3511 FH1AD3	L Si	35	50				27			175
4JA3511 AH1AD1	L Si	70	100				10			175
4JA3511 AH1AD2	L Si	70	100				18			175

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C

GENERAL ELECTRIC CO., Semiconductor Dept., Syracuse, N. Y. *(continued)*

4JA3511 AH1AD3	L Si	70	100				27				175
4JA3511 BH1AD1	L Si	140	200				10				175
4JA3511 BH1AD2	L Si	140	200				18				175
4JA3511 BH1AD3	L Si	140	200				27				175
4JA3511 CH1AD1	L Si	210	300				10				175
4JA3511 CH1AD2	L Si	210	300				18				175
4JA3511 CH1AD3	L Si	210	300				27				175
4JA3511 BH2AD1	L Si	280	200				10				175
4JA3511 BH2AD2	L Si	280	200				18				175
4JA3511 BH2AD2	L Si	280	200				27				175
4JA3511 CH2AD1	L Si	420	300				10				175
4JA3511 CH2AD2	L Si	420	300				18				175
4JA3511 CH2AD3	L Si	420	300				27				175
4JA3511 CH3AD2	L Si	630	300				10				175
4JA3511 CH3AD3	L Si	630	300				18				175
4JA3511 CH3AD1	L Si	630	300				27				175
4JA6011 FH1AA1	M Si	35	50				53				100
4JA6011 AH1AA1	M Si	70	100				53				100
4JA6011 BH1AA1	M Si	140	200				53				100
4JA6011 CH1AA1	M Si	210	300				53				100
4JA6011 DH1AA1	M Si	280	400				53				100
4JA6211 FH1AA1	M Si	35	50				41				100
4JA6211 AH1AA1	M Si	70	100				41				100
4JA6211 BH1AA1	M Si	140	200				41				100
4JA6211 CH1AA1	M Si	210	300				41				100
4JA6211 DH1AA1	M Si	280	400				41				100

Current Ratings for Resistive or Inductive Loads.

HOFFMAN ELECTRONICS CORP., Semiconductor Div., 930 Pitner Ave. Evanston, Illinois

1N536	C Si	50	0.4			15	750	0.5	
1N537	C Si	100	0.4			15	750	0.5	
1N538	C Si	200	0.3			15	750	0.5	
1N539	C Si	300	0.3			15	750	0.5	
1N540	C Si,	400	0.3			15	750	0.5	
1N1095	C Si	600	0.3	600		15	750		

INTERNATIONAL RECTIFIER CORP., 1521 East Grand Ave., El Segundo, Calif

1N1680	C Si	150	40	150	175	500	35	0.5	190
1N1681	C Si	250	40	250	175	500	35	0.5	190
1N1682	C Si	300	40	300	175	500	35	0.5	190
1N1683	C Si	350	40	350	175	500	35	0.5	190
1N1684	C Si	400	40	400	175	500	35	0.5	190
1N1685	C Si	450	40	450	175	500	35	0.5	190
1N1686	C Si	500	40	500	175	500	35	0.5	190
1N1692	P Si	100	0.5	100	100	20	250	0.6	115
1N1693	P Si	200	0.5	200	100	20	250	0.6	115
1N1694	P Si	300	0.5	300	100	20	250	0.6	115
1N1695	P Si	400	0.5	400	100	20	250	0.6	115
1N1687	C Si	600	40	600	175	500	35	0.5	190
1N1701	L Si	50	0.4	50	100	8	150	0.9	175
1N1702	L Si	100	0.4	100	100	8	150	0.9	175
1N1703	L Si	200	0.3	200	100	8	150	0.9	175
1N1704	L Si	300	0.3	300	100	8	150	0.9	175
1N1705	L Si	400	0.3	400	100	8	150	0.9	175
1N1706	L Si	500	0.3	500	100	8	150	0.9	175
1N1707	L Si	50	0.4	50	150	10	175	0.85	175
1N1708	L Si	100	0.4	100	150	10	175	0.85	175
1N1709	L Si	200	0.3	200	150	10	175	0.85	175
1N1710	L Si	300	0.3	300	150	10	175	0.85	175
1N1711	L Si	400	0.3	400	150	10	175	0.85	175
1N1712	L Si	500	0.3	500	150	10	125	0.85	175
1N1745	I Si	1500	.025	1500	25	6	380	15	170
1N1746	I Si	1500	.025	1500	25	6	140	7.5	170
1N1747	I Si	1800	.025	1800	25	6	360	18	170
1N1748	I Si	1800	.025	1800	25	6	420	9	170
1N1749	I Si	2400	.025	2400	25	6	320	24	170
1N1750	I Si	2400	.025	2400	25	6	380	12	170
1N1751	I Si	3600	.025	3600	25	6	370	27	170
1N1752	I Si	3600	.025	3600	25	6	360	18	170
1N1753	I Si	4800	.025	4800	25	6	330	36	170
1N1754	I Si	4800	.025	4800	25	6	320	24	170
1N1755	I Si	6000	.025	6000	25	6	290	45	170
1N1756	I Si	6000	.025	6000	25	6	360	30	170
1N1757	I Si	7200	.025	7200	25	6	293	54	170
1N1758	I Si	7200	.025	7200	25	6	330	36	170
1N1759	I Si	8000	.025	8000	25	6	250	60	170
1N1760	I Si	12000	.025	12000	25	6	250	60	170
1N1761	I Si	14000	.025	14000	25	6	300	52	170
1N1762	I Si	16000	.025	16000	25	6	250	60	170
1N2116	N Si	400	0.7	400	100	15	500	1.3	100
1N2128A	O Si	50	10	50	175	160	25	0.5	200
1N2129A	O Si	100	10	100	175	160	25	0.5	200
1N2130A	O Si	150	10	150	175	160	25	0.5	200

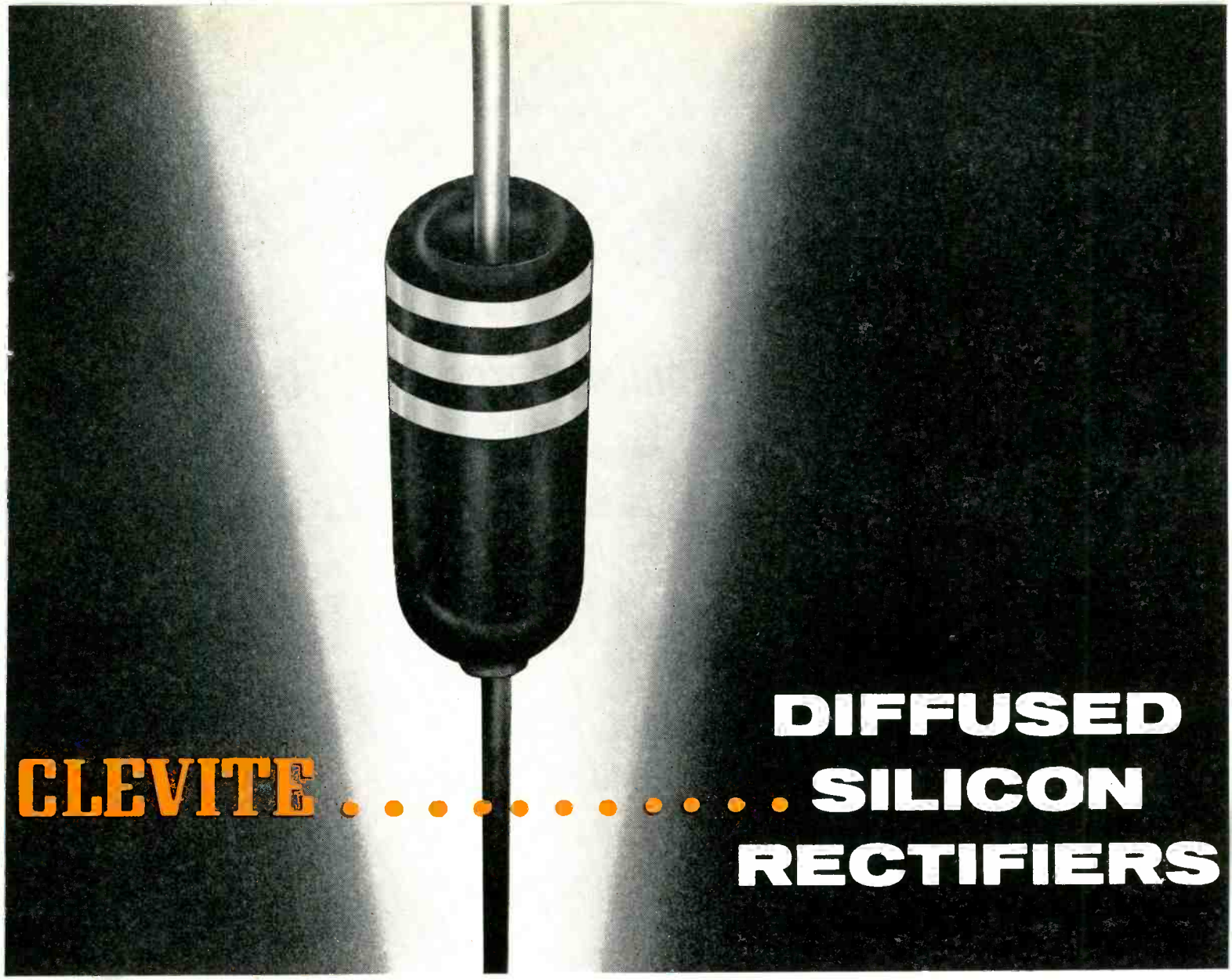
POWER RECTIFIERS

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V.	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C
INTERNATIONAL RECTIFIER CORP., 1521 East Grand Ave., El Segundo, Calif. *(continued)*											
1N2131A	O Si	200	10	200	175	160	25	0.5		200
1N2132A	O Si	250	10	250	175	160	25	0.5		200
1N2133A	O Si	300	10	300	175	160	25	0.5		200
1N2134A	O Si	350	10	350	175	160	25	0.5		200
1N2135A	O Si	400	10	400	175	160	25	0.5		200
1N2136A	O Si	450	10	450	175	160	25	0.5		200
1N2137A	O Si	500	10	500	175	160	25	0.5		200
1N2138A	O Si	600	10	600	175	160	25	0.5		200
1N2139	I Si	20000	.025	20000	25	6	.045	60		170
45L5	Q Si	50	40	50	175	500	150	0.6		200
45L10	Q Si	100	40	100	175	500	150	0.6		200
45L15	Q Si	150	40	150	175	500	150	0.6		200
45L20	Q Si	200	40	200	175	500	150	0.6		200
45L25	Q Si	250	40	250	175	500	150	0.6		200
45L30	Q Si	300	40	300	175	500	150	0.6		200
45L35	Q Si	350	40	350	175	500	150	0.6		200
45L40	Q Si	400	40	400	175	500	150	0.6		200
45L45	Q Si	450	40	450	175	500	150	0.6		200
45L50	Q Si	500	40	500	175	500	150	0.6		200
45L60	Q Si	600	40	600	175	500	150	0.6		200
45L70	Q Si	700	40	700	175	500	150	0.6		200
45L80	Q Si	800	40	800	175	500	150	0.6		200
45M5	Q Si	50	40	50	175	500	150	0.6		200
45M10	Q Si	100	40	100	175	500	150	0.6		200
45M15	Q Si	150	40	150	175	500	150	0.6		200
45M20	Q Si	200	40	200	175	500	150	0.6		200
45M25	Q Si	250	40	250	175	500	150	0.6		200
45M30	Q Si	300	40	300	175	500	150	0.6		200
45M35	Q Si	350	40	350	175	500	150	0.6		200
45M40	Q Si	400	40	400	175	500	150	0.6		200
45M45	Q Si	450	40	450	175	500	150	0.6		200
45M50	Q Si	500	40	500	175	500	150	0.6		200
45M60	Q Si	600	40	600	175	500	150	0.6		200
45M70	Q Si	700	40	700	175	500	150	0.6		200
45M80	Q Si	800	40	800	175	500	150	0.6		200
45P5	R Si	50	40	50	175	500	150	0.6		200
45P10	R Si	100	40	100	175	500	150	0.6		200
45P15	R Si	150	40	150	175	500	150	0.6		200
45P20	R Si	200	40	200	175	500	150	0.6		200
45P25	R Si	250	40	250	175	500	150	0.6		200
45P30	R Si	300	40	300	175	500	150	0.6		200
45P35	R Si	350	40	350	175	500	150	0.6		200
45P40	R Si	400	40	400	175	500	150	0.6		200
45P45	R Si	450	40	450	175	500	150	0.6		200
45P50	R Si	500	40	500	175	500	150	0.6		200
45P60	R Si	600	40	600	175	500	150	0.6		200
45P70	R Si	700	40	700	175	500	150	0.6		200
45P80	R Si	800	40	800	175	500	150	0.6		200
70U5	S Si	50	40	50	175	850	225	0.55		200
70U10	S Si	100	40	100	175	850	225	0.55		200
70U15	S Si	150	40	150	175	850	225	0.55		200
70U20	S Si	200	40	200	175	850	225	0.55		200
70U25	S Si	250	40	250	175	850	225	0.55		200
70U30	S Si	300	40	300	175	850	225	0.55		200
70U35	S Si	350	40	350	175	850	225	0.55		200
70U40	S Si	400	40	400	175	850	225	0.55		200
70U45	S Si	450	40	450	175	850	225	0.55		200
70U50	S Si	500	40	500	175	850	225	0.55		200
SD94A	Si	400	0.4	400	100	15	500	1.05		175
1N1095	G Si	500	0.3	500	150	15	250	0.5		175
1N1096	G Si	600	0.3	600	150	15	250	0.5		175
MOTOROLA, INC., Semiconductor Products Div., 5005 E. McDowell Rd., Phoenix, Ariz.											
1N1563A	B Si	100	100	150	100		70	1.5		175
1N1564A	B Si	200	200	150	200		70	1.5		175
1N1565A	B Si	300	300	150	500		70	1.5		175
1N1566A	B Si	400	400	150	400		70	1.5		175
1N1115	D Si	100	100	300	100		30	1.5	0.65	175
1N1116	D Si	200	200	300	200		30	1.5	0.65	175
1N1117	D Si	300	300	300	200		30	1.5	0.65	175
1N1118	D Si	400	400	300	400		30	1.5	0.65	175
1N1119	D Si	500	500	300	500		30	1.5	0.65	175
1N1120	D Si	600	600	300	600		30	1.5	0.65	175
NORTH AMERICAN ELECTRONICS, INC., 212 Broad Street, Lynn, Mass.											
1N248	D Si		50	5	50	150		10		
1N248A	D Si		50	5	50	150		20		
1N249	D Si		100	5	100	150		10		
1N249A	D Si		100	5	100	150		20		
1N250	D Si		200	5	200	150		10		
1N250A	D Si		200	5	200	150		20		
NA7	A Si	50	50	0.5		150		3	1.5	
NA17	A Si	100	100	0.5		150		3	1.5	
NA27	A Si	200	200	0.5		150		3	1.5	
NA37	A Si	300	300	0.5		150		3	1.5	
NA47	A Si	400	400	0.5		150		3	1.5	
NA57	A Si	500	500	0.5		150		3	1.5	
NA67	A Si	600	600	0.5		150		3	1.5	
NA0305	D Si	30	30	5		150		5	1.25	
NA0310	D Si	30	30	5		150		10	1.25	
NA0320	D Si	30	30	5		150		20	1.25	
NA0505	D Si	50	50	5		150		5	1.25	
NA0510	D Si	50	50	5		150		10	1.25	
NA0520	D Si	50	50	5		150		20	1.25	
NA1005	D Si	100	100	5		150		5	1.25	
NA1010	D Si	100	100	5		150		10	1.25	
NA1020	D Si	100	100	5		150		20	1.25	
NA1505	D Si	150	150	5		150		5	1.25	
NA1510	D Si	150	150	5		150		10	1.25	
NA1520	D Si	150	150	5		150		20	1.25	
NA2005	D Si	200	200	5		150		5	1.25	
NA2010	D Si	200	200	5		150		10	1.25	

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C
NORTH AMERICAN ELECTRONICS, INC., 212 Broad Street, Lynn, Mass *(continued)*											
NA2020	D Si	200	200	5		150		20	1.25		
NA2505	D Si	250	250	5		150		5	1.25		
NA2510	D Si	250	250	5		150		10	1.25		
NA2520	D Si	250	250	5		150		20	1.25		
NA3005	D Si	300	300	5		150		5	1.25		
NA3010	D Si	300	300	5		150		10	1.25		
NA3020	D Si	300	300	5		150		20	1.25		
NA3505	D Si	350	350	5		150		5	1.25		
NA3510	D Si	350	350	5		150		10	1.25		
NA3520	D Si	350	350	5		150		20	1.25		
NA4005	D Si	400	400	5		150		5	1.25		
NA4010	D Si	400	400	5		150		10	1.25		
NA4020	D Si	400	400	5		150		20	1.25		
NL5	B Si	50	50	1.0		100		10	1.5@ 0.5a		
NL10	B Si	100	100	1.0		100		20	1.5@ 0.5a		
NL15	B Si	150	150	1.0		100		10	1.5@ 0.5a		
NL20	B Si	200	200	1.0		100		20	1.5@ 0.5a		
NL25	B Si	250	250	1.0		100		10	1.5@ 0.5a		
NL30	B Si	300	300	1.0		100		20	1.5@ 0.5a		
NL40	B Si	400	400	1.0		100		10	1.5@ 0.5a		
NL50	B Si	500	500	1.0		100		20	1.5@ 0.5a		
NS1H0 A1A1	Z Si	17.5						0.5			125
NS1H3 A1A1	Z Si	105						0.5			125
NS1H6 A1A1	Z Si	210						0.5			125
RAYTHEON CO., 55 Chapel St., Newton 58, Mass.											
1N253	C Si	65	95	100	95		4a	1.0	1.5		150
1N254	C Si	135	190	100	190		1.5	0.4	1.5		150
1N255	C Si	270	380	150	380		1.5	0.4	1.5		150
1N256	C Si	400	570	250	570		1	0.2	2		150
1N547	B Si	600	600	300	600		10a	0.25	1.1		175
RECTICO, INC., 963 Frelinghuyden Ave., Newark 12, N. J.											
A	Se	26	36.7	10				0.15	1.3		75
BX	Se	26	36.7	15.6				0.23	1.3		75
BB	Se	26	36.7	22.5				0.37	1.3		75
BD	Se	26	36.7	30.6				0.50	1.3		75
B	Se	33	46.6	24				0.75	1.3		75
CX	Se	33	46.6	36				1.13	1.3		75
C	Se	33	46.6	54				1.53	1.3		75
CF	Se	33	46.6	72				2.12	1.3		75
D	Se	36		96				2.82	1.3		75
E	Se	36		144				4.23	1.3		75
F	Se	36		180				5.10	1.3		75
H	Se	36		216				6.00	1.3		75
J	Se	40		252				7.50	1.3		75
G	Se	40		288				7.90	1.3		75
LX	Se	40		360				9.80	1.3		75
L	Se	40		431.5				11.80	1.3		75
SARKES TARZIAN, INC., Rectifier Div., 415 No. College Ave., Bloomington, Ind.											
1N1052	D Si	35	50					30	1.5		
1N1053	D Si	70	100					30	1.5		
1N1054	D Si	105	150					30	1.5		
1N1055	D Si	140	200					30	1.5		
1N1056	D Si	210	300					30	1.5		
1N1057	D Si	280	400					30	1.5		
1N1058	E Si	35	50					40	5		
1N1059	E Si	70	100					40	5		
1N1060	E Si	105	150					40	5		
1N1061	E Si	140	200					40	5		
1N1062	E Si	210	300					40	5		
1N1063	E Si	280	400					40	5		
1N1064	Y Si	35	50					40	5		
1N1065	Y Si	70	100					40	5		
1N1066	Y Si	105	150					40	5		
1N1067	Y Si	140	200					40	5		
1N1068	Y Si	210	300					40	5		
1N1069	Y Si	280	400					40	5		
1N1070	Z Si	35	50					40	5		
1N1071	Z Si	70	100					40	5		
1N1072	Z Si	105	150					40	5		
1N1073	Z Si	140	200					40	5		
1N1074	Z Si	210	300					40	5		
1N1075	Z Si	280	400					40	5		
1N1076	F Si	35	50					50	150		
1N1077	F Si	70	100					50	150		
1N1078	F Si	105	150					50	150		
1N1079	F Si	140	200					50	150		
1N1080	F Si	210	300					50	150		
1N1085	YY Si	70	100					100	1.5		
1N1086	YY Si	140	200					100	1.5		
1N1087	YY Si	210	300					100	1.5		
1N1088	YY Si	280	400					100	1.5		
1N1089	H Si	70	100					60	5		
1N1090	H Si	140	200					60	5		
1N1091	H Si	210	300					60	5		
1N1092	H Si	280	400					60	5		
1N1157	S Si	35	50					200	20		
1N1158	S Si	70	100					200	20		
1N1159	S Si	140	200					200	20		
1N1160	S Si	210	300					200	20		
1N1161	T Si	35	50					350	35		
1N1162	T Si	70	100					350	35		
1N1163	T Si	140	200					350	35		
1N1164	T Si	210	300					350	35		
1N1165	U Si	35	50					1000	100		

Values given are for 1 cell in 1-phase ½-wave circuit.

** ITT Components Div. information was received after press time. It appears on page 170.*



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TECHNICAL DATA:			
Diode Type	Maximum DC Inverse Operating Voltage (volts)	Maximum Average Forward Current @ 25°C (ma)	Maximum Forward Voltage Drop @ 25°C (volts @ ma)
1N645	225	400	1.0 @ 400
1N647	400	400	1.0 @ 400
1N649	600	400	1.0 @ 400
1N677	100	400	1.0 @ 400
1N681	300	200	1.0 @ 200
1N683	400	200	1.0 @ 200
1N685	500	200	1.0 @ 200
1N687	600	200	1.0 @ 200

Clevite offers silicon rectifiers designed for maximum reliability in the severest military and commercial applications.

Check these features:

- **HIGH DISSIPATION — 600 mw**
- **SUBMINIATURE GLASS PACKAGE**
- **HIGH VOLTAGE — up to 600 volts**
- **HERMETICALLY SEALED**
- **HIGH TEMPERATURE OPERATION — up to 150 ma at 150°C**

For details, write for Bulletin B217A-3

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In Canada: 700 Weston Rd., Toronto 9. Tel. Roger 2-7535

Export: Ad Auriema, Inc., New York City

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C
SARKES TARZIAN, INCORPORATED, Rectifier Div., 415 No. College Ave., Bloomington, Ind. *(continued)*											
1N1166	U Si	70	100				1000	100			
1N1167	U Si	140	200				1000	100			
1N1168	U Si	210	300				1000	100			
1N1171	S Si	35	50				200	20			
1N1172	S Si	70	100				200	20			
1N1173	S Si	140	200				200	20			
1N1174	S Si	210	300				200	20			
1N1175	T Si	35	50				350	35			
1N1176	T Si	70	100				350	35			
1N1177	T Si	140	200				350	35			
1N1178	T Si	210	300				350	35			
1N1179	U Si	35	50				1000	100			
1N1180	U Si	70	100				1000	100			
1N1181	U Si	140	200				1000	100			
1N1182	U Si	210	300				1000	100			
1N1263	U Si	35	50				1500	150			
1N1264	U Si	70	100				1500	150			
1N1265	U Si	140	200				1500	150			
1N1266	U Si	210	300				1500	150			
1N1267	U Si	35	50				1500	150			
1N1268	U Si	70	100				1500	150			
1N1269	U Si	140	200				1500	150			
1N1270	U Si	210	300				1500	150			
1N1263A	U Si	35	50				2000	200			
1N1264A	U Si	70	100				2000	200			
1N1265A	U Si	140	200				2000	200			
1N1266A	U Si	210	300				2000	200			
1N1267A	U Si	35	50				2000	200			
1N1268A	U Si	70	100				2000	200			
1N1269A	U Si	140	200				2000	200			
1N1270A	U Si	210	300				2000	200			
1N1617	Q Si	70	100				100	1.5			
1N1618	Q Si	140	200				100	1.5			
1N1619	Q Si	210	300				100	1.5			
1N1620	Q Si	280	400				100	1.5			
1N1621	Z Si	70	100				150	15			
1N1622	Z Si	140	200				150	15			
1N1623	Z Si	210	300				150	15			
1N1624	Z Si	280	400				150	15			
2N26-1C1-AS	AA Se	26						0.22			
3N26-1C1-AS	AA Se	26						0.45			
4N26-1C1-AS	AA Se	26						0.9			
5N26-1C1-AS	AA Se	26						1.5			
6N26-1C1-AS	BB Se	26						2.5			
7N26-1C1-AS	BB Se	26						5			
9N26-1C1-AS	BB Se	26						8.3			
10N26-1C1-AS	BB Se	26						9.5			
12N26-1C1-AS	CC Se	26						17.8			
14N26-1C1-AS	BB Se	26						14			

Voltage and Current Ratings are for Single Phase-full Wave-Center Tap Connection.

TEXAS INSTRUMENTS, INCORPORATED, Semiconductor Components Div., P. O. Box 312, Dallas, Texas

1N1124	R Si	200	0.01	200	25	3.0				
1N1125	R Si	300	0.01	200	25	3.0				
1N1126	R Si	400	0.01	400	25	3.0				
1N1127	R Si	500	0.01	500	25	3.0				
1N1128	R Si	600	0.01	600	25	3.0				
1N1130	P Si	1500	0.05	1500	25	0.3				
1N1131	P Si	1500	0.05	1500	25	0.3				
1N1124R	R Si	200	0.01	200	25	3.0				
1N1125R	R Si	300	0.01	300	25	3.0				
1N1126R	R Si	400	0.01	400	25	3.0				
1N1127R	R Si	500	0.01	500	25	3.0				
1N1128R	R Si	600	0.01	600	25	3.0				

THERMOSEN, INC., 375 Fairfield Ave., Stamford, Conn.

P1005	A Si	50	< 5	50	10	1	150
P1010	A Si	100	< 5	100	10	1	150
P1015	A Si	150	< 5	150	10	1	150
P1020	A Si	200	< 5	200	10	1	150
P1030	A Si	300	< 5	300	10	1	150
P1040	A Si	400	< 5	400	10	1	150
P1505	A Si	50	< 5	50	15	1	150
P1510	A Si	100	< 5	100	15	1	150
P1515	A Si	150	< 5	150	15	1	150
P1520	A Si	200	< 5	200	15	1	150
P1530	A Si	300	< 5	300	15	1	150
P1540	A Si	400	< 5	400	15	1	150
P2005	A Si	50	< 5	50	20	1	150
P2010	A Si	100	< 5	100	20	1	150
P2015	A Si	150	< 5	150	20	1	150
P2020	A Si	200	< 5	200	20	1	150
P2030	A Si	300	< 5	300	20	1	150
P2040	A Si	400	< 5	400	20	1	150
P2505	A Si	50	< 5	50	25	1	150
P2510	A Si	100	< 5	100	25	1	150
P2515	A Si	150	< 5	150	25	1	150
P2520	A Si	200	< 5	200	25	1	150
P2530	A Si	300	< 5	300	25	1	150
P2540	A Si	400	< 5	400	25	1	150
P3005	A Si	50	< 5	50	30	1	150
P3010	A Si	100	< 5	100	30	1	150
P3015	A Si	150	< 5	150	30	1	150
P3020	A Si	200	< 5	200	30	1	150
P3030	A Si	300	< 5	300	30	1	150
P3040	A Si	400	< 5	400	30	1	150

UNITED STATES DYNAMICS CORP., 1250 Columbus Ave., Boston 20, Mass.

1N248	A Si	50	50	5	50	100	10			200
1N248A	A Si	50	50	5	50	90	10			175
1N249	A Si	100	100	5	100	100	10			200
1N249A	A Si	100	100	5	100	90	10			175
1N250	A Si	200	200	5	200	100	10			200
1N250A	A Si	200	200	5	200	90	10			175
1N1199	B Si	50	50	10	50		12	1.25		
1N1200	B Si	100	100	10	100		12	1.25		
1N1201	B Si	150	150	10	100		12	1.25		
1N1202	B Si	200	200	10	200		12	1.25		
1N1203	B Si	300	300	10	300		12	1.25		
1N1204	B Si	400	400	10	400		12	1.25		
1N1205	B Si	500	500	10	500		12	1.25		
1N1206	B Si	600	600				12	1.25		
1N1301	B Si	50	50	15		300	10	1.0		200
1N1302	B Si	100	100	5		300	10	1.0		200
1N1303	B Si	150	150				10	1.0		
1N1304	B Si	200	200	5		300	10	1.0		200
1N1305	B Si	250	250				10	1.0		
1N1306	B Si	300	300	5		300	10	1.0		200
1N1341	B Si	50	50				6	1.25		
1N1342	B Si	100	100				6	1.25		
1N1343	B Si	150	150				6	1.25		
1N1344	B Si	200	200				6	1.25		
1N1345	B Si	300	300				6	1.25		
1N1346	B Si	400	400				6	1.25		
1N1347	B Si	500	500				6	1.25		
1N1348	B Si	600	600				6	1.25		
1N1581	B Si	50	50				6	1.5		
1N1582	B Si	100	100				6	1.5		
1N1583	B Si	200	200				6	1.5		
1N1584	B Si	300	300				6	1.5		
1N1585	B Si	400	400				6	1.5		
1N1586	B Si	500	500				6	1.5		
1N1587	B Si	600	600				6	1.5		
1N1612	B Si	50	50				10	1.5		
1N1613	B Si	100	100				10	1.5		
1N1614	B Si	200	200				10	1.5		
1N1615	B Si	400	400				10	1.5		
1N1616	B Si	600	600				10	1.5		
USD5091A*	A Si	35	50	5	150		3	1.0@1.0a		175
USD5091B	A Si	70	100	5	150		3	1.0@1.0a		175
USD5091C	A Si	105	150	5	150		3	1.0@1.0a		175
USD5091D	A Si	140	200	5	150		3	1.0@1.0a		175
USD5091F	A Si	210	300	5	150		3	1.0@1.0a		175
USD5091H	A Si	280	400	5	150		3	1.0@1.0a		
USD5091J	A Si	350	500	5	150		3	1.0@1.0a		
USD5091L	A Si	420	600	5	150		3	1.0@1.0a		
USD5091P	A Si	560	800	5	150		3	1.0@1.0a		
USD5091T	A Si	700	1000	5	150		3	1.0@1.0a		
USD5051A	A Si	35	50	5	150		5	1.2@ 5a		
USD5051B	A Si	70	100	5			5	1.2@ 5a		
USD5051C	A Si	105	150	5			5	1.2@ 5a		
USD5051D	A Si	140	200	5			5	1.2@ 5a		
USD5051F	A Si	210	300	5			5	1.2@ 5a		
USD5051H	A Si	280	400	5			5	1.2@ 5a		
USD5051J	A Si	350	500	5			5	1.2@ 5a		
USD5051L	A Si	420	600	5			5	1.2@ 5a		
USD5051P	A Si	560	800	5			5	1.2@ 5a		
USD5051T	A Si	700	1000	5			5	1.2@ 5a		
USD210A	A Si	35	50	5	150		10	1.5@25a		
USD210B	A Si	70	100	5			10	1.5@25a		
USD210C	A Si	105	150	5			10	1.5@25a		
USD210D	A Si	140	200	5			10	1.5@25a		
USD210F	A Si	210	300	5			10	1.5@25a		
USD210H	A Si	280	400	5			10	1.5@25a		
USD210J	A Si	350	500	5			10	1.5@25a		
USD145A	A Si	35	50	0.5			3	1.0@1.0a		
USD145B	A Si	70	100	0.5			3	1.0@1.0a		
USD145C	A Si	105	150	0.5			3	1.0@1.0a		
USD145D	A Si	140	200	0.5			3	1.0@1.0a		
USD145F	A Si	210	300	0.5			3	1.0@1.0a		
USD145H	A Si	280	400	0.5			3	1.0@1.0a		
USD145J	A Si	350	500	0.5			3	1.0@1.0a		
USD142A	A Si	35	50	0.2	150		3	1.0@1.0a		
USD142B	A Si	70	100	0.2			3	1.0@1.0a		
USD142C	A Si	105	150	0.2			3	1.0@1.0a		
USD142D	A Si	140	200	0.2			3	1.0@1.0a		
USD142F	A Si	210	300	0.2			3	1.0@1.0a		
USD142H	A Si	280	400	0.2			3	1.0@1.0a		
USD142J	A Si	350	500	0.2			3	1.0@1.0a		
USD162A	A Si	35	50	0.2	150		5	1.2@ 5a		
USD162B	A Si	70	100	0.2			5	1.2@ 5a		
USD162C	A Si	105	150	0.2			5	1.2@ 5a		
USD162D	A Si	140	200	0.2			5	1.2@ 5a		
USD162F	A Si	210	300	0.2			5	1.2@ 5a		
USD162H	A Si	280	400	0.2			5	1.2@ 5a		
USD162J	A Si	350	500	0.2			5	1.2@ 5a		
USD285A	A Si	35	50	0.5	150		10	1.5@25a		
USD285B	A Si	70	100	0.5			10	1.5@25a		
USD285C	A Si	105	150	0.5			10	1.5@25a		
USD285D	A Si	140	200	0.5			10	1.5@25a		
USD285F	A Si	210	300	0.5			10	1.5@25a		
USD285H	A Si	280	400	0.5			10	1.5@25a		
USD285J	A Si	350	500	0.5			10	1.5@25a		

U. S. SEMICONDUCTOR PRODUCTS, INC., 3536 West Osborn Road, Phoenix, Ariz.

1N1907 1917	D E Si	35	10μa	50	30	1.5	2	.250		
1N1908 1918	D E Si	70	10μa	100	30	1.5	2	250		
1N1909 1919	D E Si	140	10μa	200	30	1.5	2	250		
1N1910 1920	D E Si	210	10μa	300	30	1.5	2	250		

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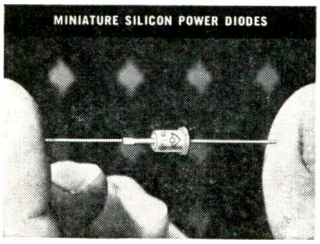
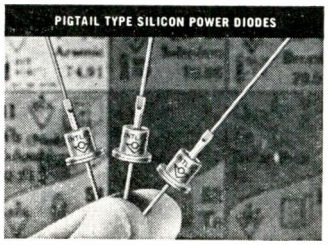
Special configurations and high reliability rectifiers for military applications may be obtained under our "Prescribed Reliability" Program. Address your inquiry to: Military Products Dept.



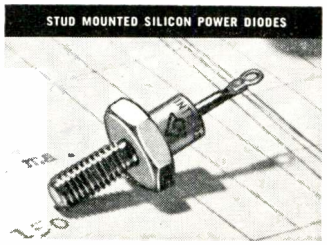
Ratings: 100 to 600 PIV, Up to 500 ma.

Specifically designed for missile and airborne equipment applications where miniaturization and reliability are prime factors. Hermetically sealed, all-welded, pigtail lead construction. Manufactured to meet the most rigid military requirements. Request **Bulletin SR-203**



Ratings: 50 to 600 volts PIV • 250 to 750 ma.

An extensive line of silicon power diodes for military and industrial applications featuring all-welded, hermetically sealed construction. All designed and manufactured to meet the most rigid military requirements. For complete technical data, write for **Bulletin SR-202.**

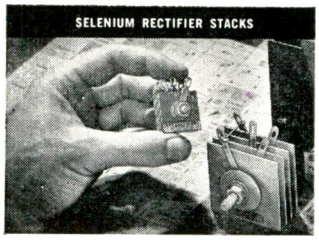


Ratings: 50 to 600 volts PIV • 400 ma. to 1 amp.

Industrial and military types including the 1N253, 1N254 and 1N255. Stud mounted, hermetically sealed, all-welded construction. Operating temperature range: −55°C to +150°C. Designed and manufactured to meet most rigid military specifications. **Bulletin SR-135C**

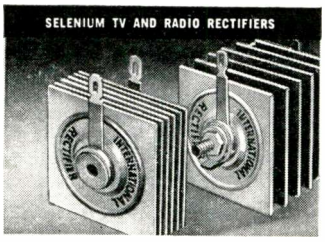
Ratings: 20 to 160 volts • 100μa to 11 ma.

Ideal components for bias supplies, sensitive relays, computers etc. High resistance, (10 megohms and higher at —10 volts). Excellent linear forward characteristics. Extremely small, low in cost. Encapsulated to resist adverse environmental extremes. **Bulletin SR-163.**



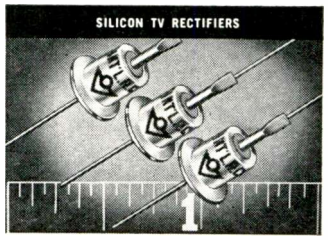
Ratings: From 100 ma. to 50 Amps.

Low forward voltage drop and low leakage characteristics make this series ideal for a wide variety of power applications. For details request **Bulletin C-349,** (26 volt cells); **Bulletin SR-160,** (45 to 52 volts per cell) and **Bulletin SR-152,** on high current density cells.



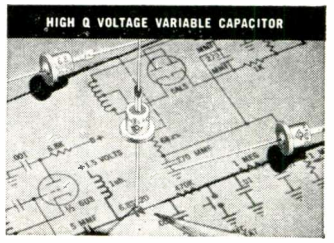
Ratings: 25 to 156 volts AC, 50 to 1,200 ma. DC

The widest range in the industry! Designed for Radio, Television, TV booster, UHF converter and experimental applications. Input ratings from 25 to 156 volts AC and up. DC output current 50 to 1,200 MA. Write for application information. **Bulletin ER-178-A**



Ratings: 400 PIV, up to 750 ma.

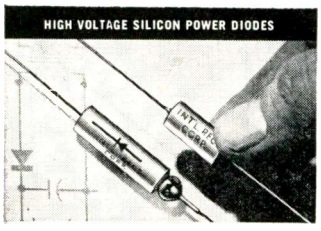
SD-500. A hermetically sealed, all-welded silicon junction rectifier offering maximum reliability in the high temperatures encountered in TV applications. Pigtail leads eliminate the need for brackets, blocks, etc., simplify installation. For complete data: **Bulletin SR-201**



Ratings: Q of 1000, 200 PIV DC

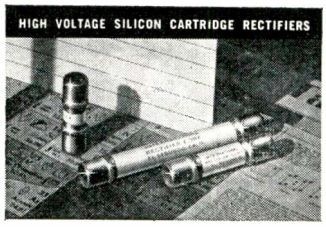
Semicap's small size, light weight, high reliability and low power requirements make it ideal for automatic frequency control, frequency modulation oscillators and filter networks. All-welded hermetically sealed, shock-proof housing. Request **Bulletin SR-205.**

SILICON AND SELENIUM HIGH VOLTAGE TYPES



Rating: 600 to 2400 volts PIV • 100 to 125 ma.

Three types available. Hermetically sealed, pigtail construction. Style J rated at 600 to 1000 volts PIV at 125 ma. **Bulletin SR-138E** Styles K and L with PIV ratings from 600 to 2400 volts at 100 ma. dc output current are described in technical detail—**Bulletin SR-157.**

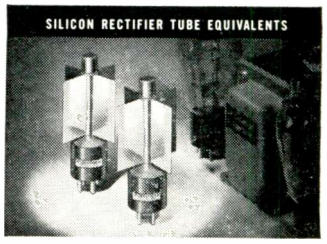


Ratings: 1000 to 20,000 volts PIV @ 45 to 440 ma.

Especially suited for miniaturized military equipment where optimum reliability is a prime factor. Standard types for normal convection cooling and high current types for forced air or oil cooling. Hermetically sealed, metallized ceramic housing. Request **Bulletin SR-225.**

Ratings: 20 to 20,000 volts • 0.2 to 195 ma.

Designed for long life and reliability in half-wave, voltage doubler, bridge, center-tap circuits, and 3-phase circuit types. Phenolic cartridges and hermetically sealed types available. Operating temperature range: −65°C to +100°C. For details specify **Bulletin H-2.**



Ratings: 85 to 600 ma • 1500 to 6000 PIV.

Highly reliable series of tube replacement rectifiers rated from 1500 to 6400 PIV, 85 to 600 ma (including the ST-7 replacement for the 866 Tube) offer the superior characteristics of silicon on a wide range of high voltage applications.

For complete data: **Bulletin SR-209.**

International

EXECUTIVE OFFICES: EL SEGUNDO, CALIF.

The World's Largest Supplier of Industrial Metallic Rectifiers • Selenium • Germanium • Silicon

RECTIFIERS FOR ALL DC REQUIREMENTS...FROM MICROWATTS TO MEGAWATTS!

RECTIFIER CORPORATION PRODUCTS

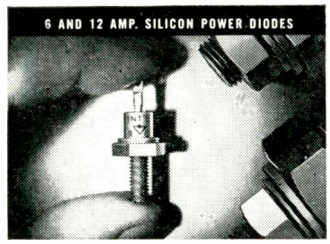
LINE OF QUALITY RECTIFIERS ON EARTH!

All designed and manufactured to meet the most rigid military requirements!

POWER TYPES FOR INDUSTRIAL AND MILITARY APPLICATIONS

SILICON AND SELENIUM MEDIUM CURRENT TYPES TO 150 AMPS.

6 AND 12 AMP. SILICON POWER DIODES

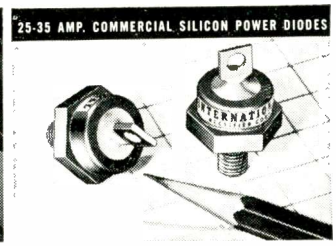


Ratings: 6 and 12 Amps • 50 to 500 PIV.

Precision-controlled diffusion process insures optimum operation and high uniformity of characteristics over the entire operating temperature range. Full 6 or 12 ampere output current over a PIV range from 50 to 500 volts. Rugged, all-welded construction.

Bulletin XSR-308.

25-35 AMP. COMMERCIAL SILICON POWER DIODES

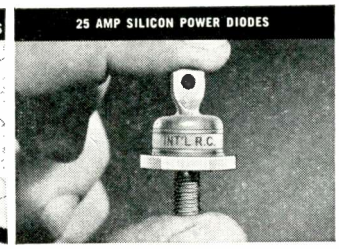


Ratings: 25 to 35 Amps • 50 to 500 PIV.

50 to 500 PIV Rated "Quad-Sealed" power diodes are low in cost yet provide extremely stable operation on a wide range of commercial applications. 4-layer "Quad-Seal" process assures high resistance to humidity, shock, vibration and temperature extremes.

Bulletin SR-310.

25 AMP SILICON POWER DIODES



Rating: 50 to 500 volts PIV • 25 to 45 Amps.

Advanced ceramic techniques assuring excellent thermal characteristics and mechanical stability are used in the production of these highly reliable, hermetically sealed rectifiers for military or industrial applications. For complete technical data, request **Bulletin SR-304**

150 AMP. SILICON POWER DIODES

Ratings: 50 to 800 volts PIV • 45 to 150 Amps.

An extensive series of standard and reverse polarity types. Optional mounting bases including machine thread and pipe thread types. Machine thread base types: **Bulletin SR-300,** Pipe thread base types. **Bulletin SR-301,** Complete stack assemblies: **Bulletin SR-302**

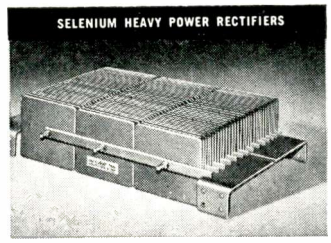
SILICON, SELENIUM AND GERMANIUM HIGH CURRENT TYPES TO 670 AMPS. PER JUNCTION

250 AMP. SILICON POWER DIODES

Ratings: 50 to 500 volts PIV • 75 to 250 Amps.

Standard and reverse polarity types offered in a series of machine thread and pipe thread mounting styles. Complete assemblies in all circuit configurations also available. Rugged construction and hermetic sealing assure long life and reliability. Ask for **Bulletin SR-305**

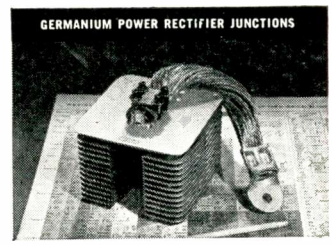
SELENIUM HEAVY POWER RECTIFIERS



Ratings: 6 to 30,000 volts • 50 to 2,300 Amps.

Specifically designed for industrial DC power needs. Patented construction features assure long life. Descriptive bulletins available are: **Bulletin C-349,** (26 volt cells); **Bulletin SR-160,** (45 to 52 volts per cell) and **Bulletin SR-152,** on high current density cells.

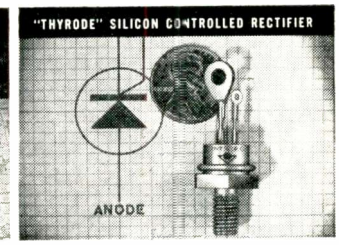
GERMANIUM POWER RECTIFIER JUNCTIONS



Ratings: 500 amperes • 26 to 66 volts rms

High capacity junctions especially designed for high-current, low-voltage electrochemical installations. Air cooled, these hermetically sealed junctions provide efficiency to 98.5%. Cast aluminum airfoil housing effects maximum heat transfer. Request **Bulletin GPR-25A.**

"THYRODE" SILICON CONTROLLED RECTIFIER



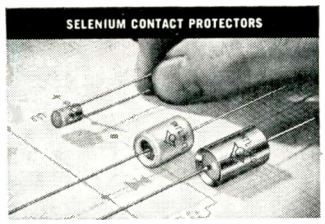
Ratings: 10 Amps • 20 to 200 PIV.

A completely new miniature control device capable of replacing the thyratron and similar units that proportionately control power to a load from an ac source. Units currently available with output currents up to 10 amps, PIV ratings from 20 to 200 volts.

Bulletin SR-350.

SPECIAL SEMI-CONDUCTOR DEVICES

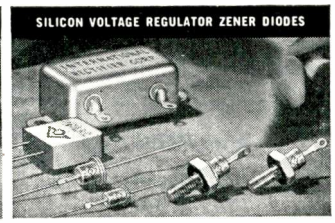
SELENIUM CONTACT PROTECTORS



Complete series of AC and DC types.

Designed to eliminate arcing and erosion across the contacts of relays, switches, etc. A complete series in each of three basic types: diode type, cartridge type and hermetically sealed types for industrial application. For complete data: **Bulletin SR-150-A**

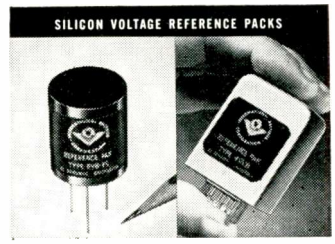
SILICON VOLTAGE REGULATOR ZENER DIODES



Ratings: From 600 milliwatts to 10 watts

A complete series in 6 types. Miniature single junction types, multiple junction types and double anode units. 750 milliwatt and 1 watt types: **Bulletin SR-251,** 3.5 and 10 watt types: **Bulletin SR-252,** Multiple junction 5 watt types: SR-253, Double anode types: SR-254

SILICON VOLTAGE REFERENCE PACKS

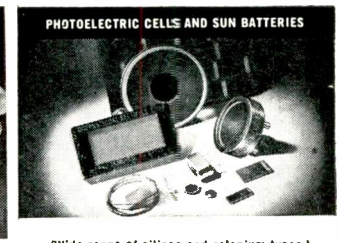


Voltage Regulation: ±0.01%

Built to withstand environmental extremes, and operable up to 125°C, these miniature, highly stable reference packs provide output voltages of either 8.4 or 16.8 volts dc—are available in 6 distinct types allowing operation from varied power sources.

Request **Bulletin SR-401.**

PHOTOELECTRIC CELLS AND SUN BATTERIES



(Wide range of silicon and selenium types.)

Self-generating cells available in standard and custom sizes, mounted or unmounted. For details on wide selection of selenium types, request Bulletin PC-649A. Silicon solar cells with efficiencies as high as 10%. Designed to rugged military specifications **Bulletin SR-275A.**

Rectifier Corp.

A WORLD OF DIFFERENCE THROUGH RESEARCH

• OREGON 8-6281 • CABLE ADDRESS: RECTUSA

NEW YORK CITY AREA OFFICE: 132 E. 70th St., TRafalgar 9-3330
NEW YORK STATE AREA OFFICE: 2366 James St., Syracuse, N.Y., HOward 3-1441
CHICAGO AREA OFFICE: 205 W. Wacker Dr., FRanklin 2-3888
NEW ENGLAND AREA OFFICE: 17 Dunster St., Cambridge, Mass., UNiversity 4-6520
PENNSYLVANIA AREA OFFICE: Suburban Square Bldg., Ardmore, Pa., MIdway 9-1428
MICHIGAN AREA OFFICE: 1799 Coolidge H'way, Berkley, Mich., LIncoln 8-1144
IN CANADA: International Rectifier of Canada, Ltd., 1581 Bank St., Ottawa, Ontario, Regent 3-6880

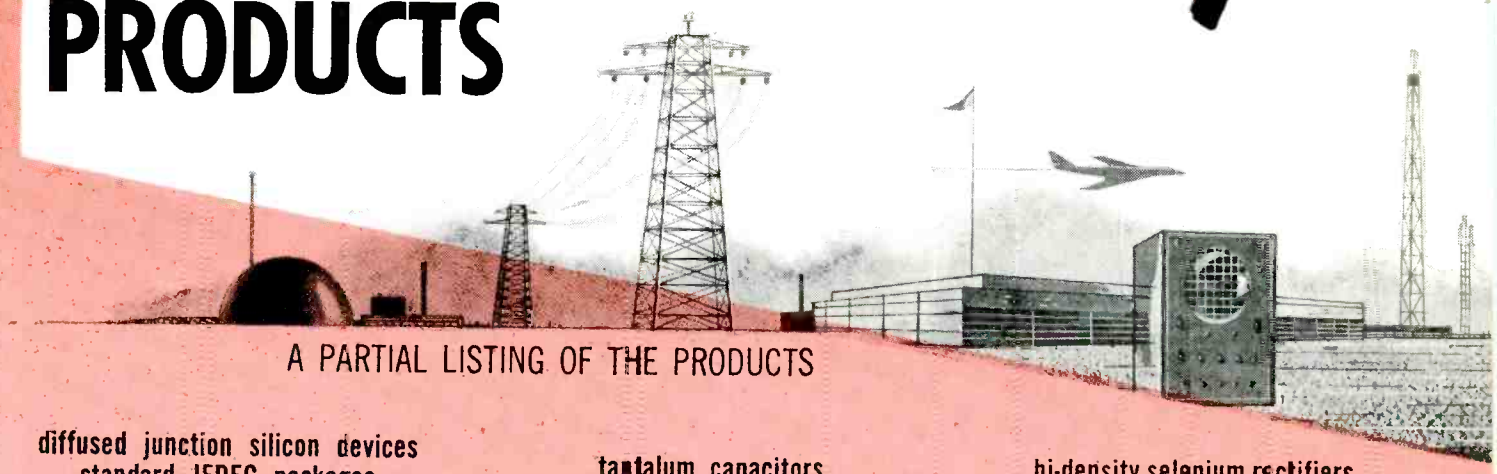
REPRESENTATIVES THROUGHOUT THE WORLD

BUYERS GUIDE FOR ITT PRODUCTS

Components Division

Compo

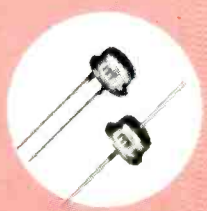
HIGH



A PARTIAL LISTING OF THE PRODUCTS

diffused junction silicon devices standard JEDEC packages

Dual positive hermetic sealing — maximum heat transfer — withstand high current surges — designed for highest electrical efficiency, and maximum operating reliability to meet military specifications.



LOW POWER TYPES "TOP-HAT" (SERIES R) AND "DERBY" (SERIES C) CONFIGURATIONS

Up to 1.5 amps for printed circuit or wire-in applications with voltage ratings up to 800 volts PIV

MEDIUM POWER TYPES SERIES "D", "K" AND "U"

Rated up to 30 amps at 150° C. case temperature Voltage ratings up to 800 volts PIV

HIGH POWER TYPES SERIES "F"

Ratings up to 70 amperes at 150° C. case temperature. Voltage ratings up to 600 volts PIV

ZENER VOLTAGE REGULATOR DIODES

3.9 to 100 volts ±5% and ±10% tolerances 750 milliwatt — 1 watt 3.5 watt and 10 watt ratings Axial lead or stud mountings

HIGH CURRENT SILICON-RECTIFIERS

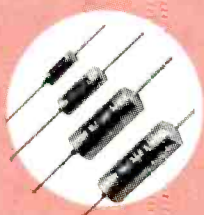
Silicon rectifier assemblies to provide desired current and voltage output. Both single and three phase assemblies are available.

tantalum capacitors

ITT miniature tantalum capacitors fill the ever growing need for lightweight, miniaturized high reliability components to meet military specifications. These capacitors offer greater electrical stability with rugged construction and larger capacity per unit volume.

WET ANODE TYPES

3 Case Sizes, with a non-corrosive electrolyte. Operate without derating from 55° C. to 125° C. Designed to MIL specifications. Large capacity per unit volume.



SOLID ANODE TYPES

4 Case Sizes . . . with excellent frequency stability over wide operating temperature range . . . hermetically sealed. All types designed to MIL specifications.

GLASS SEALS

Compression seals, solder seals, pressure, standoff and speednut terminals, condenser end seals and transistor closures, designed for uniform seal integrity and high electrical insulation under the most severe conditions. Standard types and custom designs are made to strict specifications under exhaustive quality control.

hi-density selenium rectifiers

ITT Hi-Density Selenium Rectifiers utilize maximum cell area, providing high electrical output in relation to weight, good voltage regulation within rated capacity — superior quality and performance characteristics for industrial and military applications.

NEW! 45 VOLT INDUSTRIAL RECTIFIER

Smaller, lighter, more efficient selenium rectifiers can be designed with ITT's new 45 volt cells. Other features include: smaller mounting dimension, long life, low temperature rise, conservative ratings and reliability at higher temperatures — plus cost reductions.

NEW! DOUBLE DENSITY INDUSTRIAL RECTIFIER

Carefully controlled evaporation techniques permit ITT's Hi-Density selenium rectifier cells to carry double the current of conventional cells — 180 milliamperes per square inch. This process features rectifiers of small size, high operating efficiency at a lower cost.

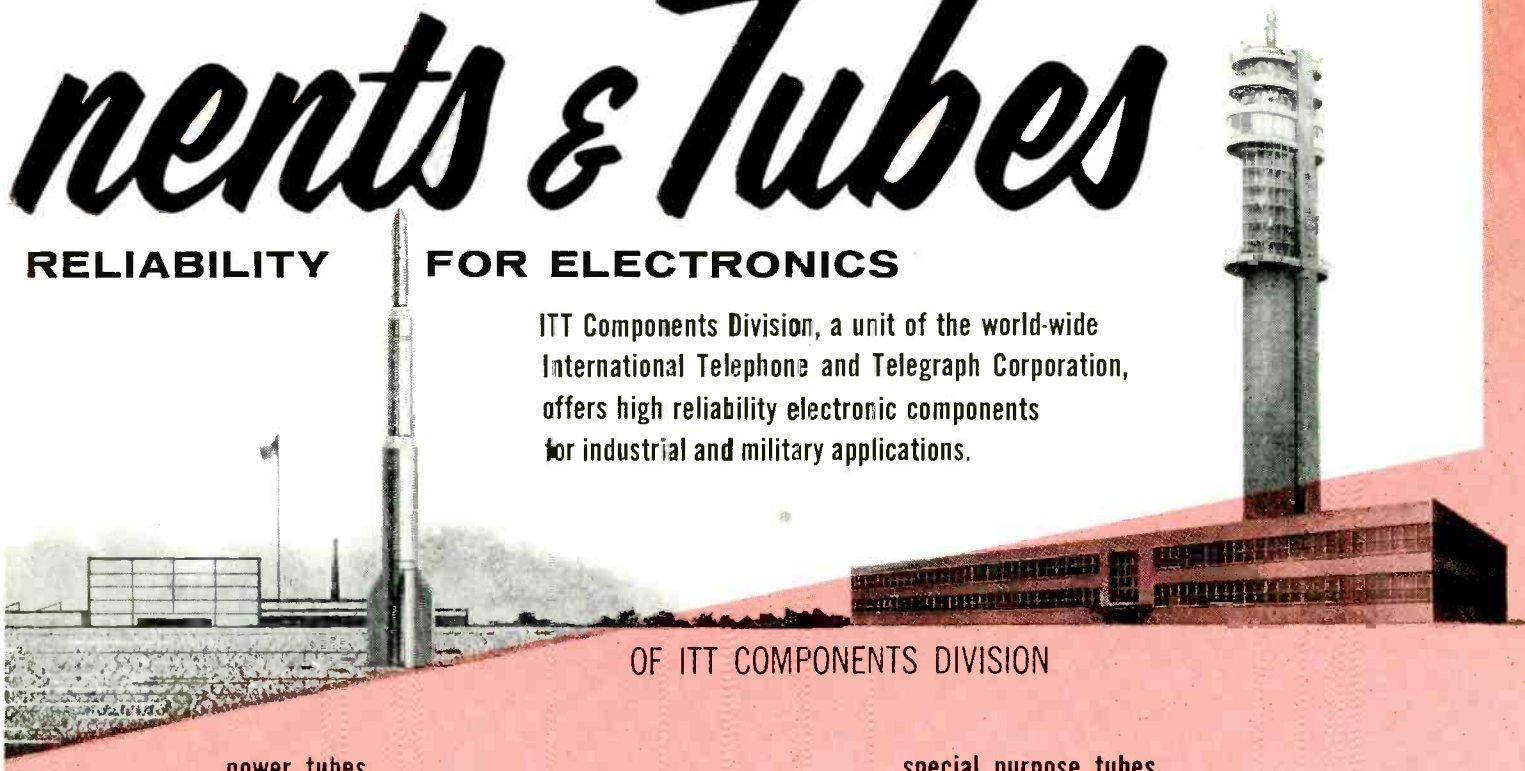
CONTACT PROTECTORS

Suppresses voltage surges in inductive circuits. Extends contact life by reducing erosion due to sparking and preventing component failure. Reduces electrical noise. Available for DC or AC applications. New! Use them to protect transistors against over voltage.

nents & Tubes

RELIABILITY FOR ELECTRONICS

ITT Components Division, a unit of the world-wide International Telephone and Telegraph Corporation, offers high reliability electronic components for industrial and military applications.



OF ITT COMPONENTS DIVISION

power tubes

ITT power triodes and rectifier tubes for communications, dielectric and induction heating, random noise generators and pulse operation applications are outstanding. An exceptionally wide range of tubes are available in air cooled, water cooled and vapor cooled types.

POWER TRIODES

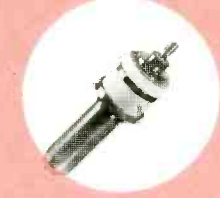
ITT Power Triodes, for CW and pulse operation are used as modulators, amplifiers and oscillators in communications and industrial service. Water cooled and air cooled types.

EVAPORATIVE COOLED POWER TRIODES

Evaporative Cooled Power Triodes feature high anode dissipation, high loading capacity and exceptional overload capability.

SUPER-POWERED TRIODES

Super-powered Triodes, developed by ITT Components Division for use as modulators, amplifiers and oscillators in communication and industrial services.



CERAMIC POWER TRIODES

Ceramic Power Triodes with rugged, coaxial design for modern requirements in high temperature, high frequency, high power applications.

special purpose tubes

Special Purpose Tubes made by ITT are available in many standard types and sizes, and custom designed types are also made for specific applications.

TRAVELING WAVE TUBES

A rugged line of traveling wave tubes with metal envelopes and ceramic seals. They are of the helix type, self-aligning in the external solenoid, and are provided with either coaxial or waveguide fittings.

IATRON TUBES**

Iatron storage tubes are used in radar and electronic display systems. They feature extreme brightness for day light viewing and controlled storage time. Information can be written, stored and erased with ease. Direct view and projection types.

HYDROGEN THYRATRONS

ITT - Kuthe hydrogen thyratrons, made by Kuthe Laboratories, Inc.*, the world's largest manufacturer of gas-filled thyratrons and diodes, feature an extensive line of glass or ceramic types.

*A unit of ITT Components Division.

GLASS HYDROGEN THYRATRONS

ITT - Kuthe hydrogen thyratrons used in pulse forming circuits and other applications deliver peak powers up to 33 megawatts. High altitude designs are available. Hydrogen reservoirs are used for long life.

CERAMIC HYDROGEN THYRATRONS

Ceramic hydrogen thyratrons feature peak performance with size reduced by one-third over equivalent glass types. They can withstand greater shock and vibration and high ambient temperatures up to 125° C.

RESEARCH AND DEVELOPMENT TYPES

In addition to the standard products of the ITT Components Division, the ITT Laboratories are making a variety of other types, in limited quantities, for development purposes.

These include:

- Image Converter Tubes
- Multiplier Photo Tubes
- Lead Telluride Infrared Detectors
- Barrier Grid Storage Tubes
- Electro Static Focusing TWT
- Permanent Magnet Type TWT
- Super Powered Pulse Triodes

**A trademark of International Telephone and Telegraph Corporation

SEE US AT WESCON BOOTHS 2510-2512

ITT *Components Division*

INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

P.O. BOX 412, CLIFTON, N. J.

Circle 94 on Inquiry Card

POWER RECTIFIERS

U. S. SEMICONDUCTOR PRODUCTS, INC., 3536 West Osborn Road, Phoenix, Ariz. *(continued)*

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C
1N1911	D										
1921	E Si	280		10 μa	400		30	1.5		2	250
1N1912	D										
1922	E Si	350		10 μa	500		30	1.5		2	250
1N1913	D										
1923	E Si	435		10 μa	600		30	1.5		2	250
1N1914	D										
1924	E Si	500		10 μa	700		30	1.5		2	250
1N1915	D										
1925	E Si	570		10 μa	800		30	1.5		2	250
1N1916	D										
1926	E Si	630		10 μa	900		30	1.5		2	250
HPR50	Si	35	50	1.0	50	25		35	1.0		
HPR100	Si	70	100	1.0	100	25		35	1.0		
HPR200	Si	140	200	1.0	200	25		35	1.0		
HPR300	Si	210	300	1.0	300	25		35	1.0		
HPR400	Si	280	400	1.0	400	25		35	1.0		
HPR500	Si	350	500	1.0	500	25		35	1.0		
HPR600	Si	420	600	1.0	600	25		35	1.0		

WESTINGHOUSE ELECTRIC CORP., Semiconductor Div., Youngwood, Pa.

1N1183	Si	50	20	50	25	500	35	0.6		190
1N1184	Si	100	20	100	25	500	35	0.6		190
1N1185	Si	150	20	150	25	500	35	0.6		190
1N1186	Si	200	20	200	25	500	35	0.6		190
--	Si	250	20	250	25	500	35	0.6		190
1N1187	Si	300	20	300	25	500	35	0.6		190
--	Si	350	20	350	25	500	35	0.6		190
1N1188	Si	400	20	400	25	500	35	0.6		190
1N1189	Si	500	20	500	25	500	35	0.6		190
1N1190	Si	600	20	600	25	500	35	0.6		190
1N1191	Si	50	10	50	25	200	18	0.75		190
1N1192	Si	100	10	100	25	200	18	0.75		190
1N1193	Si	150	10	150	25	200	18	0.75		190
1N1194	Si	200	10	200	25	200	18	0.75		190
--	Si	250	10	250	25	200	18	0.75		190
1N1195	Si	300	10	300	25	200	18	0.75		190
--	Si	350	10	350	25	200	18	0.75		190
1N1196	Si	400	10	400	25	200	18	0.75		190
1N1197	Si	500	10	500	25	200	18	0.75		190
1N1198	Si	600	10	600	25	200	18	0.75		190
1N1199	Si	50	10	50	190	200	12	0.65		190
1N1200	Si	100	10	100	190	200	12	0.65		190
1N1201	Si	150	10	150	190	200	12	0.65		190
1N1202	Si	200	10	200	190	200	12	0.65		190
1N1203	Si	300	10	300	190	200	12	0.65		190
1N1204	Si	400	10	400	190	200	12	0.65		190
1N1205	Si	500	10	500	190	200	12	0.65		190
1N1206	Si	600	10	600	190	200	12	0.65		190
1N1217	I Si	50	1.5	50	150	20	1.6	1.0		175
1N1218	I Si	100	1.5	100	150	20	1.6	1.0		175
1N1219	I Si	150	1.5	150	150	20	1.6	1.0		175
1N1220	I Si	200	1.5	200	150	20	1.6	1.0		175
1N1221	I Si	300	1.5	300	150	20	1.6	1.0		175
1N1222	I Si	400	1.5	400	150	20	1.6	1.0		175
1N1223	I Si	500	1.5	500	150	20	1.6	1.0		175
1N1224	I Si	600	1.5	600	150	20	1.6	1.0		175
1N1225	I Si	700	1.5	700	150	20	1.6	1.0		175
1N1226	I Si	800	1.5	800	150	20	1.6	1.0		175
1N1217A	I Si	50	0.5	50	150	20	1.6	1.0		175
1N1218A	I Si	100	0.5	100	150	20	1.6	1.0		175
1N1219A	I Si	150	0.5	150	150	20	1.6	1.0		175
1N1220A	I Si	200	0.5	200	150	20	1.6	1.0		175
1N1221A	I Si	300	0.5	300	150	20	1.6	1.0		175
1N1222A	I Si	400	0.5	400	150	20	1.6	1.0		175
1N1223A	I Si	500	0.5	500	150	20	1.6	1.0		175
1N1224A	I Si	600	0.5	600	150	20	1.6	1.0		175
1N1227	H Si	50	1.5	50	150	20	1.6	1.0		175
1N1228	H Si	100	1.5	100	150	20	1.6	1.0		175
1N1229	H Si	150	1.5	150	150	20	1.6	1.0		175
1N1230	H Si	200	1.5	200	150	20	1.6	1.0		175
1N1231	H Si	300	1.5	300	150	20	1.6	1.0		175
1N1232	H Si	400	1.5	400	150	20	1.6	1.0		175
1N1233	H Si	500	1.5	500	150	20	1.6	1.0		175
1N1234	H Si	600	1.5	600	150	20	1.6	1.0		175
1N1235	H Si	700	1.5	700	150	20	1.6	1.0		175
1N1236	H Si	800	1.5	800	150	20	1.6	1.0		175
1N1227A	H Si	50	0.5	50	150	20	1.6	1.0		175
1N1228A	H Si	100	0.5	100	150	20	1.6	1.0		175
1N1229A	H Si	150	0.5	150	150	20	1.6	1.0		175
1N1230A	H Si	200	0.5	200	150	20	1.6	1.0		175
1N1231A	H Si	300	0.5	300	150	20	1.6	1.0		175
1N1232A	H Si	400	0.5	400	150	20	1.6	1.0		175
1N1233A	H Si	500	0.5	500	150	20	1.6	1.0		175
1N1234A	H Si	600	0.5	600	150	20	1.6	1.0		175

WESTINGHOUSE ELECTRIC CORP., Semiconductor Div., Youngwood, Pa. *(continued)*

DIODE TYPE NO.	CASE & MAT	WORKING VOLTAGE (MAX.) $E_{cont.}$	REVERSE E_{PEAK} V	REVERSE I_{MAX} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{SURGE} (amps)	MAXIMUM RATINGS DC OUTPUT CURRENT (amps)	MAXIMUM RATINGS FULL LOAD VOLT. DROP	MAXIMUM RATINGS DIS. (W)	MAXIMUM RATINGS T °C
1N1271	Si	50	40	50	25	2000	160	0.6		190
1N1272	Si	100	40	100	25	2000	160	0.6		190
1N1273	Si	150	40	150	25	2000	160	0.6		190
1N1274	Si	200	40	200	25	2000	160	0.6		190
--	Si	250	40	250	25	2000	160	0.6		190
1N1275	Si	300	40	300	25	2000	160	0.6		190
--	Si	350	40	350	25	2000	160	0.6		190
1N1276	Si	400	40	400	25	2000	160	0.6		190
1N1277	Si	500	40	500	25	2000	160	0.6		190
1N1281	Si	50	40	50	25	2000	160	0.6		190
1N1282	Si	100	40	100	25	2000	160	0.6		190
1N1283	Si	150	40	150	25	2000	160	0.6		190
1N1284	Si	200	40	200	25	2000	160	0.6		190
--	Si	250	40	250	25	2000	160	0.6		190
1N1285	Si	300	40	300	25	2000	160	0.6		190
--	Si	350	40	350	25	2000	160	0.6		190
1N1286	Si	400	40	400	25	2000	160	0.6		190
1N1287	Si	500	40	500	25	2000	160	0.6		190
1N1291	Si	50	40	50	25	2000	160	0.6		190
1N1292	Si	100	40	100	25	2000	160	0.6		190
1N1293	Si	150	40	150	25	2000	160	0.6		190
1N1294	Si	200	40	200	25	2000	160	0.6		190
--		250	40	250	25	2000	160	0.6		190
1N1295	Si	300	40	300	25	2000	160	0.6		190
--	Si	350	40	350	25	2000	160	0.6		190
1N1296	Si	400	40	400	25	2000	160	0.6		190
1N1297	Si	500	40	500	25	2000	160	0.6		190
1N1330	Si	50	50	50	25	3000	240	0.6		190
1N1331	Si	100	50	100	25	3000	240	0.6		190
1N1332	Si	150	50	150	25	3000	240	0.6		190
1N1333	Si	200	50	200	25	3000	240	0.6		190
--	Si	250	50	250	25	3000	240	0.6		190
1N1334	Si	300	50	300	25	3000	240	0.6		190
--	Si	350	50	350	25	3000	240	0.6		190
1N1341	E Si	50	10	50	190	150	6	1.1		190
1N1342	E Si	100	10	100	190	150	6	1.1		190
1N1343	E Si	150	10	150	190	150	6	1.1		190
1N1344	E Si	200	10	200	190	150	6	1.1		190
1N1345	E Si	300	10	300	190	150	6	1.1		190
1N1346	E Si	400	10	400	190	150	6	1.1		190
1N1347	E Si	500	10	500	190	150	6	1.1		190
1N1348	E Si	600	10	600	190	150	6	1.1		190
1N1376	Si	50	50	50	25	3000	240	0.6		190
1N1377	Si	100	50	100	25	3000	240	0.6		190
1N1378	Si	150	50	150	25	3000	240	0.6		190
1N1379	Si	200	50	200	25	3000	240	0.6		190
--	Si	250	50	250	25	3000	240	0.6		190
1N1380	Si	300	50	300	25	3000	240	0.6		190
--	Si	350	50	350	25	3000	240	0.6		190
1N1443	I Si	1000	1.5	1000	150	20	1.6	1.0		175
1N1444	H Si	1000	1.5	1000	150	20	1.6	1.0		175
1N1486	I Si	500	3.5	500	100	20	0.22	0.5		150
1N1537	D Si	50	0.5	50	150	20	1.6	1.0		175
1N1538	D Si	100	0.5	100	150	20	1.6	1.0		175
1N1539	D Si	150	0.5	150	150	20	1.6	1.0		175
1N1540	D Si	200	0.5	200	150	20	1.6	1.0		175
1N1541	D Si	300	0.5	300	150	20	1.6	1.0		175
1N1542	D Si	400	0.5	400	150	20	1.6	1.0		175
1N1543	D Si	500	0.5	500	150	20	1.6	1.0		175
1N1544	D Si	600	0.5	600	150	20	1.6	1.0		175
1N1660	K Si	50	40	50	25	2000	160	0.6		190
1N1661	K Si	100	40	100	25	2000	160	0.6		190
1N1662	K Si	150	40	150	25	2000	160	0.6		190
1N1663	K Si	200	40	200	25	2000	160	0.6		190
--	Si	250	40	250	25	2000	160	0.6		190
1N1664	K Si	300	40	300	25	2000	160	0.6		190
--	Si	350	40	350	25	2000	160	0.6		190
1N1665	K Si	400	40	400	25	2000	160	0.6		190
1N1666	K Si	500	40	500	25	2000	160	0.6		190
1N1670	L Si	50	50	50	25	3000	240	0.6		190
1N1671	L Si	100	50	100	25	3000	240	0.6		190
1N1672	L Si	150	50	150	25	3000	240	0.6		190
1N1673	L Si	200	50	200	25	3000	240	0.6		190
--	Si	250	50	250	25	3000	240	0.6		190
1N1674	L Si	300	50	300	25	3000	240	0.6		190
--	Si	350	50	350	25	3000	240	0.6		190
300A	Si	50	30	50	190	1200	70	1.2		190
300B	Si	100	30	100	190	1200	70	1.2		190
300C	Si	150	30	150	190	1200	70	1.2		190
300D	Si	200	30	200	190	1200	70	1.2		190
300E	Si	250	30	250	190	1200	70	1.2		190
300F	Si	300	30	300	190	1200	70	1.2		190
300G	Si	350	30	350	190	1200	70	1.2		190
300H	Si	400	30	400	190	1200	70	1.2		190
300K	Si	500	30	500	190	1200	70	1.2		190

ITT COMPONENTS DIVISION, P.O. BOX 412, CLIFTON, N. J.

Diode Type No.	Case & Mat	Working Voltage (max.) $E_{cont.}$	REVERSE E_{peak} V	REVERSE I_{max} (ma)	REVERSE @ V	REVERSE @ °C	MAXIMUM RATINGS I_{surge} (amps)	MAXIMUM RATINGS DC Output Current (amps)	MAXIMUM RATINGS Full Load Volt Drop
Series C / Series R	Si	—	800	0.3 ma	—	150°	—	1.5	1.1 v.
Series K / Series R	Si	—	800	2 ma.	—	150°	—	12 a.	1.1 v.
Series D	Si	—	800	5 ma.	—	150°	450	30 a.	1.1 v.
Series F	Si	—	600	10 ma.	—	150°	1200	70 a.	1.1 v.

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

AUTOMATIC silicon rectifiers

all the available JAN TYPES to meet MIL-E-1 specifications

Maximum Values for AUTOMATIC Military Type Silicon Rectifiers

Type No.	Peak Reverse Voltage (VDC)	DC Output Current (MA) Av. @ 135° C. Case Temp.	@ 25° C. Ambient	@ 150° C. Ambient	Maximum Reverse Current (MA)	Mounting	MIL-E-1 Technical Spec. Sheet No.
1N253	100	1000	—	—	0.1*	Stud	1024A
1N254	200	400	—	—	0.1*	Stud	989B
1N255	400	400	—	—	0.15*	Stud	990B
1N256	600	200	—	—	0.25*	Stud	991B
1N538	200	—	750	250	0.350†	Axial Lead	1084A
1N540	400	—	750	250	0.350†	Axial Lead	1085A
1N547	600	—	750	250	0.350†	Axial Lead	1083A

*Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current; case temperature 135° C.

†Averaged over 1 cycle for inductive or resistive load with rectifier operating at full rated current at 150° C. ambients.

Without qualification, these rectifiers are the finest available today, designed and manufactured to meet stringent government requirements and the exceedingly high quality control standards of General Instrument Corporation.

These JAN types are offered in volume quantities for *on time delivery* at prices that reflect General Instrument's years of production experience. Data sheets on these and other AUTOMATIC silicon rectifiers are available upon request.

AUTOMATIC MANUFACTURING

RR RADIO RECEPTOR

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GENERAL INSTRUMENT CORPORATION
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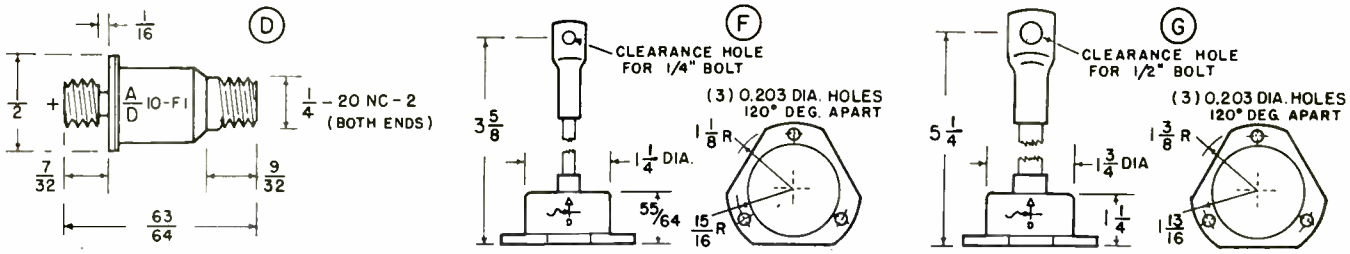
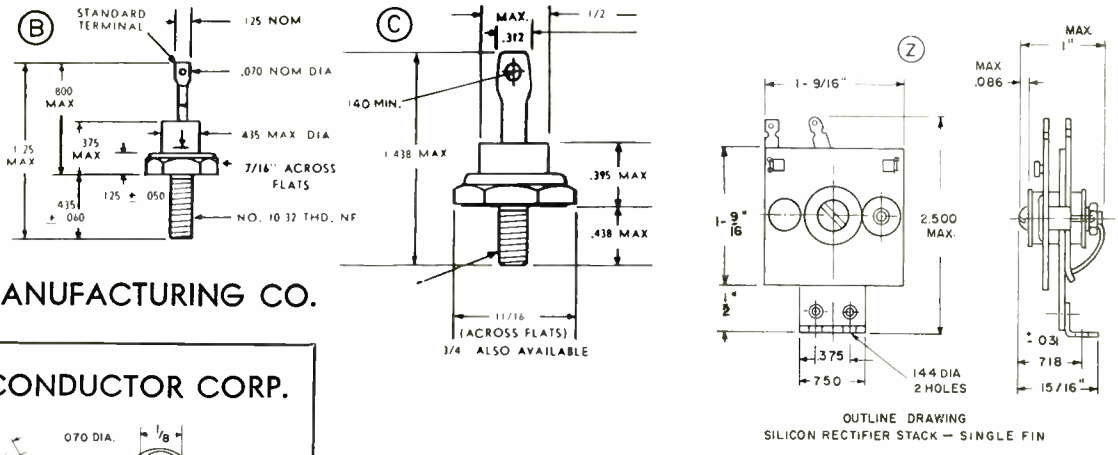
GENERAL INSTRUMENT CORPORATION INCLUDES F. W. SICKLES DIVISION, AUTOMATIC MANUFACTURING DIVISION, RADIO RECEPTOR COMPANY, INC. AND MICAMOLD ELECTRONICS MANUFACTURING CORPORATION (SUBSIDIARIES)

GENERAL INSTRUMENT DISTRIBUTORS: Baltimore: D & H Distributing Co. • Chicago: Merquip Co. • Cleveland: Pioneer Electronic Supply • Los Angeles: Valley Electronics Supply Co., Burbank • Milwaukee: Radio Parts Co., Inc. • New York City: Hudson Radio & Television Corp., Sun Radio & Electronic Co. • Philadelphia: Herbach & Rademan, Inc. • San Diego: Shanks & Wright Inc. • San Francisco: Pacific Wholesale Co. • Seattle: Seattle Radio Supply • Tulsa: Oil Capitol Electronics

AUDIO DEVICES, INC.

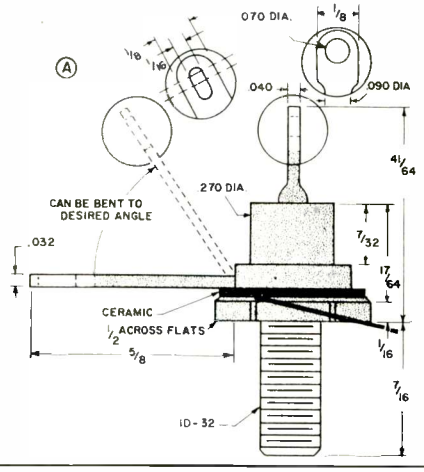


AUTOMATIC MANUFACTURING CO.

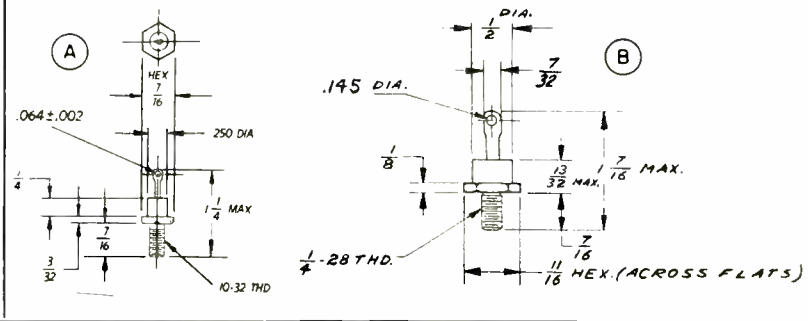


OUTLINE DRAWING
SILICON RECTIFIER STACK — SINGLE FIN

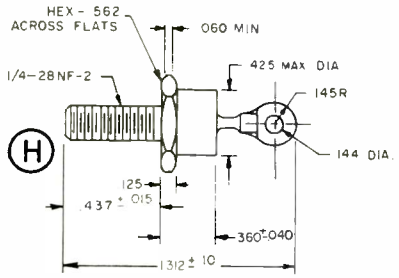
BRADLEY SEMICONDUCTOR CORP.

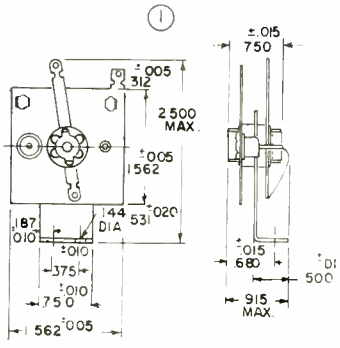


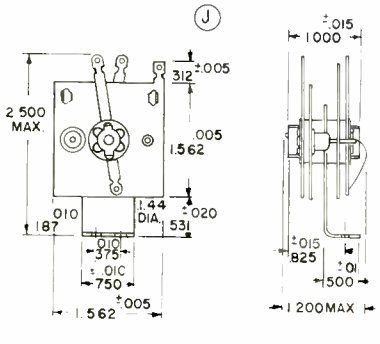
COLUMBUS ELECTRONICS CORP.



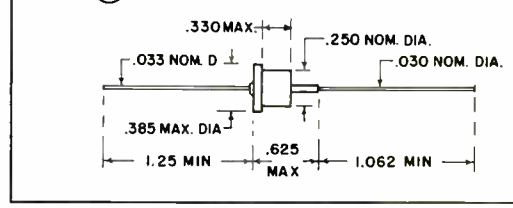
GENERAL ELECTRIC CO.

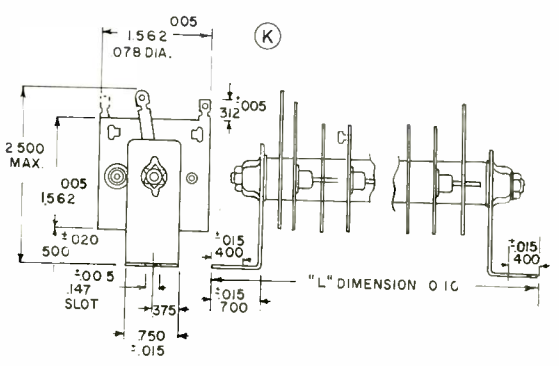






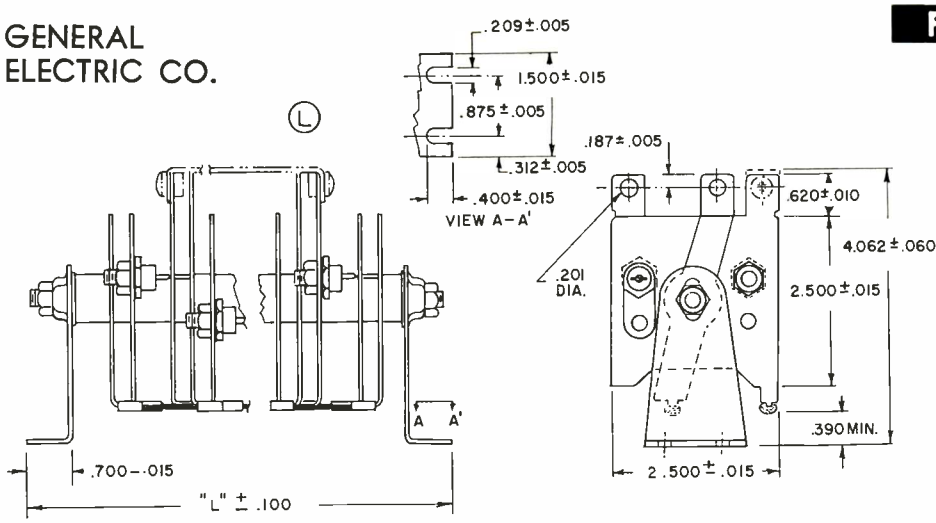
HOFFMAN SEMICONDUCTOR DIV.

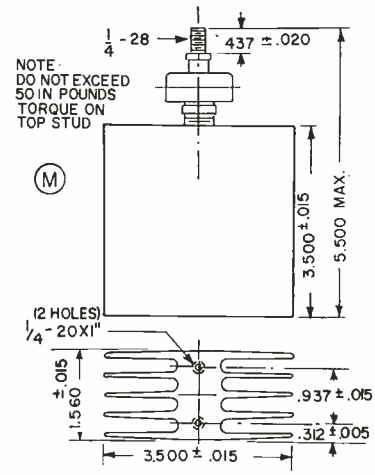




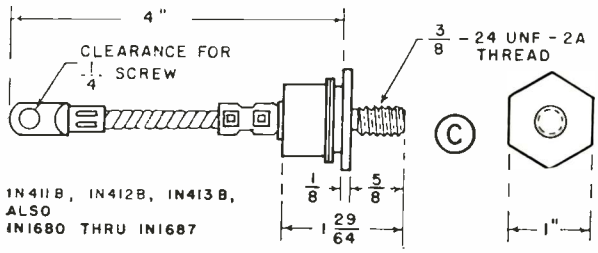
POWER RECTIFIERS

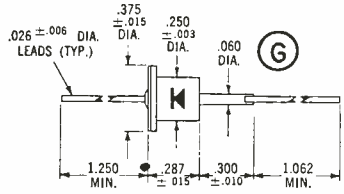
GENERAL ELECTRIC CO.

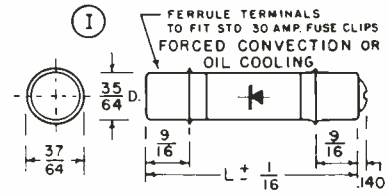


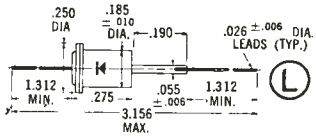


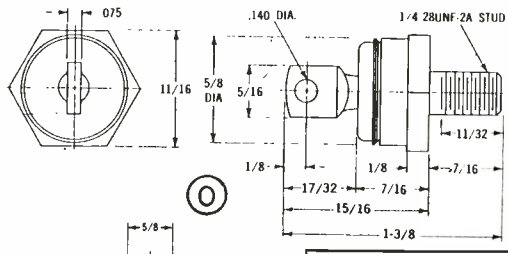
INTERNATIONAL RECTIFIER CORP.

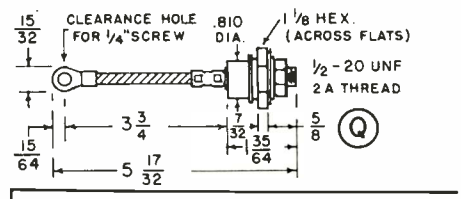


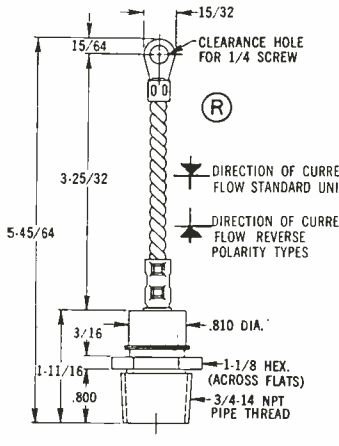


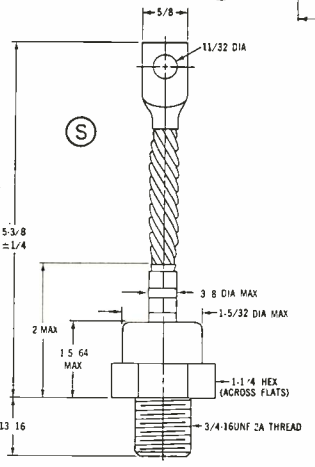












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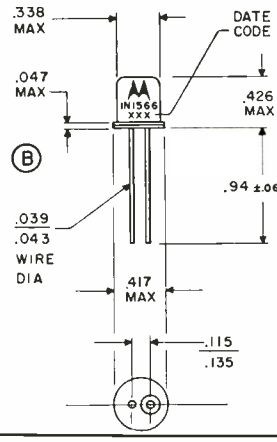
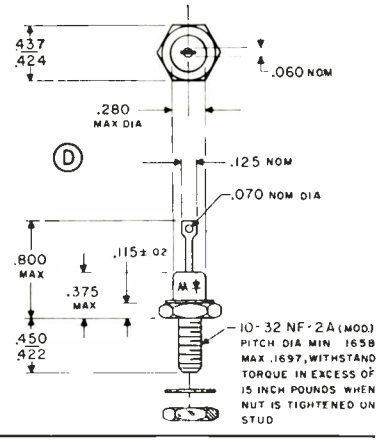
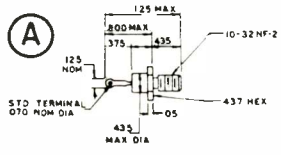
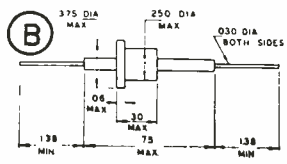
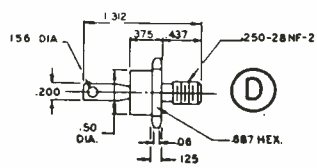


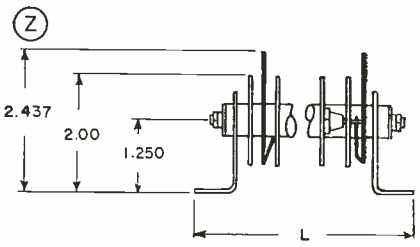


NORTH AMERICAN ELECTRONICS INC.

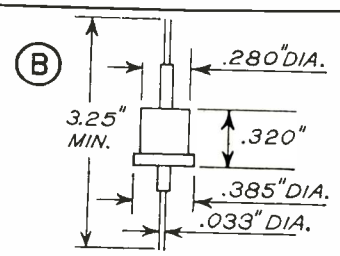


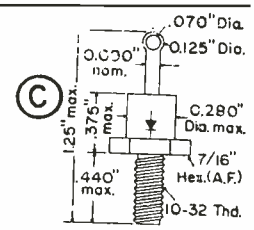






RAYTHEON COMPANY





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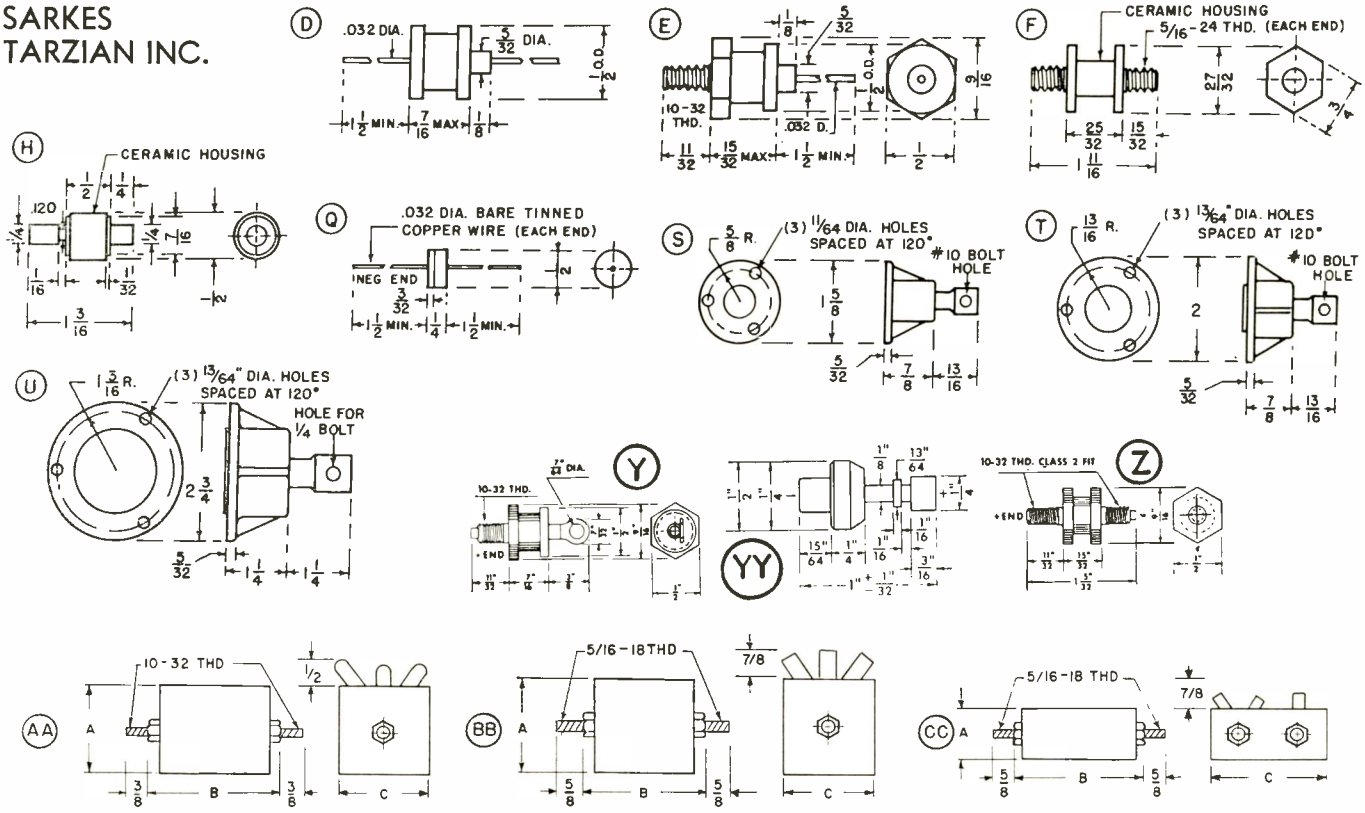

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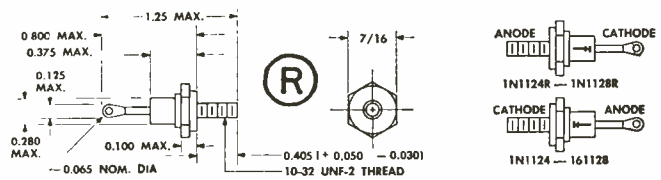
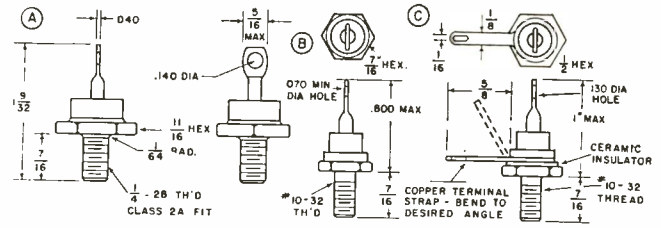
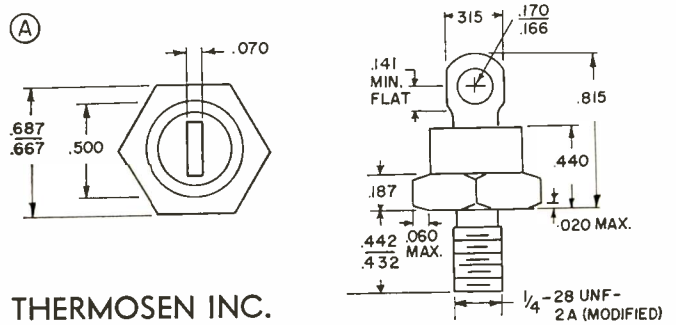


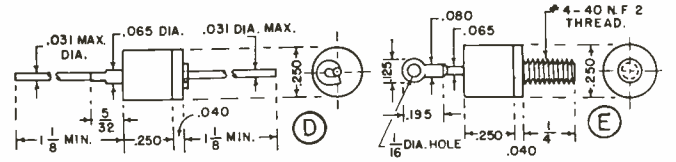
U. S. DYNAMICS CORP.



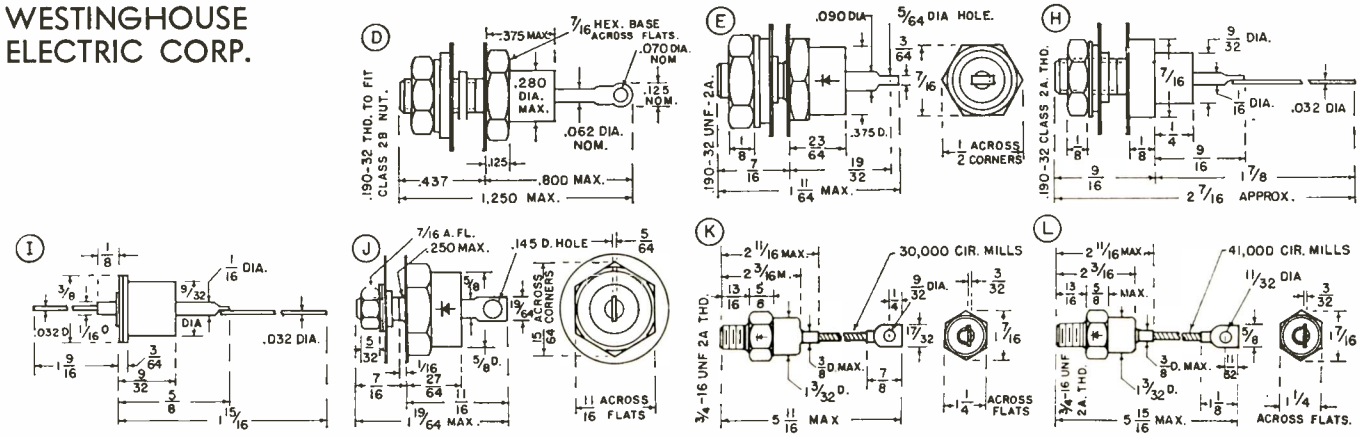
THERMOSEN INC.



U. S. SEMICONDUCTOR PRODUCTS



WESTINGHOUSE ELECTRIC CORP.



New Products

MERCURY VAPOR FLOODLIGHT

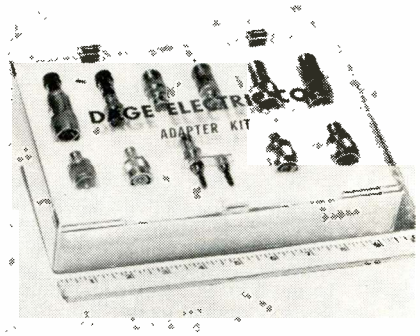
Type MVE-20 1000 w mercury vapor floodlight has a 20 in. dia. reflector and lens. Floodlight is dust-tight and weatherproof. Housing is cast aluminum, of copper free alloy. With

adjustable stops it can be turned around or tipped over for relamping an cleaning, and returned to its exact original setting. Horizontal and vertical degree scales are provided for aiming at pre-determined angles at the time of installation. This virtually eliminates need for night-time adjustments. Crouse-Hinds Co., Syracuse 1, N. Y.

Circle 251 on Inquiry Card

COAX CABLE ADAPTERS

Kit of adapters between coaxial cable connectors is packaged in a transparent plastic box. Assortment included eleven adapters covering most connectors in common use: UG 349 A/U; UG 201 A/U; UG 636



A/U; UG 273 A/U; UG 255 A/U; UG 83 /U; UG 146 /U; UG 564 /U; Dage 100-381-1; G 924 /U and Dage 2038-1. Dage Electric Co., Inc., 67 North Second Street, Beech Grove, Ind.

Circle 252 on Inquiry Card

Another way
RCA serves you
through
Electronics

Skills + Experience / Top Quality

Benefit from the experience gained in building 21,000,000 picture tubes...

specify RCA!

In over a decade of experience, RCA has produced more than 21,000,000 picture tubes. What does this experience promise you?

First, it promises *quality*...high standards for checking every tube component, every production step. It promises *improvements*...the constant research that has given you the latest developments in picture-tube design. Every improvement in technique, every new design is thoroughly proved-out before release. Further, this "know-how" promises the *dependability* and *availability* you need to meet tight production schedules. Why settle for less?

RCA offers you every active picture-tube type for black-and-white television...types with either low or high grid-No. 2 voltage, either short or long neck, either 90° or 110° deflection, as well as the very latest in color picture tubes. For details, get in touch with the RCA Field Representative at our office nearest you.

FIELD OFFICES

EAST: 744 Broad Street, Newark 2, N. J.
HUmboldt 5-3900

MIDWEST: Suite 1154
Merchandise Mart Plaza, Chicago 54, Ill.
WHitehall 4-2900

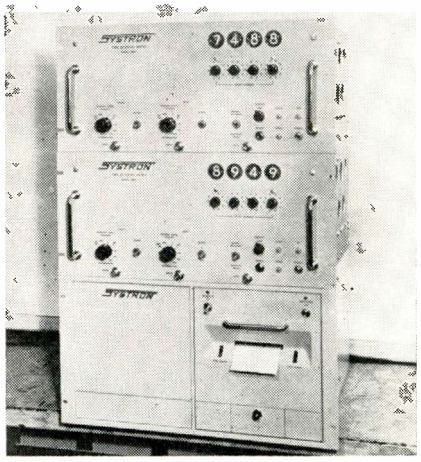
WEST: 6355 E. Washington Blvd.
Los Angeles 22, Calif.
RAymond 3-8361

RADIO CORPORATION OF AMERICA
Electron Tube Division — *Harrison, N. J.*

New Products

RANGING SYSTEM

Airborne Ranging Systems are designed for airborne use and used to check and calibrate airborne and ground DME equipment. As the aircraft flies a prescribed course, two

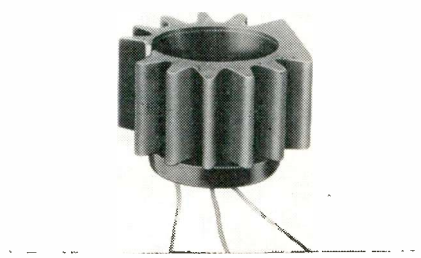


Model 1021-1 time interval meters take simultaneous measurements of elapsed time between the emitted signal and the return signal from two different ground stations. A Systron Model 1401-1 digital recorder provides a permanent printed record of both times and identifying code. Features include Nixie in-line readout, direct readout in nautical miles, and automatic subtraction of fixed delays. Systron Corp., 950 Galindo St., Concord, Calif.

Circle 253 on Inquiry Card

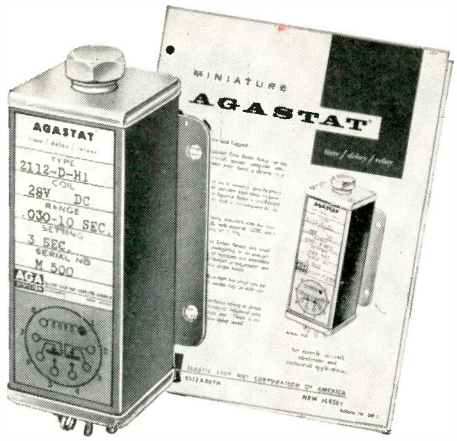
TRANSISTOR RADIATOR

Series of radiators for cooling transistors, the 3AL-680 series, are similar to the 3AL-675 series, transistor radiators, but mount directly on the chassis or printed circuit board, thus serving as retainers. Mounting is by a tapped hole in the mounting base of the radiator. Tests show that the increased radiating surface provides significant heat reduction in transistors. Sizes and modifi-



cations are available to cover the range of TO-6, TO-7 and TO-9 packages. Material is aluminum with anodized finish. Industrial Div., The Birtcher Corp., 4371 Valley Blvd., Los Angeles 32, Calif.

Circle 254 on Inquiry Card



Now! get complete data on

MINIATURE AGASTAT®
time/delay/relays

This free folder contains complete specs on 24 models of the miniature AGASTAT Time Delay Relay for missile, aircraft, computer, electronic and industrial applications. They're small as 1-13/16" x 4-7/16" x 1½", with adjustable timing ranges starting at .030 and as high as 120 seconds.

The folder gives operating and environmental specs, coil data, contact capacities, dimensions, diagrams of contact and wiring arrangements. *Write:* Dept. A-33-832.

AGA DIVISION **ELASTIC STOP NUT CORPORATION OF AMERICA**
Elizabeth, New Jersey

Circle 101 on Inquiry Card

✓ PRECISION ✓ PRICE ✓ PERFORMANCE

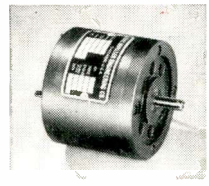
HM MOTORS DELIVER EVERY TIME!

Heinz Mueller makes motors for hundreds of applications—and they all bear the unmistakable mark of Heinz Mueller's excellent quality control. From original design through the last phase of production, Heinz Mueller engineering skill and experience are devoted to supplying you with dependability you can count on.

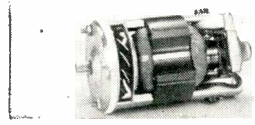
Write for detailed information on standard specifications or let us tackle your particular engineering requirements.

DC Motors Cool running, quiet operating motors in especially compact designs where space requirements are rigid.

Capacitor Type Motors For 24 to 220 Volts. Can be supplied with terminal studs or leads, as specified. Ball bearing or sleeve bearing, commercial or military applications.



DC Dynamotor Especially designed for high altitude aircraft operation where service is critical.



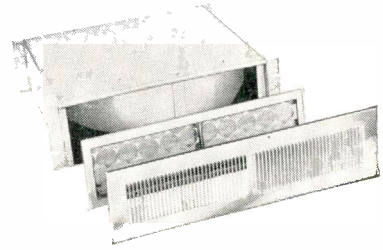
AC/DC Series Motors Especially low-priced power units for appliances, office machines, etc. Has wide range of practical applications.

HEINZ MUELLER Engineering Co., Inc.
1906 N. Cicero Avenue • Chicago 39, Illinois

Circle 102 on Inquiry Card

Beat the Heat IN ELECTRONIC CABINETS and RACKS

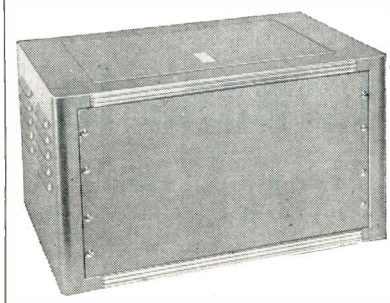
with BUD Trans-aire BLOWER



Operates better, occupies less space and is the lowest priced unit of equal capacity and performance.

Ideal to dissipate excessive heat generated in housings by electronic equipment.
May be used as an exhaust or intake depending upon mounting position. Operates on 110 V., 60 cycle current. Delivers either 550 or 250 cfm. air displacement at 0° static pressure. Oilite bearings; oil impregnated, fiber glass disposable fiter. Thermal overload protection to prevent over heating. Automatic re-set. Quiet operation. Minimum vibration. Size is 5¼" x 17" x 14½." Fits in standard 19" wide housings.

DELUXE CABINET RACKS



Now complete with front panel at no extra charge

A popular housing for electrical and electronic control or testing equipment. Attractively finished with red lined, chrome strips on top and bottom of front. Will accommodate standard 19" panels. Top door with flush handle catch permits easy servicing or inspection. Ten sizes available in choice of three finishes. Larger sizes have hinged rear door.

See these and the other fine Bud Products at your nearest authorized Bud Distributor or write us for complete details.

SEE US AT THE WESCON SHOW

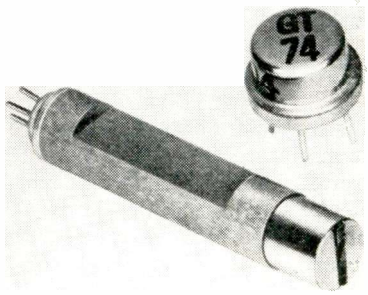
BUD RADIO CORP.
2118 East 55th Street, Cleveland 3, Ohio
Dept. T

Circle 103 on Inquiry Card

New Products

MAGNETIC DRUM HEADS

The Model MDHM-35-328 miniature drum head is designed for installation where many tracks are required or where a large number of recirculating registers are necessary. The heads

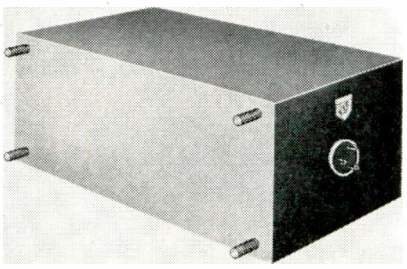


can be mounted so that the gaps of two adjacent heads are only 0.150 apart circumferentially, making the head ideal for close recirculating registers. The heads are low inductance for efficient transistor driving. Mechanically the diameter of the head is only 0.216 with an overall length of 1.062. The head is available with shielded and jacketed cable. Magne-Head Div., General Transistor Western Corp., 2660-64 So. La Cienega Blvd., Los Angeles 34, Calif.

Circle 255 on Inquiry Card

DELAY NETWORK

Analog computer delay network's characteristics are: delay time (overall), 700 μsec. ±7 μsec., tapped at 70 μsec. intervals ±1%; characteristic impedance, 3,000 ohms ±%5; delay linearity, ±1.0%, 300 CPS to 25 KC;



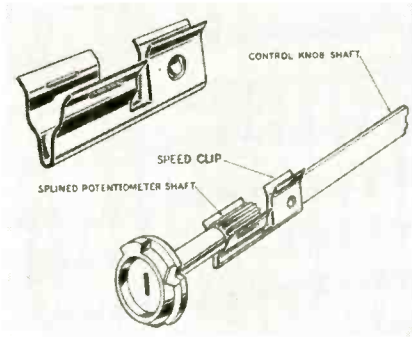
ripple, ±1.0%; Insertion loss, 1.0 db maximum; frequency response, ±1.0 db, 300 CPS to 10 KC; dimensions, 9 x 5⅜ x 4⅞ in. ESC Corp., 534 Bergen Blvd., Palisades Park, N. J.

Circle 256 on Inquiry Card

New Products

CONTROL SHAFT COUPLER

Multiple-functioning Speed Clip, for TV receivers is used as a coupler joining a long, flat steel control knob shaft to the splined shaft of a potentiometer. The control shaft is

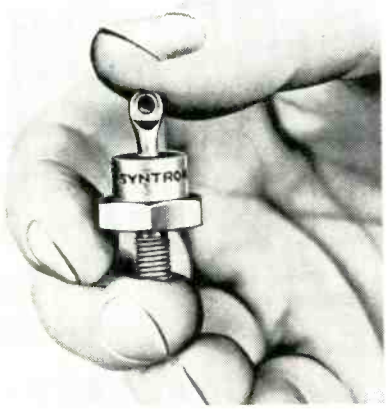


snapped into the U-shaped end of the speed clip where it is locked in position by a spring tab. The splined potentiometer shaft can then be inserted by pressing it between the semi-tubular spring legs, or by sliding it into the open end. Once the potentiometer has reached its turning limits, further turning of the knob results only in slippage of the clip. Tinnerman Products, Inc., Cleveland, Ohio.

Circle 257 on Inquiry Card

SILICON RECTIFIERS

Silicon ac to dc power rectifiers weigh ½ oz. Complete diode has an 11/16 in. hex stud base, and max. ht. is 1 7/16 in. They are rated at 10 a



av. at 150°C amb. peak inverse voltages range from 50 to 400 v. in 50 v. steps. Their outer case is nickel plated. Syntron Company, 263 Lexington Avenue, Homer City, Pa.

Circle 258 on Inquiry Card

Tunnel Diode

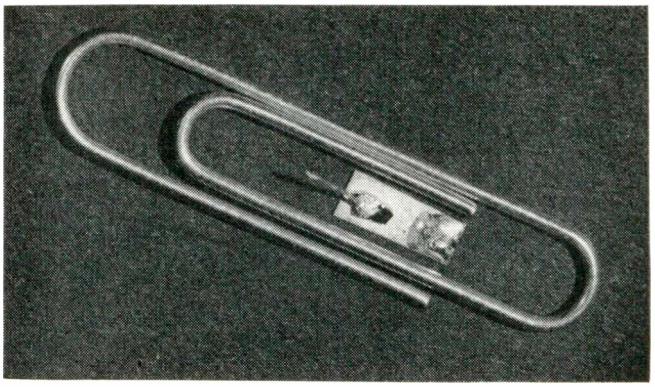
(*Continued from page* 83)

haps be more easily visualized as the "load line" superimposed on a set of triode Ep-Ip static characteristic curves. It is for this reason that the tunnel diode can act as an amplifier and perform its may other functions. Instead of absorbing the signal as a resistor does, it increases it.

Tunnel Diode Junction

A semiconductor has a forbidden region where there are no states available for its electrons. This region is called the band gap. The states below this gap (which comprise the valence band) are almost all filled. The states above it (the conduction band) are almost all empty. The number of empty states in the valence band, or electrons in the conduction band, can be controlled by adding either acceptor impurities or donor impurities to the semiconductor crystal. Each acceptor impurity takes one electron out of the valence band, and each donor gives one electron to the conduction band. In this way p-type (empty states in valence band) and n-type (electrons in conduction band) regions can be built into a crystal. The surface where two of these regions touch each other is called a p-n junction.

Figs. 1 and 2 represent the conduction and valence bands in the vicinity of a junction at different values of applied bias. One can see that as the bias is increased the bands which overlap each other at zero bias become uncrossed. Since tunneling is represented by a horizontal transition on this picture, the current decreases as the bands become uncrossed.



Tunnel diode nestles inside paper clip

When a larger forward voltage is applied, the diode goes out of the reverse breakdown condition, and the current falls to a small level. The reverse breakdown current that flows with a forward applied bias is the Esaki current.

G.. E.'s Research Contributions

Through studies of tunnel diodes made from many different materials in many different ways, General Electric scientists gained new knowledge of the operation of the device. This additional insight led to the

(*Continued on page* 184)

GE's Dr. Guy Suits, director of research and Dr. Jerome J. Tiemann demonstrate vest-pocket transmitter using tunnel diode

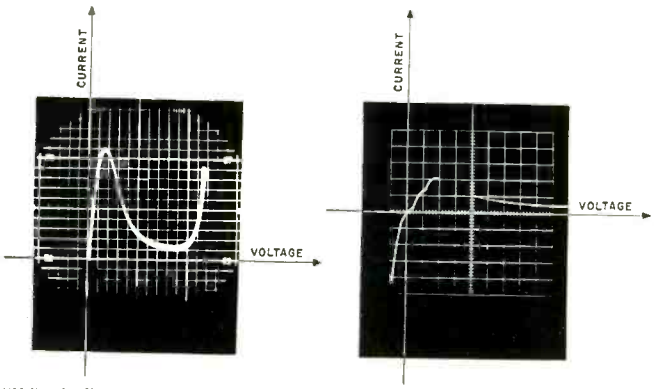
Tunnel Diode

(*Continued from page* 182)

solution of most of the problems associated with the tunnel diode. As a result, it was possible to develop an improved tunnel diode which, because of its vastly superior electrical characteristics, is a versatile and useful new component. The availability of these improved experimental tunnel diodes, in turn, made further research possible, and it was the research on these improved diodes that led to a major scientific discovery, which has explained the most puzzling aspect of the tunneling process.

One of the unanswered questions regarding the operation of the tunnel diode was that the tunneling process seemed to occur equally well in materials with indirect band gaps and in materials with direct band gaps. An indirect band gap is one where the minimum energy state in the conduction band occurs at a different value of momentum from that of the maximum energy state in the valence band. In other words, an electron would have different momentum after tunneling than it had before tunneling. This would seem to violate the classical laws on the conservation of momentum. It would appear, therefore, that the tunneling process was in some way more complicated than the simple concept formerly held.

Additional evidence that the tunneling process was



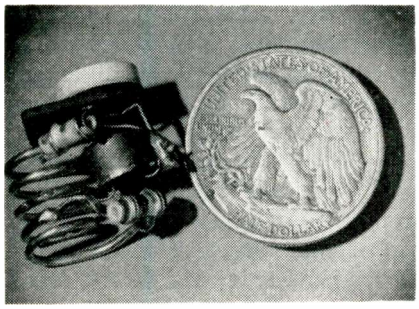
"Wiggles" in performance curve of tunnel diodes prove that ultrasonic vibrations of the crystal are involved in tunneling process

more complicated was uncovered. This evidence involved the appearance of some mysterious "wiggles" in the current-voltage characteristics which were measured on tunnel diodes made from silicon cooled to very low temperatures. Acting on the hunch that these "wiggles" were related in some way to the conservation of momentum problem, further experiments were performed and the hunch was proven correct.

The Tunnel Effect

The tunnel diode takes its name from the tunnel effect—a process wherein a particle (obeying the law of the quantum theory) can disappear from one side of a potential barrier and appear instantaneously on the other side, even though it does not have enough energy to surmount the barrier. It is as though the particle can "tunnel" underneath the barrier.

In the case of the tunnel diode, the barrier is the space charge depletion region of a p-n junction.



Complete transmitter using tunnel diode

This is the same barrier which prevents the current from flowing in the reverse direction in the case of the ordinary rectifier diode. In the tunnel diode, this barrier is made extremely thin (less than a millionth of an inch)—so thin, in fact, that penetration by means of the tunnel effect becomes possible. This gives rise to an additional current in the diode at very small forward bias which disappears when the bias is increased. It is this additional current, called the Esaki current in honor of the scientist who first observed it, that produces the negative resistance in a tunnel diode.

The origin of the Esaki current can be qualitatively understood by considering the changes in the characteristics of a conventional p-n junction diode as one goes

(*Continued on page* 186)

(*Continued from page* 185)

to higher and higher concentrations of free carriers in the semiconductor crystal. As one increases the density of the charge carriers, the reverse breakdown voltage decreases. One might think that there would be a limiting case when the reverse breakdown voltage was reduced to zero. This is not correct, however, the limit is determined by the solubility of the impurities which determine the carrier concentrations. Experiments have shown that one can dope many semiconductor materials more heavily than is needed to reduce the breakdown voltage to zero. If one does dope more heavily, the diode can still be in reverse breakdown condition at a slight forward bias.

The "wiggles" correspond to tunneling processes which are assisted by an ultrasonic vibration of the crystal. These vibrations of the crystal, called phonons, turned out to have exactly the right frequency for momentum conservation.

From the point of view of basic science this work is also extremely important. The ultrasonic vibrations are about 100 times higher in frequency than any coherent vibrations produced heretofore. This is, therefore, an important new tool for investigating the vibrational properties of solids. Measuring the size of the "wiggles" yields information concerning the strengths of the electron-phonon interactions of the crystal. The spacing of the "wiggles" yields information regarding the frequencies of the phonons, and the breadth of the "wiggles" discloses some of the effects of impurities of the spectrum of the phonons.

Comparison with Other Electronic Devices

In the field of communication, tunnel diodes compete with transistors, parametric amplifiers, vacuum triodes, magnetrons, klystrons, traveling wave tubes, and masers. The pertinent characteristics for comparison in this field are maximum oscillation frequency, minimum power requirements, and low noise amplification.

For Computer Applications

For computer applications the diode is at least 100 times faster than today's transistors, and can be

made to use only about 1/100 as much power. Moreover, the tunnel diode is insensitive to temperature changes, in contrast to the transistor. The improved stability of the tunnel diode may make it possible to take short cuts in circuitry without sacrificing reliability.

MAXIMUM OSCILLATION FREQUENCY

(In Kilomegacycles)

Tunnel Diode (10+ Kmc in a few years; 100+ Kmc is conceivable)	2 Kmc
Transistor	2 Kmc
Parametric Amplifier	6 Kmc
Vacuum Triode	10 Kmc
Maser	10 Kmc
Close Space Triode	10 Kmc
Traveling Wave Tube	60 Kmc
Klystron	75 Kmc
Magnetron	100 Kmc

MINIMUM POWER REQUIREMENTS

Tunnel Diode	one-millionth of a watt
Transistor	one-thousandth of a watt
Vacuum Triode	one-tenth of a watt
Klystron	10 watts
Traveling Wave Tube	10 watts
Parametric Amplifier	10 watts
Magnetron	20 watts
Maser	400 watts

LOW NOISE AMPLIFICATION

Noise Temperatures (at a frequency of 1000 megacycles)	
Noise Temperature (proportional to noise level)	
Maser*	20° K
Parametric Amplifier* (room temperature; 20° K when cooled with liquid nitrogen)	35° K
Tunnel Diode*	100° K to 300° K
Traveling Wave Tube	300° K
Klystron	300° K
Vacuum Triode	900° K
Transistor	3000° K

* Note: In the area of low noise amplification, only parametric amplifiers and masers compete closely with tunnel diodes. The tunnel diode is the only one of these three devices capable of operating directly from a battery. The parametric amplifier and the maser require an additional source of radio frequency power, and the maser requires an additional cryostat for cooling, and a magnet for bias.

"1959 Transistor Specifications"

The above chart in the June 1959 All-Reference Directory used abbreviations to denote the types of construction. The definitions are as follows:

A—Alloy	m—Mesa
D—Diffused	MA—Micro Alloy
d—Drift	MAD—Micro Alloy Diffused
F—Fused	NP—Unijunction
G—Grown	SB—Surface Barrier

Technical Papers Program

(Continued from page 8)

500°C Component Applications," A. S. Backus and P. S. Hessinger.
"An Ultra Stable Diffused Subminiature Voltage Reference Diode," Windsor Hunter.
"Microlamp," Donald J. Belknap.

SESSION 34—AERONAUTICAL AND NAVIGATIONAL ELECTRONICS

Fri., Aug. 21, 10:00 AM to 12:30 PM

"Landing Aids for Aircraft," James Holahan.
"Analysis of a New Glide-Slope System for Landing Fixed-Wing Aircraft," A. Tatz and F. H. Battle.
"A Frequency Domain Approach to Sub-Clutter Visibility Limitations Due to Statistic and Non-Statistic Phenomena as Encountered in Coherent M.T.I. Operation," Frank S. Rees and George F. Thomas.

SESSION 35—INSTRUMENTATION

Fri., Aug. 21, 10:00 AM to 12:30 PM

"Sampling Oscillography, R. Carlson and associates.
"Faint Signal Limitations of Radiometers," Roger S. Colvin.
"Spectrum Analysis with Delay Line Filters," Henry J. Bickel.

SESSION 36—AUTOMATIC CONTROL 2

Fri., Aug. 21, 10:00 AM to 12:30 PM

"Evaluating Residues and Coefficients of High Order Poles," D. Hazony and Jack Riley.
"Improved Optical Analog Computer," E. N. Leith, L. J. Cutrona and L. J. Porcello.
"Pole Determination with Complex Zero Inputs," John A. Brussolo.

SESSION 37—MICROWAVE THEORY AND TECHNIQUES 2 MICROWAVE COMPONENTS AND SYSTEMS

Fri., Aug. 21, 10:00 AM to 12:30 PM

"Harmonic Suppression by Leaky Wall Waveguide Filters," Vernon C. Price and Richard H. Stone.
"Application of a Solid-State Ruby Maser to an X-Band Radar System," R. L. Forward, F. E. Goodwin and J. E. Kiefer.
"An Automatic RF Matching Device," R. G. Martin, L. Young, D. S. Friedman and G. Runke.

SESSION 38—NUCLEAR SCIENCE

Fri., Aug. 21, 2:00 PM to 4:30 PM

"An Electronic Positional Assist for Film Readers," Robert N. Lewis.
"Radiation Effects on Electron Tube Materials," Everett R. Johnson.
"Oscilloscopes and Detectors Used for Measurement of Nuclear Detonations," Richard C. Epps.

SESSION 39—COMMUNICATION SYSTEMS

Fri., Aug. 21, 2:00 PM to 4:30 PM

"The Design of Wideband Scatter Links," M. O. Felix.
"Evaluating Total Noise in a Multi-Trunk Communicotions System," N. W. Feldman.
"A Miniature Underwater Cable System," B. G. King, L. R. Wrathall, L. O. Schott and Gordon Raisbeck.

SESSION 40—INDUSTRIAL ELECTRONICS

Fri., Aug. 21, 2:00 PM to 4:30 PM

"Silicon Controlled Rectifier — Triggering and Turn-off Circuitry for Inverter Applications," Dwight V. Jones.
"An Intermittent-Action Camera with Absolute Time Calibration," Robert H. Doherty, G. Hefley and E. L. Berger.
"Thermoelectric Spot Cooling Applications," Robert S. Lackey.

SESSION 41—AUTOMATIC CONTROL 3

Fri., Aug. 21, 2:00 PM to 4:30 PM

"Random Noise with Bios Signals in Nonlinear Devices," George S. Axelby.
"Nongyroscopic Inertial Reference," J. J. Klein.
"Sampled-Data Design by Log Gain Diagrams," Marvin P. Pastel and G. V. Thaler.

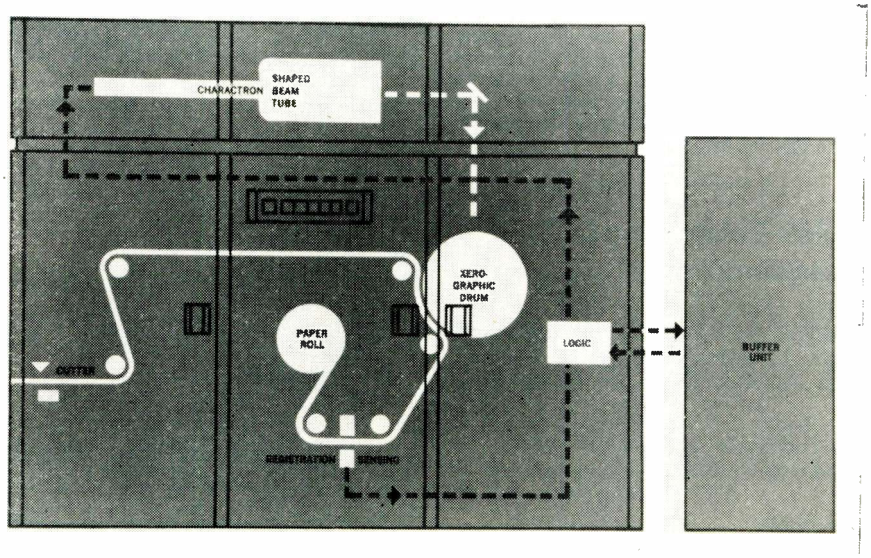
SESSION 42—MICROWAVE THEORY AND TECHNIQUES 3 MICROWAVE MAGNETIC-RESONANCE APPLICATIONS

Fri., Aug. 21, 2:00 PM to 4:30 PM

"Microwave Applications of Thin Films," P. E. Tannenwald.
"Cavity and Traveling-Wave Masers Using Ruby at S-Band," W. S. C. Chang, J. Cromack and A. E. Siegman.
"An S-Band Traveling Wave Maser," H. Tenney and P. Vartanian.

Electronic Printing

Printing 5000 lines per minute, this system, for pre-printed forms was developed by the San Diego facility of Stromberg-Carlson. No high speed mechanical parts are used. Characters formed on the tube face are projected to sensitized surface of revolving selenium-coated xerographic drum of the printer. Thermoplastic powder adheres to light exposed drum area. Developed image is electrostatically transferred to paper and thermally fused. Printed paper is cut to desired size.

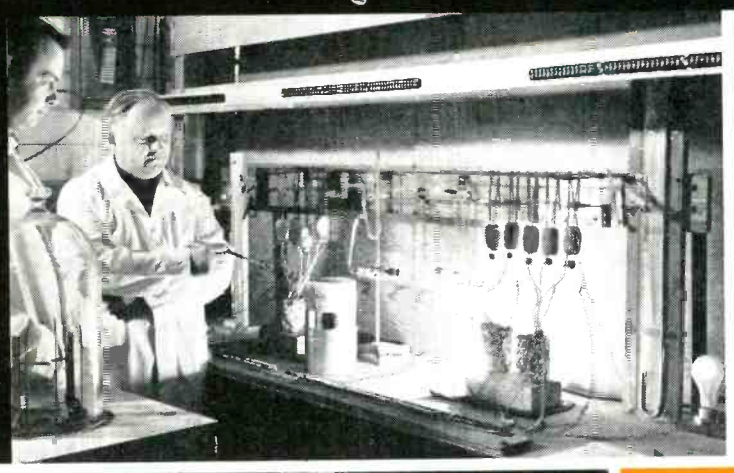


Circle 116 on Inquiry Card ——→

The CARE that produces QUALITY in THERMISTORS

Besides the technology and manufacturing resources you'd expect of Keystone, there's a great deal of individual patience and care bound up in each thermistor we make. Our Thermistor Division is staffed by people who appreciate the importance of precision workmanship—and many of them have been with us since we made our first negative temperature coefficient resistance unit over 20 years ago • Along with our complete laboratory, engineering and manufacturing facilities, our "people who care" have made Keystone *the key name* in thermistors today.

How do you benefit by all this? It's simple. Whether the thermistor you need is as large as your thumb or as small as a gnat's eye, it will perform as specified . . . on earth, in space, or below the seas . . . if made by the people at Keystone. • We'd be more than pleased to hear from you about your possible application for thermistors. Chances are we can help. Write us.

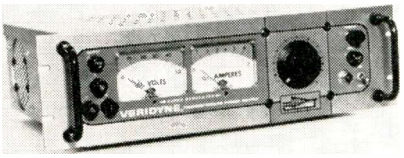


Keystone
CARBON COMPANY
Thermistor Division
ST. MARYS, PA.

New Products

POWER SUPPLIES

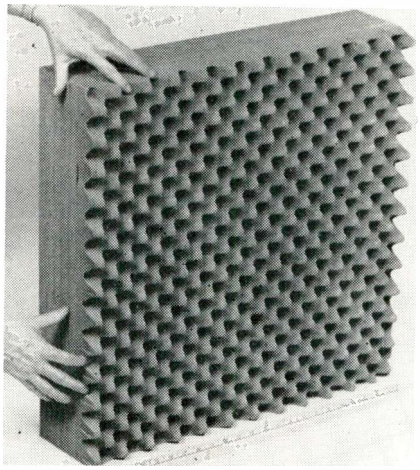
Two series (Z & W) rack mounted laboratory power supplies operate with ac inputs from 105 to 125 v., 60 to 400 CPS. Outputs are continuously variable from 0 to 32 vdc. The outputs can be used as either positive or negative supply. Provision is made for remote sensing so that supply values can be determined at the load. Input is a standard 2-conductor receptacle. Output is through jacks (front panel) or terminals (rear of the chassis). Ripple in the "Z" series is under 1 mv; the "W" version is below 5 mv. Both tpes available in 2, 5, 10 and 15 max. output. Consolidated Diesel Electric Corp., 880 Canal St., Stamford, Conn.



Circle 274 on Inquiry Card

MICROWAVE ABSORBER

Microwave absorber product, Eccosorb CV, is guaranteed at a —40 db reflectivity level for the appropriate frequency band. Available in 6 in. and 9 in. thicknesses. Specs are: Eccosorb CV —6, Freq. range, 5.5 kmc through 50 kmc, Reflectivity, 40 db down; Eccorsorb CV —9, Freq. range, 2.5 kmc through 50 kmc, reflectivity, 40 db down. Emerson & Cuming, Inc., Canton, Mass.

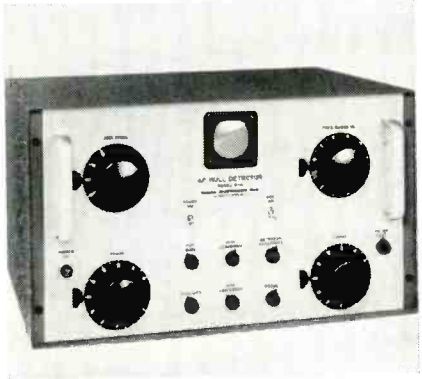


Circle 275 on Inquiry Card

New Products

AC NULL DETECTOR

Model 51-A, ac null detector, is a sensitive tuned detector covering the frequency range of 20 CPS to 200 KC. Input impedance is 1 megohm shunted by 100 uuf. A 10 μv input

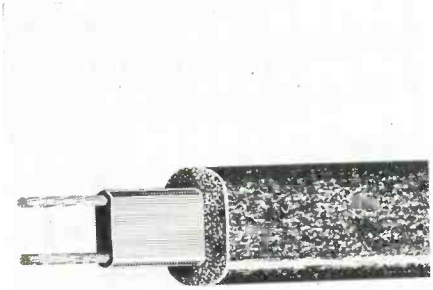


produces a ¼ in. deflection on the 2 in. cathode ray indicator and/or a 0.1 ma deflection on an external meter. Discrimination against the 2nd harmonic of the tuned frequency is 40 db over most of the frequency range. May be calibrated for use as a tuned peak-to-peak voltmeter or as a wave analyzer. Boonton Electronics Corp., 738 Speedwell Ave., Morris Plains, N. J.

Circle 276 on Inquiry Card

TV LEAD-IN CABLE

Permohm, a 300-ohm TV lead-in cable provides constant impedance regardless of adverse atmospheric conditions such as salt spray, smog, fumes, rain, and ice, offers lower losses and better reception of VHF, UHF, and color signals in all areas. It also improves signal reception in fringe areas where long leads are used. Constructed of copperweld con-



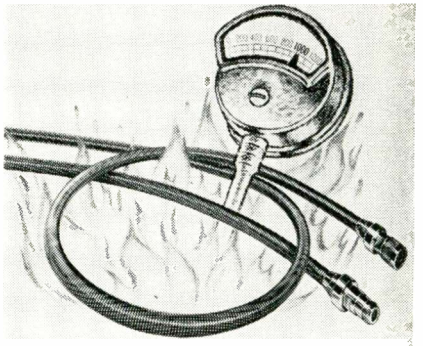
ductors and virgin polyethylene primary insulation encapsulated in cellular polyethylene. Available in 50', 75', and 100' lengths. Belden Mfg. Co., Chicago, Ill.

Circle 277 on Inquiry Card

New Products

FLEXIBLE CABLE

Flexible r-f coaxial cable operates continuously at 1000°F and at higher temp. for short time excursions. It is resistant to nuclear radiation, to shock and to vibration, and is alti-

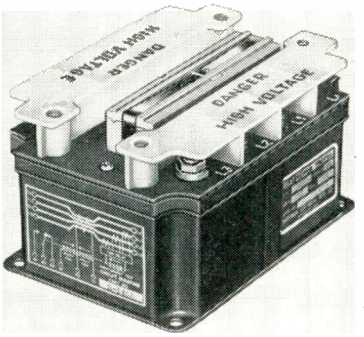


tude insensitive and moisture resistant. The cable core is modified semi-solid silica; inner and outer conductors are coated oxygen-free high conductivity copper wire. Nominal impedance is 50 ohms. Velocity of propagation is 69.0%. Maximum operating voltage is 1000 vrms. Amphenol Cable & Wire Div., Amphenol-Borg Electronics Corp., S. Harlem Ave. at 63rd St., Chicago 38, Ill.

Circle 278 on Inquiry Card

RELAYS

B-145 series of relays provide time delay overload protection and also signals motors contactor at first sign of trouble. Inverse time delay allows for starting inrush and transients, but quickly senses locked rotor, overloads, winding to winding, or turn to turn faults. Time delay can be designed for fixed or integrated period in this group of motor protector re-



lays. B-145 series specs are: current, 5 a up, 115 to 140 v., 60 to 400 CPS. Hartman Electrical Manufacturing Co., 175 N. Diamond St., Mansfield, Ohio.

Circle 279 on Inquiry Card

Circle 122 on Inquiry Card →

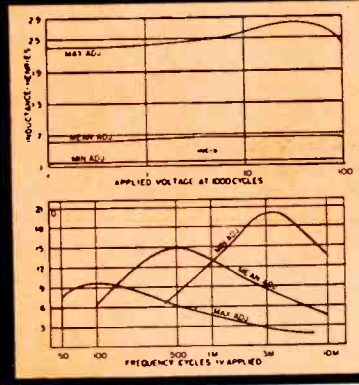
Hi-Q Inductors . . . . FROM STOCK

As largest producers in this field for over two decades, UTC inductors cover virtually every need for both fixed and variable units of exceptional stability. Hermetic units have been proved to MIL-T-27A, eliminating costs and delays of initial MIL-T-27A testing.

For complete listing of our 700 stock items (300 hermetic) write for catalog.

HVC Hermetic Variable Inductors

A step forward from our long established VIC series. Hermetically sealed to MIL-T-27A...extremely compact...wider inductance range...higher Q...lower and higher frequencies...superior voltage and temperature stability. Case 25/32 x 1⅛ x 1 7/32, 2 oz.

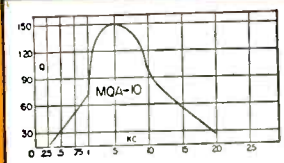


Type No.	Min. Hys.	Mean Hys.	Max. Hys.
HVC-1	.002	.006	.02
HVC-2	.005	.015	.05
HVC-3	.011	.040	.11
HVC-4	.03	.1	.3
HVC-5	.07	.25	.7
HVC-6	.2	.6	2
HVC-7	.5	1.5	5
HVC-8	1.1	4.0	11
HVC-9	3.0	10	30
HVC-10	7.0	25	70
HVC-11	20	60	200
HVC-12	50	150	500

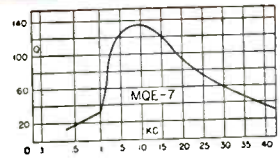
HVC

MQ drawn case structure

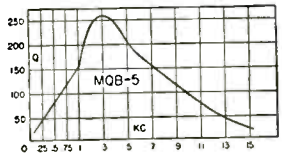
	Length	Width	Height	Oz.
MQE	1/2	1-1/16	1-7/32	1.5
MQA, MQD	11/16	1-9/32	1-23/32	4
MQB	1-5/16	2-9/16	2-13/16	14



MQA
19 stock values from 7 Mhy. to 22 Hy.



MQE
15 stock values from 7 Mhy. to 2.8 Hy.



MQB
12 stock values from 10 Mhy. to 25 Hy.

MQD

New extreme stability inductors for 12KC to 130KC range. Typical Q is 170 @ 50KC. 6 stock values from 2 mhy. to 20 mhy.

MQ Series Compact Hermetic Toroid Inductors

The MQ permalloy dust toroids combine the highest Q in their class with minimum size. Stability is excellent under varying voltage, temperature, frequency and vibration conditions. High permeability case plus uniform winding affords shielding of approximately 80 db.

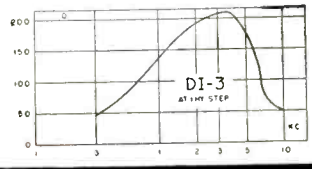
MQL Low Frequency High Q Coils

The MQL series of high Q coils employ special laminated Hipermalloy cores to provide very high Q at low frequencies with exceptional stability for changes of voltage, frequency and temperature. Two identical windings permit series, parallel, or transformer type conections. 1-13/16 dia. x 2½" H.

MQL-0	.25/1 Hys.
MQL-1	2.5/10 Hys.
MQL-2	5/20 Hys.
MQL-3	50/200 Hys.
MQL-4	100/400 Hys.
MQL-5	625/2500 Hys.

DI Inductance Decades

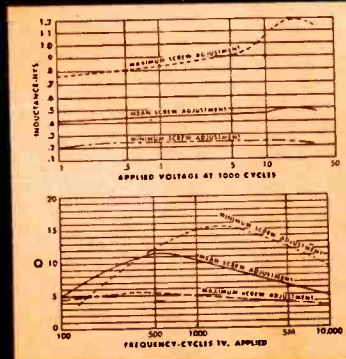
These decades set new standards of Q, stability, frequency range and convenience. Inductance values laboratory adjusted to better than 1%. Units housed in a compact die cast case with sloping panel ideal for laboratory use . . . 4½ x 4⅜ x 2⅜ high.



DI-1	Ten 10 Mhy. steps.
DI-2	Ten 100 Mhy. steps.
DI-3	Ten 1 Hy. steps.
DI-4	Ten 10 Hy. steps.

VIC case structure

Length	Width	Height	Oz.
1-1/4	1-11/32	1-7/16	5-1/2



Type	Mean Hys.	Type	Mean Hys.
VIC-1	.0085	VIC-12	1.3
VIC-2	.013	VIC-13	2.2
VIC-3	.021	VIC-14	3.4
VIC-4	.034	VIC-15	5.4
VIC-5	.053	VIC-16	8.5
VIC-6	.084	VIC-17	13.
VIC-7	.13	VIC-18	21.
VIC-8	.21	VIC-19	33.
VIC-9	.34	VIC-20	52.
VIC-10	.54	VIC-21	83.
VIC-11	.85	VIC-22	130.

VIC Variable Inductors

The VIC Inductors have represented an ideal solution to the problem of tuned audio circuits. A set screw in the side of the case permits adjustment of the inductance from +85% to −45% of the mean value. Setting is positive.

Curves shown indicate effective Q and L with varying frequency and applied AC voltage.

SPECIAL UNITS TO YOUR NEEDS
Send your specifications for prices.

UNITED TRANSFORMER CORPORATION

150 Varick Street, New York 13, N. Y.

PACIFIC MFG. DIVISION: 4008 W. JEFFERSON BLVD., LOS ANGELES 16, CALIF.
EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES: "ARLAB"

Coil Winder

(*Continued from page* 90)

voltage coils used in alternating current applications, the material will be an insulator. The bobbin used in the original application were made of nylon. All bobbins necessarily become an integral part of the coil and, therefore, can be impregnated as a complete unit in any one of the many accepted methods.

A Dayton Electric 1M-954 AC-DC motor provides power to the drive wheels through "O" rings, which are used as belts in ⅛-inch pulleys, in a 4:1 step-down ratio to the main pulley shaft. All other ratios to the drive shafts are 1:1. All drive shafts are mounted with nylon bushings. The idler wheel shaft is mounted on ball bearings. Either nylon bushings or ball bearings may be used throughout, although the nylon bushing is undoubtedly conducive to quieter operation.

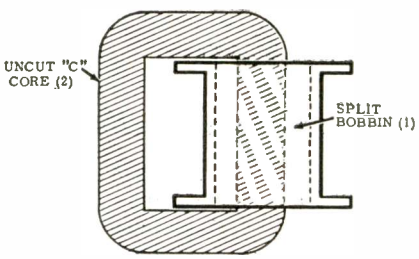


Fig. 2: Split bobbin fitted on the core.

Maximum bobbin speed is approximately 1000 rpm since there is a 2:1 step-down ratio in the drive-wheel-to-bobbin relationship. A Singer Sewing Machine motor controller (part number 194828) is used to control the winding speed. A Veeder Root counter with key reset is provided to count the winding turns; it is also belt-driven. The drive ratio of the counter is 1:1 with the bobbin.

Insulation is inserted after each layer of winding. Tape is not usually required to hold the insulation in place. This is accomplished by the downward pressure of the wire, which is under a slight tension, and by the guiding action provided by the ends of the bobbin. The start and finish, however, should be taped down. Any conventional termination is suitable for the finish of the winding itself.

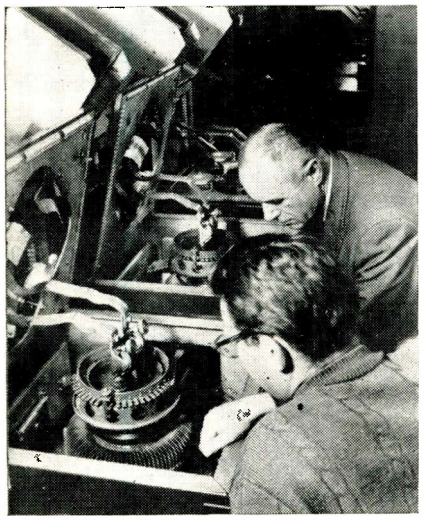
Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES • AUGUST 1959

SYSTEMS—WISE . . .

▸ Automation of TV stations has proceeded very slowly. Less than 25 stations have seen fit to "automate," i.e., cue switching and timing by pre-set electro-mechanical means. Equipment manufacturers expect this number to double by the end of the year, however. Gradual change-over to automatic switching by all large and medium-sized outlets is virtually inevitable, according to both manufacturers and operators of "automated" stations.

▸ More support for the revision of Section 315, Federal Communications Act has been received. This time the help comes from the Freedom of Information Committee of the NAB. This group has urged prompt passage of legislation removing news operations from the equal time provision.



LONG-LIFE POWER TUBES

Power tubes in driver and r-f power amplifier stages of RCA transmitter at Radio Free Europe's station near Lisbon, Portugal, are examined by RCA technical personnel. Tubes shown have an average of 31,000 hours of program service logged to date.

▸ META, Metropolitan Educational Television Association, has set as its goal the acquisition of a VHF channel for full-time educational broadcasting in the New York area —as soon as possible. This is the only way in which the 4½ million homes—17 million viewers—in that area will be able to enjoy the cultural advantages now available to 41 other metropolitan areas—60 million viewers.

▸ Videotape recorders will be installed in the top 100 TV markets in the United States before the end of the year, according to Tom Davis, Marketing Manager of that Ampex division. Tape coverage of these markets opens the door for national advertisers to set in motion their extensive plans for taped "spots." Tape floodgates will unfold concurrently with the Christmas selling season.

▸ F. C. Sowell, VP and General Manager of WLAC, Nashville, has been elected to the Chairmanship of the Radio Board of the NAB. Vice Chairman of the group is Thomas C. Bostic, VP and General Manager of the Cascade Broadcasting Co.—and Mayor of Yakima, Wash.

▸ Senator Frank E. Moss (D-Utah), appearing before a Senate subcommittee, said that enactment of his new "TV booster" bill is needed if smaller communities are to be protected in their right to establish free television services. His bill would place community antenna television under FCC regulation and give the Commission authority to license new as well as existing vhf "booster" stations.

▸ FCC commissioners may continue in office, after the termination of their membership, if a bill (S.1965) presently before the Senate is passed into law. The bill is designed to amend the Federal Power Act and the Communications Act of 1934 to make uniform the termination of membership on these commissions with membership on the FTC, ICC, and CAB. Under existing law, members of these three groups continue in office until their successors have been appointed and have qualified.

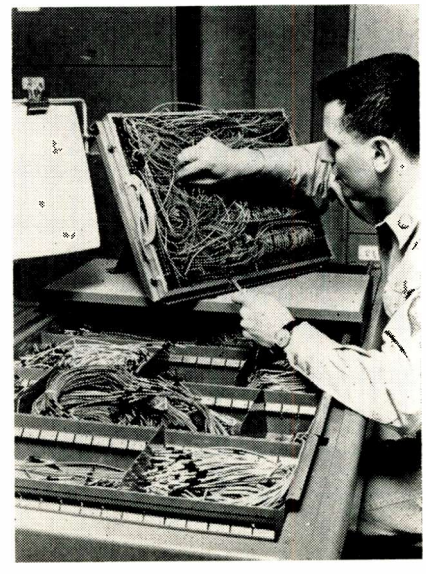
▸ Nine grants totaling more than $35,000 have been awarded in the third year of the continuing joint educational radio programming project of the National Educational Television and Radio Center (NETRC) and the National Association of Educational Broadcasters (NAEB). Eight institutions received awards this year for the project theme, "The American in the Twentieth Century."

▸ Frank Morris, veteran writer-producer and continuity director, is now West Coast representative for the Television Code Affairs Department of the National Association of Broadcasters.

▸ The FCC has extended its deadline on type-approved TV monitors, frequency and modulation, until June 1, 1960. Action was taken in view of the continued development of more stable frequency control circuits in AM, FM, and TV transmitters.

FILE-COMPUTER FOR FIRST ARMY

Specialist prepares a program for the Univac File - Computer recently installed at the Adjutant General Automatic Data Processing Center, First U. S. Army, Governor's Island, N. Y. First system of its kind at a field Army level, it introduces a new concept in efficient, error-free control of data on active and reserve personnel, their units and equipment.



This article is academic. It reviews those fundamentals which are often omitted in courses in network analysis, Laplace transforms, or servomechanisms. The methods—convolution, superposition integrals, impulse and step functions—furnish a more general understanding of the theory.

Analyzing Systems by

By JEROME E. TOFFLER
Member of Technical Staff
Hughes Aircraft Co.
Florence & Teale Sts.
Culver City, California

THE convolution integral provides a direct method of determining the response of a linear system to an arbitrary input in the time domain. The word "system" is used here in a broad sense and could be a servomechanism, an electrical or a mechanical network, a filter, etc.

Convolution

Although the problem is usually simplified by Laplace transform techniques, convolution provides a graphical method of solution in cases where, for various reasons, an analytical solution is not possible. It is also of theoretical importance in furnishing an insight into system behavior which is different from that obtained in the complex frequency domain.

Stated mathematically, the convolution of two functions $f(t)$ and $g(t)$ is as follows:

$$h(t) = \int_0^t f(t-x)\, g(x)\, dx \qquad (1)$$

$$= \int_0^t f(x)\, g(t-x)\, dx \qquad (2)$$

$$= f(t) * g(t) \qquad (3)$$

The integrals are functions only of the limit t and not the variable of integration x. The asterisk in Eq. 3 is a symbolic notation for convolution.

From the system viewpoint, $f(t)$ represents a driving or excitation function, and $g(t)$ represents the response of a linear system at time t after it has been excited by a unit impulse occurring at $t = 0$. A unit impulse, also called a delta function, may be considered physically as a pulse of high amplitude, very narrow width compared to the system time-constants, and an amplitude-time integral equal to unity. Mathematically, a unit impulse occurring at $t = a$, is defined as follows:

$$\delta(t-a) = 0 \qquad \text{if } t \neq a$$

$$\delta(t-a) = \infty \qquad \text{if } t = a$$

$$\int_{-\infty}^{+\infty} \delta(t-a) = 1$$

The normal response, $g(t)$, to a unit impulse is sometimes called the "weighting function" for a reason to be explained later. It is closely related to the "Green's function" method of solving differential equations.

A linear system is completely defined by its weighting function because the output for any arbitrary input can be computed using Eq. 1 or 2. Because of the symmetrical form of these equations, it is seen that the driving function of the weighting function play similar roles in determining the response.

The convolution integral can be formulated by resolving any arbitrary input into a series of narrow rectangular pulses each with an are of magnitude $f(t_n)\ \Delta\ t_n$, Fig. 1.

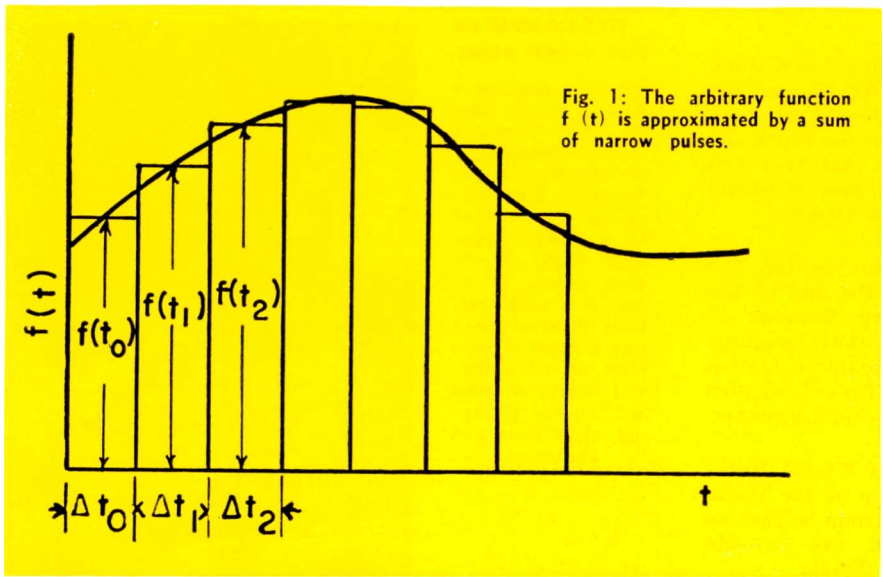


Fig. 1: The arbitrary function f (t) is approximated by a sum of narrow pulses.

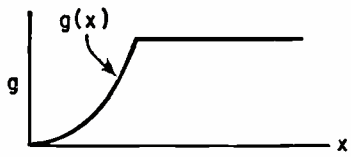
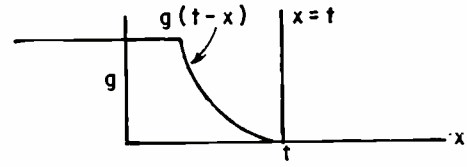


Fig. 2: Reflection and shifting of a function.



Superposition

The response is represented as the sum of the responses to each pulse. The narrow pulses represent the magnitudes of impulse functions, and the weighting function $g(t\text{-}a)$ is, by definition, the response to a unit impulse at time $t = a$. Therefore the response is approximated as follows:

$$h(t) \approx [f(t_o)\,\Delta t_o]\,g(t - t_o) + [f(t_1)\,\Delta t_1]\,g(t - t_1) \cdots + [f(t_n)\,\Delta t_n]\,g(t - t_n) \quad (4)$$

$$\approx \sum_{o}^{n} [f(t_n)\,\Delta t_n]\,g(t - t_n)$$

In the limit as Δt_n approaches zero, this summation becomes the convolution integral:

$$h(t) = \int_o^t f(x)\,g(t - x)\,dx \quad (5)$$

The reason for using the name "weighting function" can be seen from Eq. 4, where each impulse is "weighted" in contributing to the total response. It is evident that the response at any instant may be influenced not only by the driving function $f(t)$ at that instant but also by all previous values of $f(t)$. In this sense, the system may be said to "remember" former inputs.

From Eq. 4, it is apparent that convolution is based on the principle of Superposition; that is, the total response is a summation of the responses due to each portion of the input. The theory, therefore, applies only to linear systems because only in these systems is superposition valid.

Graphical Interpretation

Convolution has an important graphical interpretation which can be obtained directly from the defining integral in Eq. 1, provided the significance of each term is clearly understood. In particular, if the weighting function $g(x)$ is given, the function $g(t\text{-}x)$ represents a shift of t units to the right and a reflection about the vertical line $x = t$, Fig. 2.

Corresponding ordinates of $f(x)$ and $g(t\text{-}x)$ are multiplied to form the product function $f(x) \times g(t\text{-}x)$. The area enclosed by the product curve represents the value of the integral. The process is tedious when performed manually because the multiplying of ordinates and evaluation of area must be repeated for each value of time t. However, the two functions involved can be empirical and need not be expressed analytically. Further details of graphical convolution can be found in Reference 1.

Another important type of excitation is the step function. The step function of amplitude K, occurring at $t = a$, is defined as follows:

$$K\,[u(t - a)] = K \text{ if } t \geq a$$
$$= 0 \text{ if } t < a$$

This function is illustrated in Fig. 3; it is seen to be analogous to closing a switch.

The characteristic response to a unit step is called the indicial admittance, $c(t)$, which completely defines a linear system just as well as the weighting function, $g(t)$. In fact, these two functions are related as follows:

$$c(t) = \int_o^t g(x)\,dx$$

Representation of an arbitrary input, $f(t)$, as the sum of a series of positive and negative step functions is illustrated in Fig. 4.

The normal response to any input, in terms of indicial admittance, is the following:

$$h(t) = f(o)\,c(t) + \int_o^t f'(x)\,c(t - x)\,dx \quad (6)$$

The proof will not be given here. It is similar to the proof of Eq. 4. It consists of summing the responses to each step and allowing the steps to increase in number idefinitely. The limit of the infinite

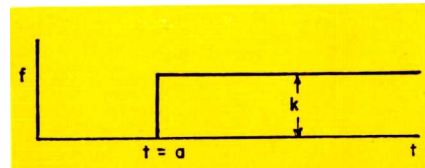


Fig. 3: Step function of amplitude K.

summation is the integral of Eq. 6. This integral contains the derivative of the driving function rather than the driving function itself. However, it is a useful form, since in many cases step-function response is easier to determine than impulse response.

Response Representation

Eqs. 5 and 6 are equivalent and exact representations of the response, although their derivations involved approximations. Both Eq. 5 and Eq. 6 are based on the principle of Superposition. In Eq. 5, the output is a summation of responses to impulses, while in Eq. 6 the output is a summation of

(*Continued on page* 200)

CUES for Broadcasters

Audio Switching

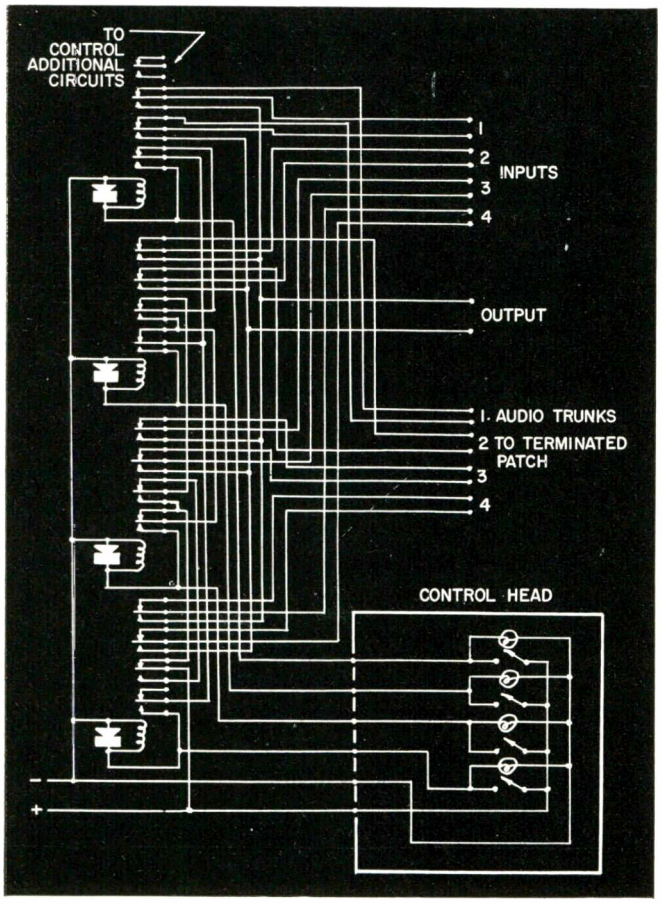
W. D. HAY & C. S. MORRIS
WUSC, Columbia, S. C.

As our operation matured, the need for selecting among several program sources to feed the transmitter line became apparent. We wanted a means that was simple, foolproof, rapid, and versatile. The end product of this situation is a relay switcher which selects one of four audio circuits, while cancelling any one previously connected. Push-buttons activate the switcher. Only two sets of buttons are used, but others may be added since all sets are identical and in parallel.

We used Mossman illuminated push-buttons. However, any sort of S.P.S.T., non-locking, normally open button with associated tally lights would do just as well. There is a fail-safe feature in the event of difficulty. Each program relay, when off, feeds its audio to a terminated patch. This affords manual switching with patch cords in emergency conditions and also keeps the trunks correctly loaded at all times.

Four hours of our broadcast day are pre-taped for unattended programming and we use one position to start a tape transport as well as to switch its audio. The number of circuits may be extended indefinitely by continuing the circuit with additional button and relay combinations in its present form. Diodes across each coil prevent switching transients.

Since we use two separate control rooms, being able to transfer the program source without having to trot from one place to another has made control work much smoother. This feature is especially appreciated when only one person is on duty. The unit has given six months of continuous trouble-free service and seems to be the solution to our switching problems.



Fail-safe is provided for this switching system by feeding the audio from each program relay, when off, to a terminated patch. Manual switching is then available and the trunks are kept correctly loaded.

A Useful Tool—The Awl

NORMAN F. ROUND, Ch. Engr.
WCCM, Lawrence, Mass.

A small awl with wooden handle and a point of 3 to 4 inches is a very useful tool to have around the shop—not a carpenter shop either! The following reasons should justify it:

(1) When taking voltage or ohm readings on wires that come out of transformers, etc., and terminate on the other side of the chassis or in hard to reach places, just prick the wire with the awl and place the probe on the awl and you have your reading without hunting for the wire termination. (Be careful not to press too hard when taking voltage readings or something else may need replacement.)

(2) Most noisy or intermittent tube sockets can be repaired by squeezing together the small tube prong holders with the point of the awl so that they'll fit more tightly on the prong of the tube. Especially useful for tube checkers.

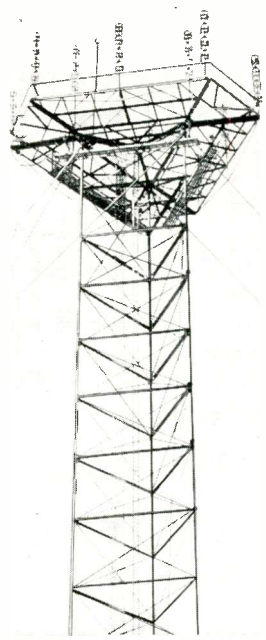
(3) It can be used to enlarge the tiny hole in tube caps to facilitate soldering the cap back on and to enlarge small holes in the chassis to allow using larger screws, etc. The awl will work fine on practically any thickness of chassis material.

(4) It permits easy unwinding of the outer braid on shielded cable without doing damage to the tiny wires.

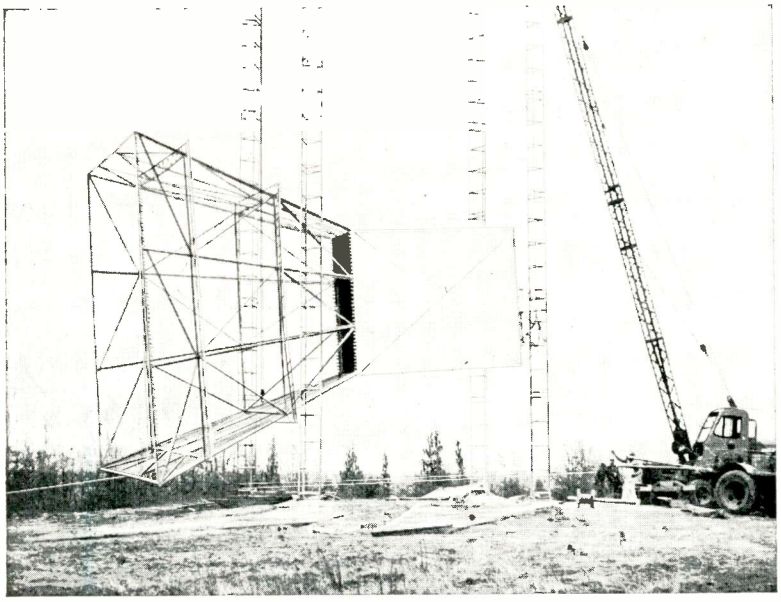
Other uses can be found for this simple but effective tool. The point will stay sharp for a long time without resharpening.

$$$ for Your Ideas

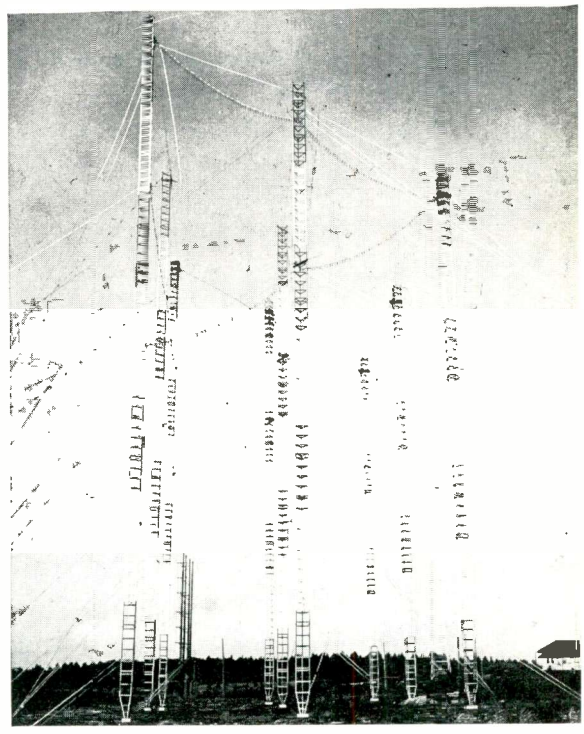
Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is requested. Our usual rate will be paid for material used.



Special-design tower supporting Air Force antennas for test purposes.



Horn-type receiving antenna and support towers for signal amplification.



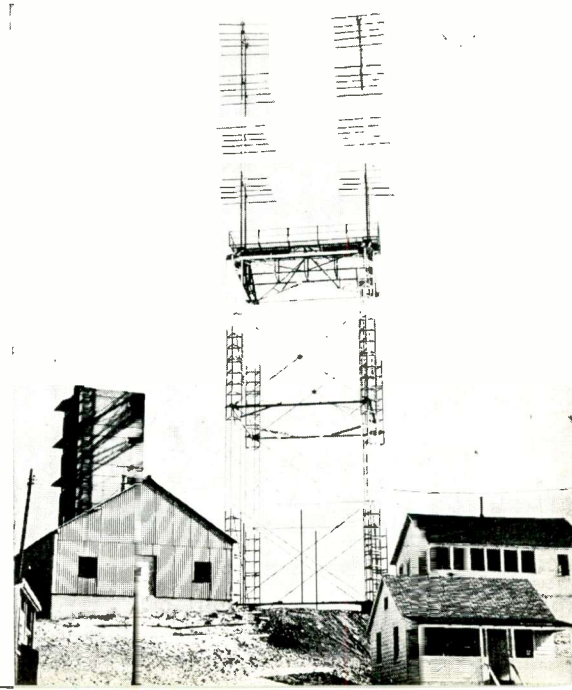
Towers supporting large curtain type antenna for scatter communication.

STAINLESS TOWER DESIGNS OFFER UNUSUAL VERSATILITY FOR SPECIAL APPLICATIONS

"Custom" design utilizing Stainless stock tower sections is the answer to many special tower requirements. Standard stock tower sections may be modified and adapted to special specifications at minimum cost.

A wide variety of self-supporting or guyed structures are available to support all types of top or antenna loads and withstand all types of wind, ice and rigidity conditions.

Let Stainless' Design Staff advise and assist you with your structural problems.



Special design self-supporting test structure having very rigid deflection and ice load specification.

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Circle 124 on Inquriy Card

Superposition

(Continued)

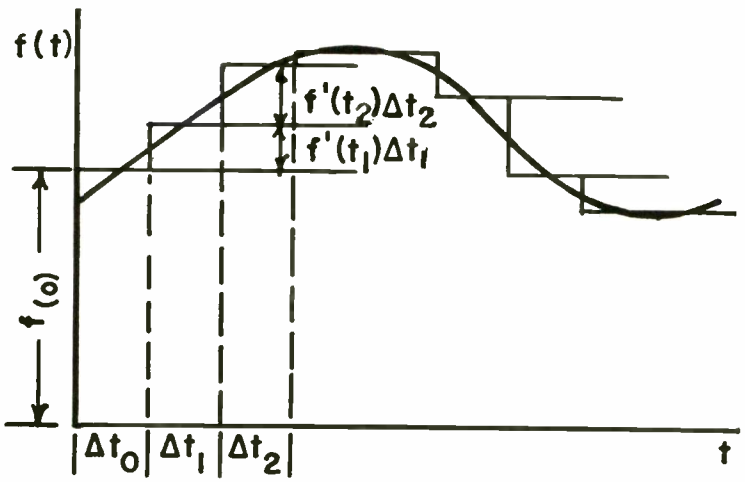


Fig. 4: Arbitrary function f(t) approximated as a sum of step functions. The decreasing portion is obtained by using negative steps.

responses to step functions. Since an arbitrary input can be considered to consist of either impulses or step functions, Eqs. 5 or 6 must yield the same result. In using these equations, it is assumed that the system is initially at rest before application of the excitation function at time $t = 0$.

To this point, all calculations have been performed in the real time domain without use of transforms. However, there is an important relationship between the convolution integral and Laplace transform techniques, as shown below.

Taking the Laplace transform of each side of Eq. 4 yields

$$H(p) \approx [f(t_o)\,\Delta t_o]\,G(p)\exp(-pt_o) + [f(t_1)\,\Delta t_1]\,G(p)\exp(-pt_1) \cdots + [f(t_n)\,\Delta t_n]\,G(p)\exp(-pt_n) \quad (7)$$

$$\approx G(p)\sum_{o}^{n} f(t_n)\,\Delta t_n \exp(-pt_n)$$

where,

$H(p)$ = transform of $h(t)$

$G(p)\exp(-pt_n)$ = transform of $g(t - t_n)$

In the limit, as Δt_n approaches zero, this becomes

$$H(p) = G(p)\int_{o}^{\infty} f(t)\,e^{-pt}\,dt \quad (8)$$

or

$$H(p) = G(p)\,F(p)$$

Eq. 9 follows directly from Eq. 8 because the integral in Eq. 8 is the definition of $F(p)$, the Laplace transform of $f(t)$.

It is apparent from the above derivation that convolution in the time domain corresponds to multiplication in the complex frequency domain. Conversely, it can be proven that multiplication in the time domain corresponds to convolution in the complex frequency domain.

The function $G(p)$ is called the system function or transfer function. It is the ratio of the response

transform to the excitation transform:

$$G(p) = \frac{H(p)}{F(p)}$$

$G(p)$ is also the transform of the weighting function $g(t)$, as was shown above. The same result can be obtained by letting the excitation $f(t)$ be an impulse function. Since the transform $F(p)$ of a unit impulse is unity, Eq. 9 becomes:

$$H(p) = G(p) \cdot 1 \qquad (10)$$

or

$$h(t) = g(t) \qquad (11)$$

Eq. 11 shows that the response $g(t)$ to a unit impulse is the inverse transform of the system function $G(p)$.

It must be remembered that Eq. 9, although it is algebraic, represents the solution of a differential equation. Thus, if

$$G(p) = \sqrt{ap^2 + bp + c}$$

then Eq. 9 becomes

$$H(p) = G(p)\,F(p) = \frac{F(p)}{ap^2 + bp + c} \qquad (12)$$

This algebraic expression is equivalent to the differential equation

$$a\frac{d^2 h(t)}{dt^2} + b\frac{d\,h(t)}{dt} + c\,h(t) = f(t)$$

The inverse transform of $H(p)$ in Eq. 12 is $h(t)$, the solution of the differential equation.

References:

(1) *Transients in Linear Systems*, by M. F. Gardner and J. L. Barnes; John Wiley and Sons, New York, 1942; Pages 231-235, and 262-263.

(2) *Theory of Servomechanisms*, by James, Nichols and Phillips; McGraw Hill, New York, 1947; Pages 30-38.

(3) *Transformation Calculus and Electrical Transients*, by Stanford Goldman; Prentice-Hall, New York, 1949; Pages 112-124.

Peltier Thermostating

On page 79 of the July, 1959, issue of *Electronic Industries*, there appears the "What's New . . ." item titled "Peltier Thermostating." Credit for this material should have been given to E. L. Armi, Chief Research Staff, and C. G. Kirkpatrick, Senior Research Engineer, Advanced Engineering Dept., Autonetics, a Division of North American Aviation, Inc., Downey, Calif. The item was abstracted from their paper, "Peltier Thermostating for Increased Reliability."

WASHINGTON News Letter

MICROWAVE ACTION POSSIBILITY — In their final meetings before the August vacation recess, the FCC had under concentrated consideration its determinations about the microwave radio services above 890 MC, based on its lengthy hearings of two years ago. The Commission, in its meetings during the latter part of July, closely studied the formulation of its policies as to the operation of common carrier and private microwave services, the eligibility of the different categories of microwave user organizations and technical standards for the service in the form of proposed rules. Because of the many difficult problems and conflicting positions of microwave services, the FCC could well defer issuance of its proposed rules until September.

CONGRESSIONAL SCRUTINY — The scarcity of frequencies for the expanding mobile and industrial radio services, as well as the continuing quest of television interests for more channels, has created a substantial interest on the part of the Senate and House Interstate & Foreign Commerce Committees which handle legislative policy for the FCC and the communications-broadcasting fields. Even though handling a myriad of subjects involving many fields of commerce, the Congressional committees have become well aware of the tightness of the spectrum for civilian use and are aiming the study of this situation toward an improved method of determining the frequency space requirements for the armed services and other governmental agencies. A comprehensive panel discussion of the latter problem was conducted by the House Committee.

TV HOLD THE LINE — The conclusion of the lengthy hearings on frequency allocations between 25 and 890 MC resulted in the opinion of expert observers, interrogated by ELECTRONIC INDUSTRIES' Washington news bureau, that the FCC will be able to do little, if anything, with the multitude of issues presented by the non-broadcast radio services until some decisions are made on the pending TV allocations problems. In fact, it is apparent that the FCC will adopt a "hold the line" approach on television spectrum assignments so that there will be no disruption of existing TV allocations. Similarly, due to strong pleas about increased interest of listeners, an expansion of UHF television space is planned.

FM and UHF television broadcasting allocations will not be disturbed until the Commission has given that broadcast service a thorough reappraisal. UHF television space, even with the significant testimony by non-broadcast radio services that it was not being effectively used, likewise appears to be safe from allocation to other services for the time being. However, proponents for the common carrier broadband mobile radiotelephone system made a strong presentation about such a program's value in the public interest. Therefore, UHF television bands could well be taken away from that service and the spectrum space made available to mobile, industrial and similar non-broadcast radio users.

National Press Building
Washington 4

ROLAND C. DAVIES

DEPARTMENT OF SCIENCE AND TECHNOLOGY —Bills have been introduced to Congress, H. R. 7954 and S. 1851, for the establishment of a commission to study the desirability and function of a Department of Science and Technology. The Engineers Joint Council has announced that they would like it called the Department of Science and Engineering.

FOREIGN INVESTMENT—Roy C. Ingersoll, Chairman of the Board of Borg-Warner Corporation, told the Ways and Means Committee of the House of Representatives that American business needed passage of H. R. 5, the Boggs Bill. He told them that passage of the bill would provide the necessary incentives for firms to expand their foreign activities.

He pointed out that American industry has pressing capitol requirements to satisfy domestic needs and limited funds left for foreign market. The Boggs Bill would make it possible for profits generated abroad to be utilized for further investments abroad without their being severly reduced by the present 52% U. S. corporate tax.

ADVANCED RESEARCH PROJECTS — The Advanced Research Projects Agency has authorized the Army Missile Command to conduct space-supporting research projects in 16 selected items. Some of these items are advanced space propulsion, materials, and guidance and control. AOMC has been allocated $1.25 million for these projects. They will do some of the work themselves at Huntsville, Ala., and let contracts for the balance.

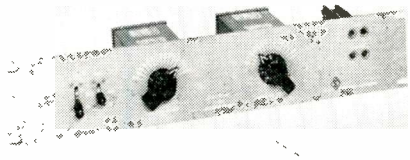
EXPORT DOCUMENTS — Applications to export civil aircraft and related parts and electronic equipment filed now must be accompanied by appropriate documentation according to the Bureau of Foreign Commerce, U. S. Department of Commerce.

Exporters should consult the Bureau's export regulations to determine the type of documentation required in submitting their applications.

New Products

RECORDING FILTER

Model S-305, variable band pass filter is for use in disc, tape and motion picture sound recording applications and for industrial uses requiring the reduction of audio bandwidth to pre-

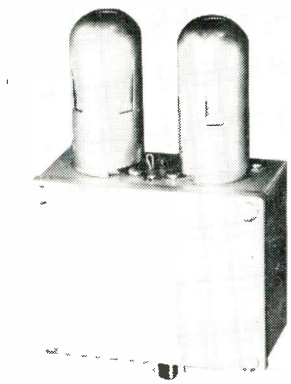


determined limits. Two key switches are provided permitting insertion of the low frequency and/or high frequency filter sections independently, at the time and cut-off frequency desired. Normalled input and output jacks provided. Selector switches permit choice of 15 low frequency cut-off points, from 30 to 200 cycles, and 15 high frequency points from 2 to 15 KC. Studio Electronics Corp., 711 S. Victory Blvd., Burbank, Calif.

Circle 259 on Inquiry Card

OSCILLATOR

A 2-tube, plug-in oscillator, Model LF-3, can operate over a broad range of crystal frequencies. It can be used with crystals having a natural frequency as low as 5 KC and as high as 500 KC without requiring any tuning adjustment or circuit change. Output frequency may be changed by plugging in crystals or using a switch to choose the desired crystal. A non-critical value of resistance is generally connected from crystal to ground to compensate for the widely varying



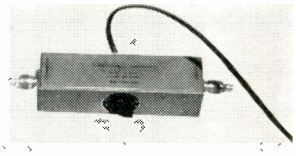
serial resistance of crystals in this low-frequency range. Long-Term stability of the output is better than ±2%, with an output voltage of over 1.5 v. RMS into 50K ohms. Telonic Industries, Inc., Beech Grove, Ind.

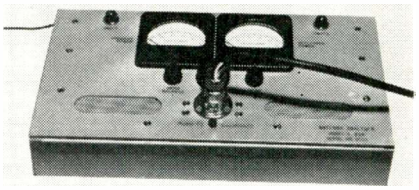
Circle 260 on Inquiry Card

New Products

ANTENNA ANALYZER

Model B-3-58, for matching of antennas and feeder lines can be used to maintain max. operating range in mobile radio networks. It instantly points to any mismatch be-



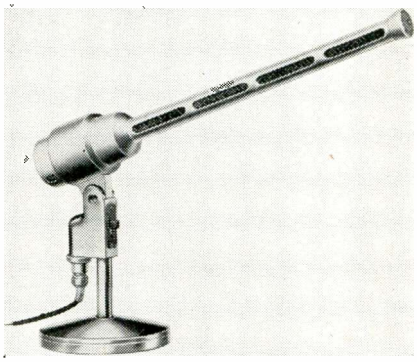


tween transmitter and feeder line or between feeder line and antenna. The check takes less than 10 min. The analyzer operates from 3 to 260 MC with powers up to 1 KW. It consists of 2 units—a directional coupler and a double dc amplifier containing meters that display incident and reflected power directly. The antenna analyzer does not alter the characteristic impedance of the line and does not cause major insertion losses. Haydu Industries, Inc., 1426 W. Front St., Plainfield, N. J.

Circle 261 on Inquiry Card

MICROPHONE

Model 644, sound spot directional microphone, uses a combination cardioid and distributed front opening, enabling it to maintain proper response far away from the sound source. Its front effectiveness acceptance angle is 45° on each side of



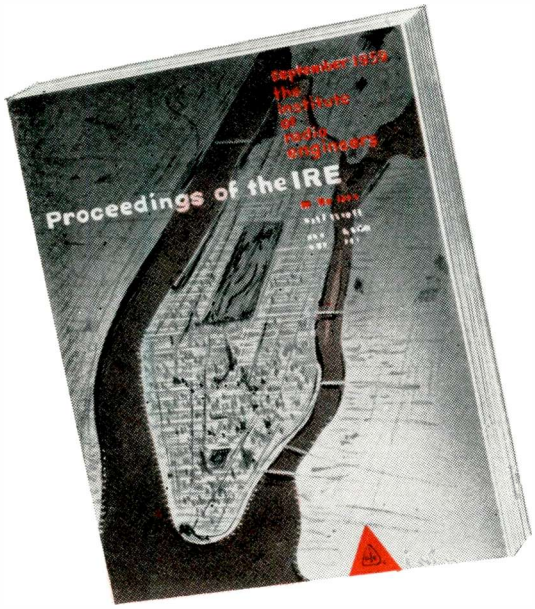
center. Random noise cancellation from the rear and sides exceeds 20 db. E-V rates the 644 sound spot's frequency response smooth from 40 to 12,000 CPS. Weight 2 lb. 9 oz. Electro-Voice, Inc., Buchanan, Mich.

Circle 262 on Inquiry Card

As Comprehensive A Review of

INFRARED

as Security Restrictions Will Allow!



The turning point in the practical application of infrared to military problems was during World War II when the Allies discovered the German Army was using infrared for secret signaling between infantry troops, for the surveillance of Russian tanks supposedly secure in the darkness, and for the detection of Allied night bombers which confused radars by the use of chaff. The turning point for the commercial application of infrared came about the same time when the American synthetic rubber program required rapid analysis of the C_4 fraction in butadiene production. Since this could best be achieved through infrared spectroscopy, commercial infrared spectrophotometers for chemical analysis began to appear in 1943.

Today, despite great advancements in the application of infrared to military and commercial uses, it appears to be only on the threshold of its full realization. That's what makes infrared such an exciting and challenging topic to investigate.

SEPTEMBER PROCEEDINGS OF THE IRE EXPLORES ENTIRE INFRARED FIELD

This special INFRARED ISSUE of the Proceedings of the IRE is the first unclassified American publication to bring together in one place the bulk of the basic information on infrared physics and technology. The material is current, authentic, and much of it recently declassified. It was prepared under the auspices of the Infrared Information Symposia (IRIS), an organization sponsored by the office of Naval Research and under joint-service direction.

This comprehensive review of a rapidly growing science—infrared—is only one of the many services offered members of the IRE. Non-members of the Institute of Radio Engineers, however, are invited to reserve a copy of this vital issue by returning the coupon below, today.

PARTIAL CONTENTS OF THIS INFRARED ISSUE:

Preface, by Dr. Arthur R. Laufer.

Infrared, a New Frontier of Physics and Technology, by Dr. Stanley S. Ballard.

A History of Infrared, by Dr. Warren N. Arnquist and Dr. E. Scott Barr.

The Physics of Infrared, by Dr. Lewis E. Larmore.

The Infrared System, by Dr. Sidney Passman.

Applications, by Dr. Paul J. Ovrebo and Dr. R. Bowling Barnes.

General Bibliography, by Mr. William Wolfe.

PROCEEDINGS OF THE IRE
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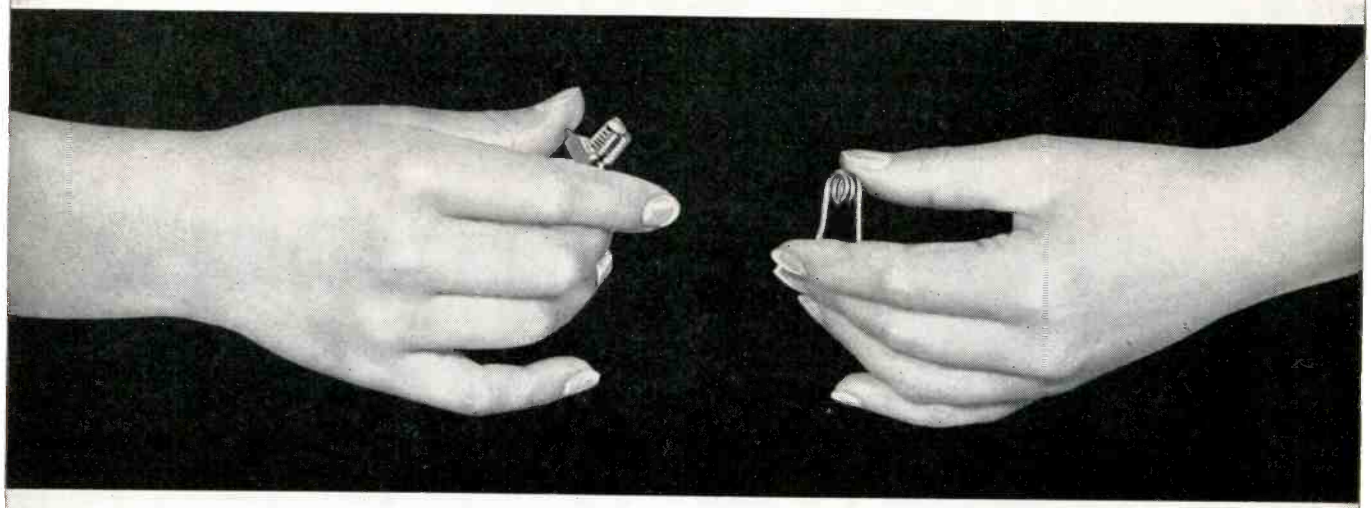
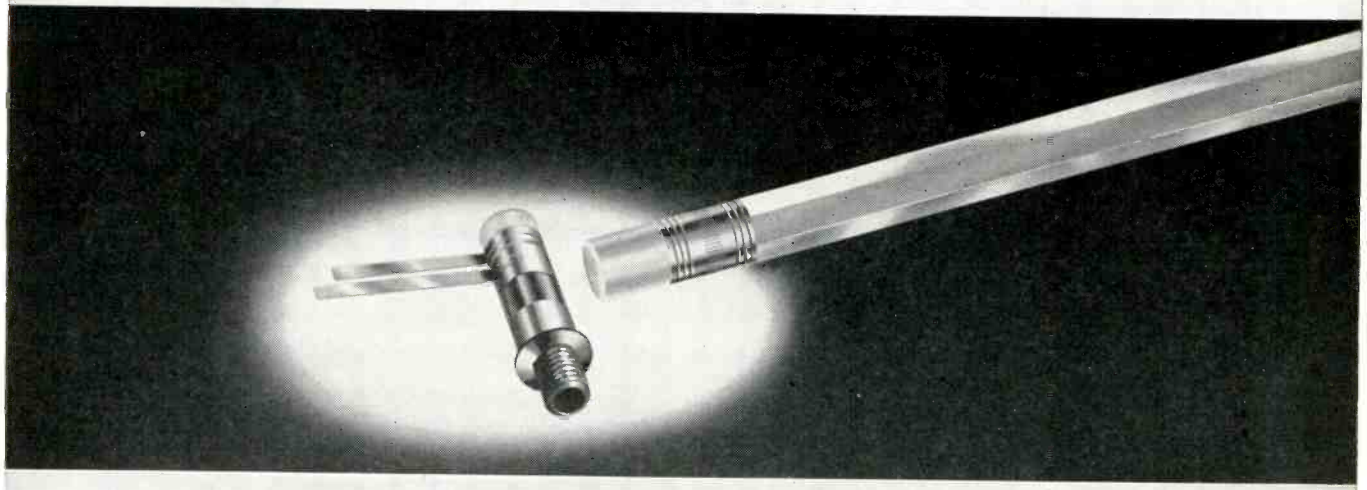
WHY USE TWO?



WHEN ONE JFD LC TUNER WILL DO!



The versatile new JFD LC Tuner combines the characteristics of a precision variable capacitor and a metallized inductor. Its unique miniaturized construction helps effect compact electronic packaging to meet space challenging demands . . . affords higher reliability, faster assembly, and greater economy in prototype design or production.

A wide selection of 12 LC Tuners (in panel and printed circuit mounting types), each offering a large range of resonating frequencies, meet most circuitry requirements. If our standard line does not meet your needs, our engineering staff will be glad to design LC Tuners that suit your individual circuit specifications.

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Model	Self Resonating Frequency Range	Length Above Panel	Diameter
LC303	450–700 MC	.635	5/16"
LC304	300–500 MC	.845	5/16"
LC306	200–450 MC	1.104	5/16"
LC309	125–200 MC	1.691	5/16"

Write for Bulletin 216 for further facts. Include your current design or performance problems for specific recommendations.

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Please send me further information on the items I have circled below. 2

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FIRM ADDRESS .....

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ALPHABETICAL LISTING OF

CIRCLE THE NUMBERS OPPOSITE THE NAMES OF THE

A

107 Acme Electric Corporation — Constant voltage stabilizers
28 Acoustica—Ultrasonic equipment
47 Advance Relays, Electronics Div. Elgin Nat'l Watch—Miniature rotary relay
78 Air-Marine Motors, Incorporated — Blowers
68 Alden Products Company — Test jacks
123 Alford Manufacturing Company—Microwave components
117 Allegheny Electronic Chemicals Company—Silicon processing
27 Allegheny Ludlum Steel Corporation—Electrical steels
65 Allied Chemical Corp., General Chemical Div.—Gaseous insulation
157 Amperex Electronic Corporation—Tubes
48 AMP Incorporated — Formed and solid taper pins
62 Artos Engineering Company — Production machines
154 Augat Brothers, Incorporated—Mounting brackets

B

85 Baldwin-Lima-Hamilton—Strain instruments, strain gages
29 Ballantine Laboratories, Incorporated — Voltmeter
37 Barker & Williamson, Incorporated—Instruments
26 Beckman/Berkeley, A. Div. of Beckman Insts., Inc.—10 Mc counter
10 Belden Manufacturing Company — Electronic wire
150 Birtcher Corporation, The—Diode radiators
127 Blwax Corporation—Asphalt base compounds
2 Bomac Laboratories, Incorporated—Microwave tubes and components
73 Borg Equip. Div. Amphenol-Borg Corporation—Instrument motors
44 Bourns, Incorporated — Potentiometer
56 Brush Instruments Division of Clevite Corp.—Recorder
103 Bud Radio Corporation, Incorporated—Cabinet racks and blowers
81 Burgess Battery Company—Batteries
77 Burnell & Company, Incorporated — Toroidal inductor
35 Bussmann Manufacturing Div. McGraw-Edison—Fuses

C

71 Cambridge Thermionic Corporation — Printed circuit components
38 CBS Electronics Div. of CBS Incorporated—Switching transistors
36 Centralab, Div. of Globe-Union, Incorporated—Feed-thru capacitors
162 Chamber of Commerce, Hollywood, Florida—Plant location
100 Chicago Standard Transformer Corporation—Transistor transformers
18 Chicago Telephone Supply Corporation—Potentiometers
53 Cinch Manufacturing Company—Connectors
135 Circo Ultrasonic Corporation — Ultrasonic cleaners
69 Clare & Company, C. P.—Relays
75 Clarostat Manufacturing Company, Incorporated—Potentiometers
92 Clevite Transistor Products — Silicon rectifiers
97 Columbian Carbon Company—Iron oxides
15 Connecticut Hard Rubber Company—Teflon tapes
76 Corning Glass Works—Resistors, capacitors

D

52 Dale Products, Incorporated—Metal film resistors
143 DeJur-Amsco Corporation — Precision panel instruments
13 Delco Radio Div. General Motors Corporation—Power transistors
40 Deutsch Company, The—Miniature connectors
98 Dialight Corporation—Pilot lights
34 Du Mont Laboratories, Inc., Allen B.—Radar tubes
118 Du Pont, Freon Division—Solvents
86 Dymec, Incorporated — Voltage-to-frequency converter

E

60 Eastman Kodak Company—Ektron detector
119 Eisler Engineering Company, Incorporated—Spot welder
101 Elastic Stop Nut Corp. Agastat Div.—Time delay relays
12 Electric Auto-Lite Company — Magnet wire
25 Electro Engineering Works—High voltage transformers
50 Electro Motive Manufacturing Co., Inc. The—Capacitors
132 Electronic Instruments Company (EICO) —Electronics catalog
7 Engineered Electronics Company—Transistorized decades
41 Erie Resistor Corporation—Trimmers

F

46 Fairchild Semiconductor Corporation—Silicon transistors
105 Fansteel Metallurgical Corporation — Silicon power rectifier
104 Fansteel Metallurgical Corporation — Tantalum capacitor
163 Freed Transformer Company, Incorporated—Transformers, magnetic amplifiers

G

159 Gamewell Company, The — Multi-turn potentiometer
133 General Electric Company Heavy Military Electronics Dept.—Shift registers
95 General Instrument Corporation Semiconductor Div.—Silicon rectifiers
128 General Products Corporation—Terminal boards
30 General Transistor Corporation—Silicon transistors
113 General Transistor Western Corporation —Magnetic tape and drum heads
145 Gertsch Products, Incorporated — AC voltage divider
72 Grainger, Incorporated, W. W.—Wholesale catalog
137 Graphic Systems—Visual control

H

54 Handy & Harman — Precious metal alloys
158 Haydon Company, The, A. W.—A.C. timing motor
87 Hewlett-Packard Company—Digital voltmeter
8 Hitemp Wires, Incorporated—Insulated wire
91 Hoffman Electronics Corporation—Semiconductor devices
51 Houdaille Industries, Incorporated — Radar antenna buffers
5 Hughes Products, Hughes Aircraft Company—Crystal filter

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503	508	513	518	523
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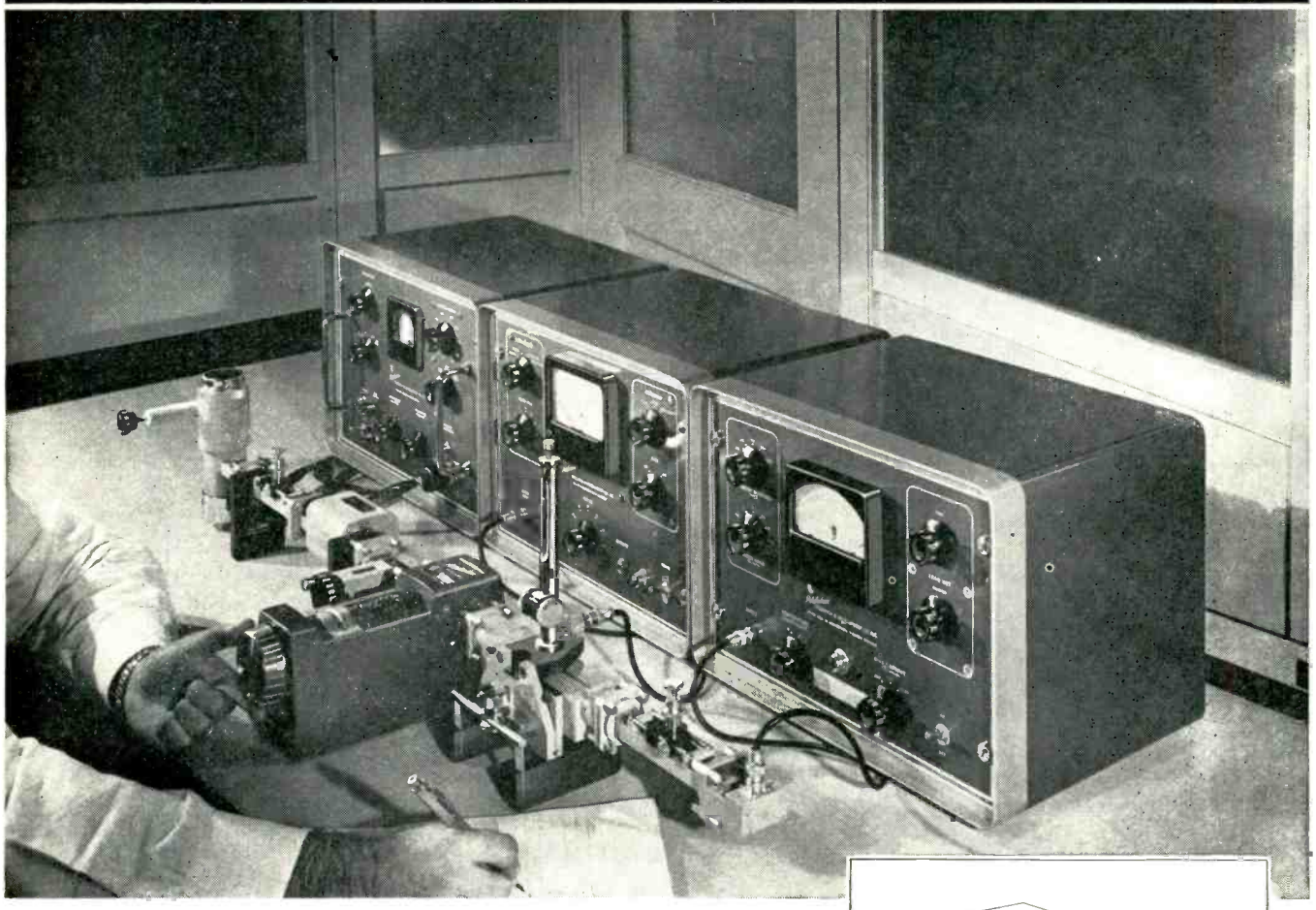
Chilton Company

HOW TO MEASURE POWER



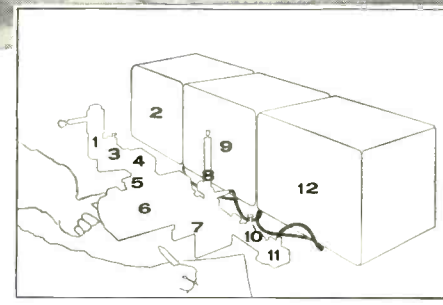
This microwave bench set-up is for the measurement of power by the Self-Balancing Bolometer Bridge method. Other systems, including PRD's more accurate Calorimetric Instrumentation could have been shown, but the Bridge represents the most universally used technique.

The operating procedure is quite simple. First adjust the PRD 650-B Universal Power Bridge for the thermistor or bolometer available. Next tune and match the transmission line for a minimum VSWR indicated on the PRD 277-A Standing Wave Amplifier. Then record the reading of the PRD 650-B Self-Balancing Bridge (directly in milliwatts) and you're ready for your next microwave measurement.

Easy, isn't it? Even more important it's accurate. The PRD 650-B Bridge has guaranteed accuracy of ±5% full scale. The use of the PRD 303-A Slide Screw Tuner eliminates the slightest mismatch of the 643 Thermistor Mount. The importance of fine matching can best be shown by example: a mismatch VSWR of only 1.2 would result in a power error of 1%.

The precision and ease of operation of all the products shown in this example are typical of each of over 300 microwave test instruments currently produced by PRD, the company that's FIRST IN MICROWAVES... our cable address is MICROWAVE, New York, U.S.A.

For technical details and specifications covering products shown write:



TEST INSTRUMENTS USED IN THIS X-BAND POWER BENCH

1—703 Shielded Tube Mount, catalog page F-8
2—809 Klystron Power Supply, catalog page F-10
3—303-A Slide Screw Tuner, catalog page B-14
4—1203 Isolator, catalog page A-21
5—159-A Level Set Attenuator, catalog page A-17
6—535 Frequency Meter, catalog page D-12
7—203-D Slotted Section, catalog page B-11
8—250-A Broadband Probe, catalog page B-12
9—277-A Standing Wave Amplifier, catalog page E-7
10—303-A Slide Screw Tuner, catalog page B-14
11—643 Broadband Thermistor Mount, catalog page E-9
12—650-B Universal Power Bridge, catalog page E-13

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Polytechnic Research and Development Co., Inc.

202 Tillary Street, Brooklyn 1, New York. Telephone: ULster 2-6800
West Coast Office: 2639 So. La Cienega Blvd., Los Angeles 34, California. Telephone: TExas 0-1940

Special problems in attenuation and other related measurements? Contact our Applications Engineering Department.

SEE US AT WESCON BOOTHS 1805-1807

Surface Ignition Analyzer

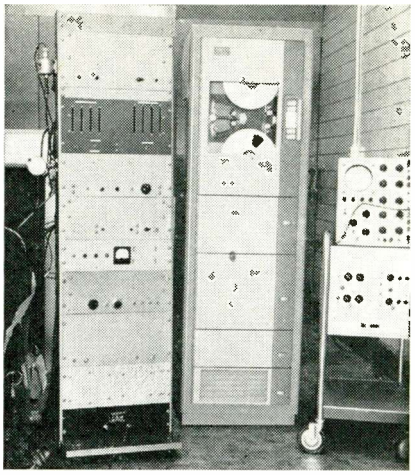
(*Continued from page* 101)

High compression ratios are a significant key to economy. They have an important effect on the efficiency of gasoline engines and the power delivered from each gallon of fuel. Compression ratios in U. S. cars have moved steadily upward from an average of about 7:1 in 1952 models to as high as 10.5:1.0 this year. Further important improvements may be limited by the surface ignition problem.

The instrument senses and plots, on a double-tracked recording tape, the pressures developed in the combustion chambers of the automobile cylinders and the exact time at which each pressure reaches a peak. Thousands of these pressure peaks occur in the engine within a few seconds. In fact so much data are recorded in a 15-second acceleration test that it would require about eight hours of a statistician's time to translate the data into charts and graphs.

Heart of the equipment is a special normal-size spark plug, equipped with a built-in miniature piezoelectric pressure transducer. This senses minute changes in pressures generated within the cylinder and translates them into electrical impulses which can be recorded graphically on tape. The special plugs can be substituted easily and quickly for the standard plugs in any automobile.

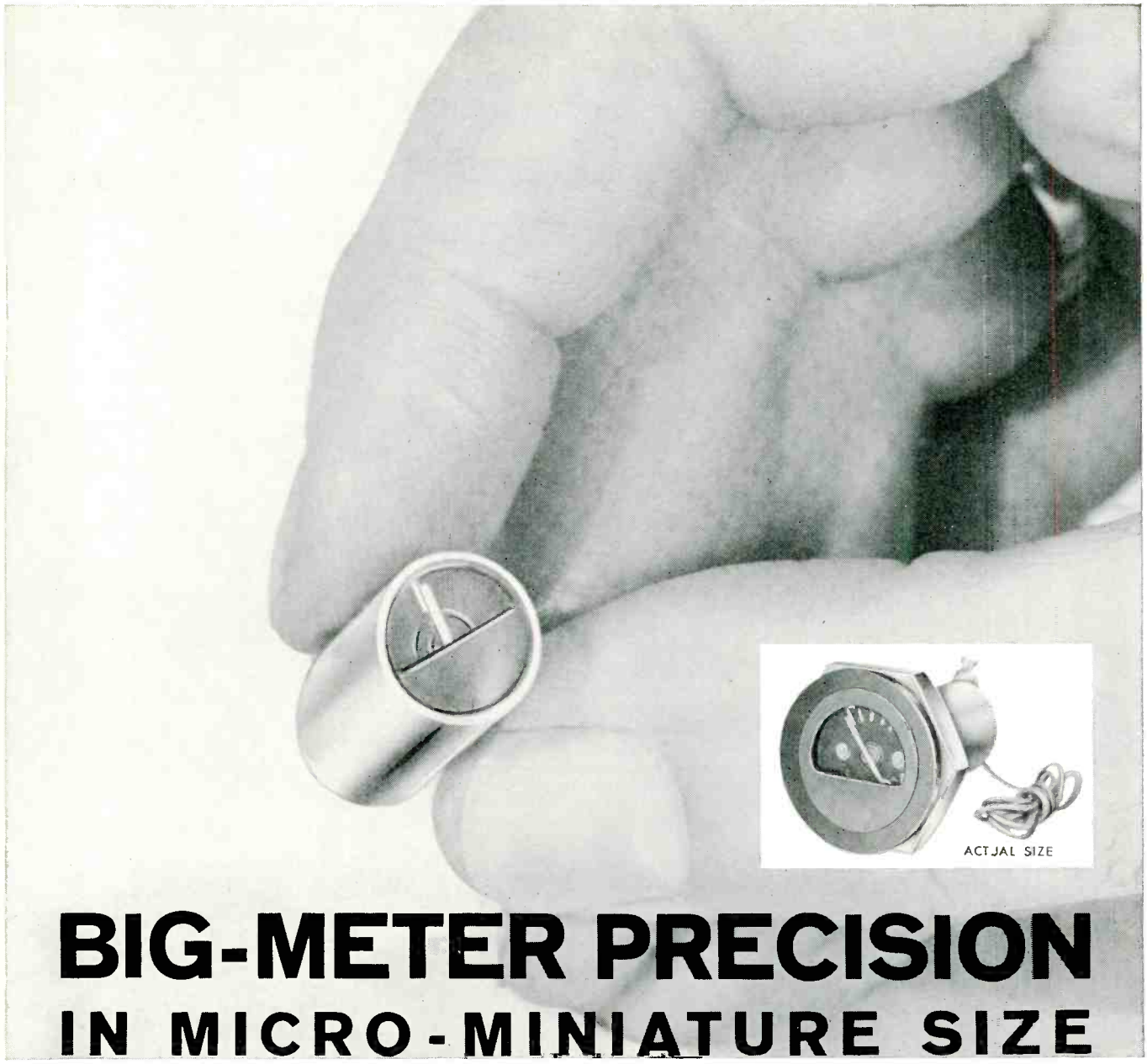
Formerly such detailed investigations were difficult, if not impossible, because of the problems associated with installing pressure-sensing devices in automotive engines. As a result, studies were usually limited to specially equipped laboratory engines.



Surface ignition detection instrumentation, including peak pressure pulse generator and data read-out rack, two channel magnetic tape recorder, and calibrating oscilloscope.

Although not developed specifically for such purposes, the equipment also is a very sensitive misfire detector, since misfire cycles will show up with peak pressure pulses at top-dead-center in the compression cycle and these can be counted separately. Variability of the Du Pont-developed instrument, apart from any engine variabilities, is less than plus or minus one-tenth of a crank-angle degree, or about five millionths of a second at 3200 engine revolutions per minute.

Results of surface ignition tests in 97 privately owned 1957 and 1958 model cars showed more than half of the cars had an instrumentally detectable amount of surface ignition, while more than 10% of the late model cars gave audible evidence of the phenomenon.

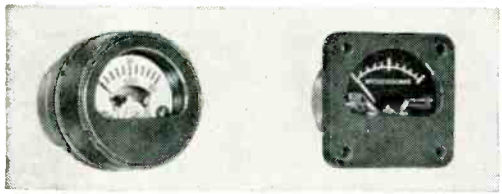


BIG-METER PRECISION
IN MICRO-MINIATURE SIZE

Now you can stop worrying about meter weight and size limitations in missiles, aircraft, computers, communication and other electronic equipment. DeJUR precision panel instruments give you big-meter sensitivity and accuracy in rugged, sealed units in extremely small sizes. For example, check these features on the new Series SC-030 —ACCURACY: ±5% of full scale. RANGES: 100-800 UA, DC; 1-800 MA, DC; 1-800 V, DC; 50 MV basic movements for DC Ammeters with external multipliers. CALIBRATION: Magnetic or non-magnetic. Internal Zero Adjuster. (Note: This meter is available with optional face plate and hex nut for front mounting...see illustrations.)

And like all DeJUR panel instruments, the micro-miniature series uses gasket sealed scale window and terminals, miniaturized external pivot D'Arsonval movement and high flux density Alnico magnet. Look into DeJUR's meter line today by writing for complete specs on standard and special units for commercial and military applications.

Manufacturers of precision electrical indicating instruments for over 20 years.



MODEL 100. 1" round Meets MIL-M-3823 watertight specs External pivot, D'Arsonval movement. Wide range of resistances and scales available.

MODEL 131. 1½" ruggedized. Withstands shock, vibration and temperature extremes. Meets MIL-M-10304 specs. Square case.

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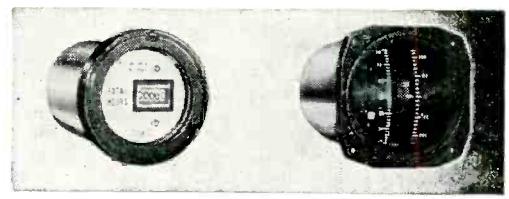


ELAPSED TIME INDICATORS. 1½", 2½", 3½". Registers 1/10 minute or 1/10 hour increments to 9999.9. Hour steps to 99999. Self-starting, 110-125VAC, 60 cycles.

MULTIMETER. 3½" AN type for data link or analog application. Hermetically sealed and gas filled. Four simultaneous readouts.

VISIT US AT SAN FRANCISCO WESCON SHOW, BOOTH 402

New Products

AMPLIFIERLESS RESOLVER

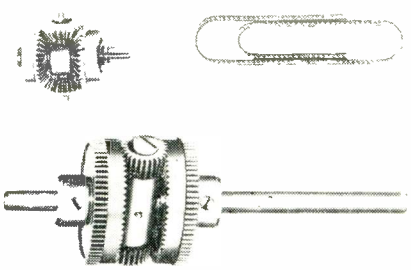
Size 11, amplifierless resolvers, incorporate an integral transformer which simulates a resolver function at max. coupling. They are used in a typical chain application for angular data transmission. A quick disconnect allows ease in harnessing. Accuracy: ±5 ft. of arc or less; winding perp. ±5 ft. Electrical characteristics: Input to either rotor or stator. Input voltage 115 v. 1600 CPS; output voltage 110 v. both stator and rotor as primary; phase shift (stator

primary) 1.1°; phase shift (rotor primary) 1.9°; Z_{so} (nom.) 990+j13500; Z_{ro} (nom.) 1150+j13500. Clifton Precision Products Co., Inc., 9014 W. Chester Pike, Upper Darby, Pa.

Circle 263 on Inquiry Card

GEAR DIFFERENTIALS

Line of miniature hollow shaft and face gear differentials are available as Class I or II in stainless steel. Three models offer variations in shaft size — 1/16 and ⅛ in.; clearance



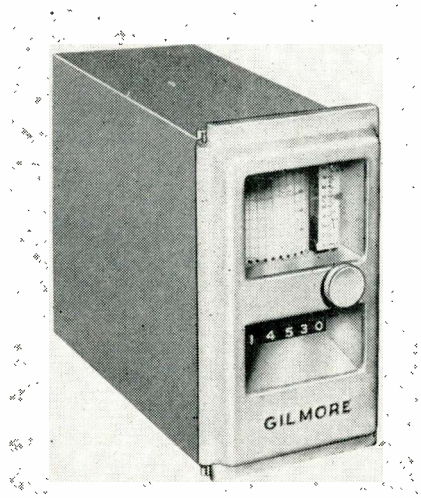
diameters —0.580 and 0.790 in.; number of precision ball bearings used —4 to 8, and displacement arcs of 15, 6 and 12 ft. Dynamic Gear Co., Inc., 20 Merrick Road, Amityville, L. I., New York.

Circle 264 on Inquiry Card

New Products

SERVO INDICATOR RECORDER

Model 243 Digital Servo Indicator features a 3 in. synchronized chart drive and simultaneously provides a permanent recording of transducer output and a high accuracy, digital

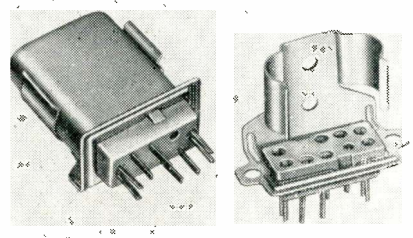


readout. It indicates and records forces, fluid flow, weights, or rpm's which can be converted into ac or dc mv. and eliminates errors due to parallax and interpolation of readings. It has a permanent recording chart. Dimensions: 6 x 11⅛ x 12 in. Digital readout accuracy: 1/10 of 1%; chart accuracy is ±1%. Gilmore Industries, Inc., 13015 Woodland Ave., Cleveland 20, Ohio.

Circle 265 on Inquiry Card

RELAY SOCKET ASSEMBLY

Micro-miniature relay socket assembly is designed for use with micro-miniature relays conforming to MIL-R-5757. Features unit packaging of socket and holding clip. Holding clip is available with either Beryllium copper alloy 25 (per QQ-



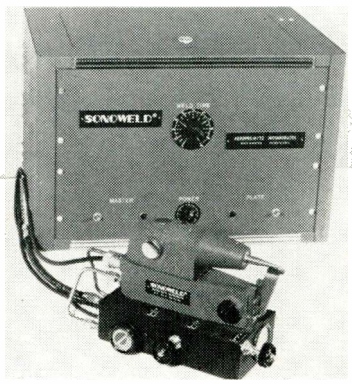
C-533) or annealed carbon steel SAE 1065 per MIL-S-17919 (Navy) No. 4. Both clips are cadmium plated per QQ-P-416A, Class 2, Type II, golden iridite. Augat Bros., Inc., 33 Perry Ave., Attleboro, Mass.

Circle 266 on Inquiry Card

New Products

ULTRASONIC WELDER

An instrument-type ultrasonic welder, SONOWELD Model W-100-TSL-58-6, is designed to make welds in small parts and delicate assemblies. Power capacity is 100 w. Ultrasonic welding is accomplished

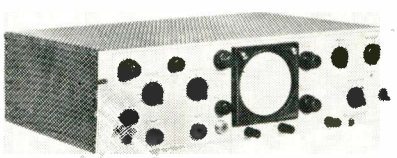


without melting or fusion and since no electrical current passes through the parts being joined, contamination of surrounding areas by sputter, arcing or spatter is eliminated. Superior ohmic contacts can be made between such semi-conductors as silicon or germanium and aluminum or gold wire. Electric match and other fine bridge wire assemblies using high resistance wire in the thickness range of 0.003 to less than 0.001 in. are welded by SONOWELD with a high degree of reproducibility. Aeroprojects Inc., West Chester, Pa.

Circle 267 on Inquiry Card

DOUBLE BEAM SCOPE

A double beam oscilloscope in rack-mounting form, Model D31R, includes a dual-gun CRT and has individual brightness controls and twin amplifiers dc to 6 MC, —3db. Panel height



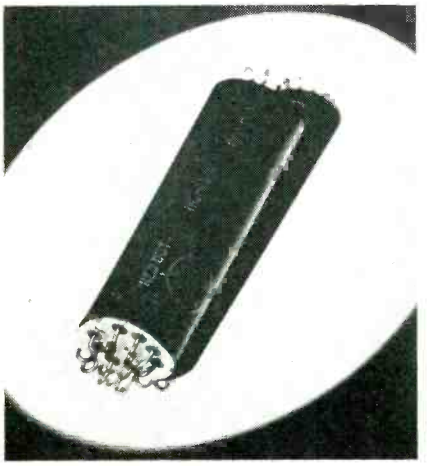
is 7¾ in. Model D31R also has automatic sync, trigger level control and built-in time and voltage calibrators. Booth 2033. The Scopes Company, Inc., P. O. Box 56, Monsey, N. Y.

Circle 268 on Inquiry Card

New Products

RELAY

The HG 4DM relay is a double-ended, 4 pole, double throw relay approximately ⅝ in. dia. May be used as an in-cable assembly, with the coil leads being connected both ends in-

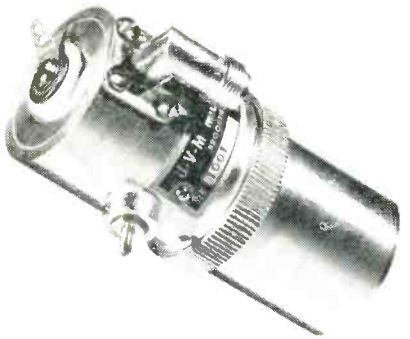


ternally. It uses 2 parallel, magnetically isolated structures and 1 common coil. The 2 armatures are of the balanced rotary type, making the relay suitable for use under vibration of 20 g to 2000 CPS. Contacts are rated at 2 a resistive at 28 vdc or 115 vac for a life of 100,000 cycles. Relay dia. is ⅝ in. Case length is approximately 1½ in. Hi G, Inc., Bradley Field, Winsor Locks, Conn.

Circle 269 on Inquiry Card

TRIODE CAVITY

Complete, standardized line of triode cavity components, Mercury '10' series are engineered for restricted 10% tuning range. For a variety of tube-types, the series is designed for max. power and/or voltage ratings of tubes. Cavity designs are available from 255 MC up to high frequency limits of existing planar triodes. 720



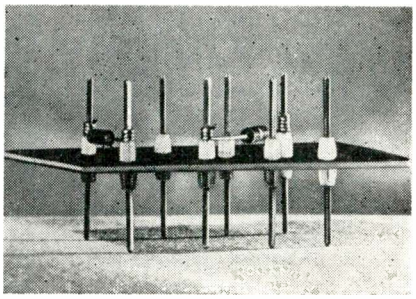
different cavities are available in the line. Cavities meet environmental requirements of MIL-E-5272 and military construction requirements of MIL-E-5400. J-V-M Microwave Co., 9300 W. 47th St., Brookfield, Ill.

Circle 270 on Inquiry Card

New Products

FEED-THROUGH TERMINALS

Pushlock terminals have a self-locking nylon body for one-step insertion. Molded flutes project radially from the nylon body. When the terminal is pressed into a mounting



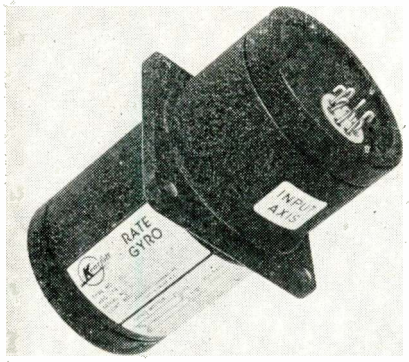
hole, the flutes deflect and their tendency to return to normal position creates positive, uniform holding power around the inside circumference. They will exert this pressure under temps from −65° to +300° and with exposure to oils, greases and common solvents. Whitso, Inc., Dept. ES-2, 9330 Byron St., Schiller Park, Ill.

Circle 271 on Inquiry Card

New Products

RATE GYROS

Miniature fluid-filled rate gyros are for use in missile and aircraft designs. Fluid filling provides greater immunity to shock and vibration effects and helps to reduce bearing friction in ac tpes and potentiometer

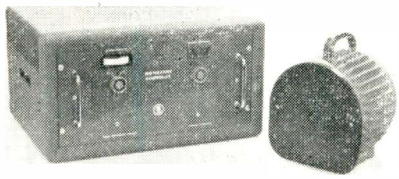


wiper friction in dc types. Warm-up time is 30 sec. Designed for operation within a temp. range of −65° to −185°F, they are single-degrees-of-freedom, viscous damped, spring restrained (torsion bar) tpyes whose gimbals are supported by precision bearings. Compensatory damping mechanisms obviate the need for accessory heaters. Ninety per cent of the parts are interchangeable. Unit rates range from 45°/sec. to 1000°/sec. Kearfott Co., Inc., 1500 Main Ave., Clifton, N. J.

Circle 272 on Inquiry Card

INFRARED SOURCE

Model RS-8B infrared radiation reference source emits black body radiation over the temp. range 200°C to 1000°C. It can be used as a standard against which other infrared sources and measuring instruments can be checked and calibrated. The temp. of the black body radiation source is selected by a control dial precisely calibrated in °C. The area of the black



body exit aperture is adjustable by selector disk containing 7 precision apertures. The radiation source temp. is maintained within ±0.5%. Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.

Circle 273 on Inquiry Card

Recorder

(*Continued from page 99*)

sturdy electronics package which measures only 14 in. x 7⅝ in. x 3⅝ in. The small modular structure includes a protective, removable casing which allows its user immediate access to the subassemblies.

To accommodate requests from instrumentation users, durable Bendix Pygmy connectors are used throughout the system for reliability and ruggedness.

Controls

Both local and remote controls are provided for recording, with switches controlling all modes of operation. Indicator lights show whether the power is on and whether recording is in process. A meter shows the quantity of tape remaining on the supply reel at all times. Also, the system is designed to indicate, with a blinking lamp, whether the tape is moving past the magnetic heads at the proper speed.

(*Continued on opposite page*)

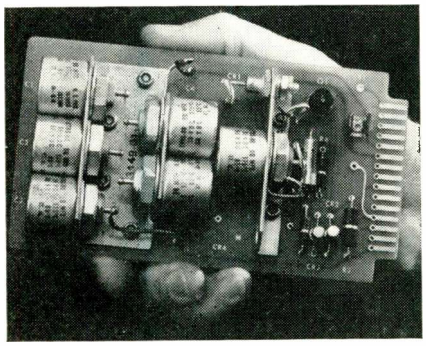
The remote control unit is designed to mount in a standard 3⅛ inch aircraft instrument panel "knock-out" hole.

The AR-200 is a record only machine, but because of its wide range of tape speeds, tapes recorded on the AR-200 can be readily reproduced on most standard reproduction units.

Designers of the AR-200 have used every precaution known in the magnetic recording art to assure reliability. Flutter, the elusive imp of the recording industry which describes speed errors above 10 cycles per second, is almost nonexistent.

Power

Another outstanding feature of the device is the low power input required to operate it. Operation of the entire system is accomplished with only 150 watts. Since the power required to operate a data-acquisition system drains from the aircraft's power, it is a case of every reduction counting.



This view of the regulator reference board, part of the electronic unit, shows method of mounting some of the components.

Although the unit is designed to operate directly from a 28-volt DC source, which is available in most aircraft, a choice of three power converters can be used when the power is not 28-volt DC. One single-phase converter will provide 28-volts DC from a 115-volt, 400-cycle AC source. Another three-phase converter will provide 28-volts DC from a 208-volts, 400-cycle AC source. If commercial power is the source, a single-phase converter is available for providing 28-volts DC from 117-volts, 48 to 63 cycles, AC source.

* * *

Potentiometer

(*Continued from page* 101)

jected to electrolysis, 120 vdc being applied between the resistance element and the potentiometer shaft while the unit was exposed to 15 days of humidity-temperature cycling per MIL-E-5272A. No breakdown of insulation resistance occurred during the exposure period. Noise and linearity were checked prior to and immediately following the test and no change was observed.

MDH 20 units have also been subjected to Moisture Resistance tests per Method 106 MIL-STD-202 (including polarization and vibration). Measurements of total resistance and insulation resistance were taken periodically in the chamber with a relative humidity of from 90-95% as required by the spec. The total resistance of the specimens remained constant within ±0.1% and the insulation resistance measured between terminals and shaft remained above 90 megohms for all specimens.

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
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New Firm To Exploit Unused Patents, Ideas

Hundreds of valuable patents, processes and ideas that have been gathering dust in the files of U. S. corporations may now become available for useful and profitable development through the work of a new company, the National Patent Development Corp.

Jess Larson, former Federal Works Administrator and Chief of the War Assets Administration, is Chairman of the Board of Directors of the new firm which will have offices in Washington, D. C., and New York City.

National Patent Development Corporation is unique in its purpose and function. It will represent the companies owning patents and processes in finding other concerns that are ready to develop and manufacture them for the benefit of the public, the defense program, the government and other potential users. Corporate clients will be aided in the selling or licensing of patents and ideas which have been developed by their research programs, and which do not have a natural outlet within their own operations.

A survey by Mr. Larson and his associates indicated that patents available for such belated exploitation represent several hundred million dollars in research and development.

Engineering Degrees Up

The Engineering Manpower Commission of Engineers Joint Council, 29 W. 39th St., N. Y,. reports a 13.1% increase in bachelor of engineering degrees in 1958, and a 9.5% increase in bachelor of science degrees. Masters in science degrees increased by 322, but there was no significant increase in the number of doctorates. The actual figures: for engineering degrees, 35,332; for science degrees; 14,-352.

$10,000 FOR SIGHT

Jos. Sprung, pres. of the Radio & TV Square Club, presents check for $10,000 to Mildred Weisenfeld, founder of the "Fight For Sight" in the offices of New York Mayor Robt. Wagner

Engineers 5 to 1 Against Collective Bargaining

A study by Prof. John W. Riegel, director of the Univ. of Mich. Bureau of Industrial Relations, reveals that four out of five scientists and engineers now oppose collective bargaining for themselves. The study was based on interviews with 277, non-supervisory, professional employees in 10 large firms. Fields covered included: mechanical, electrical, chemical, civil, electronic, and automotive engineering.

There was some sentiment for collective bargaining which increased when the terms and conditions of the members' employment takes a turn for the worse from their point of view or when a new standard, such as a higher wage scale in another company, becomes known.

The study, "Collective Bargaining as Viewed by Unorganized Engineers and Scientists" (105 pages, $4.00) is available from Publications Distribution Service, University of Michigan, Ann Arbor, Mich.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 209.

Employment Jumped 50% In Florida Electronics

The Florida Development Commission reports that employment in electronics plants is up 50% over last year and that sales figures are steadily climbing.

A new Commission survey shows that Martin-Orlando, manufacturing five major U. S. missile-electronics systems, has become the largest single electronics employer in the state in a little over a year after starting operations.

President E. S. Johnson of the Association of Florida Electronic Industry told the Commission, "The future of the electronic field in Florida is tremendous and I would say that in five years it could triple or more."

Backing up this optimism, the survey showed, as it did a year ago, that industry growth was not confined to one section of the state. Expansions of plants were reported in the last year in Fort Walton Beach, Gainesville, St. Petersburg, Orlando, Melbourne, Fort Lauderdale and Miami.

New plants opened in Sarasota, Fort Myers, Tampa, Sanford., West Palm Beach, Winter Park and Miami.

One executive, Robert G. Kramer, said, "The whole electronics industry is expanding and nowhere faster than in Florida." Kramer's Airtronics International, a communications and aviation electronics firm at Fort Lauderdale, recently launched a multi-million-dollar expansion program.

In the Florida survey, ten new electronics plants and ten major expansions were listed. Employment has increased from 10,000 a year ago to more than 15,000.

Factory sales of communications equipment, electronic components, automatic controls, and similar devices are now estimated at from $180,000,000 to $200,000,000. Total payrolls approximate $60,000,000 a year.

Companies are merging at a rapid rate to gain capital, know-how, strong marketing organizations, prestige, or for investment purposes along with many other motivations listed below. The article also explains why the acquired company's organization should be kept intact.

Why Do Companies Merge?

By PETER SLUSSER
Associate,
Dean Witter & Co.
14 Wall St.
New York 5, N. Y.

During the past five years there has been a boom in corporate acquisitions in the electronics industry. Such young giants as Litton Industries and Siegler Corp. have grown primarily via the acquisition route. In our opinion, this trend will continue and undoubtedly will be augmented by acquisitions of electronics concerns by companies in other fields.

Not all acquisition programs have succeeded. The defense stretchouts and business recession of 1957-58 brought out many of the defects in these programs. It became obvious in some cases that management was spread too thin, products were not what they should be, and consolidated income statements could no longer hide red ink in a losing acquisition. To be candid, even in the best of mergers, there is no telling when the worms may begin to come out of the woodwork.

The electronics industry lends itself, possibly more than any other, to growth by acquisition. An engineer gets a good idea, creates a product or acquires an R & D contract, and he is in business; provided that he has the necessary courage. If he is lucky enough to click, and his company grows, suddenly his working capital problems begin to expand by something resembling a geometric progression—not to mention the problems involving administration, production, sales, etc.

Working Capital Needed

Frequently the entrepreneur finds that he has a $500,000 order with a $5,000 net worth; or much worse, a few months later he may be handling $1,000,000 in volume with a negative working capital position. This is usually the time when he begins to look to the financial communities of South Spring, Montgomery or Wall Street for assistance, or will begin casting about for tempting merger offers. This process is happening every day in the electronics industry, and there are even those rugged individuals who are now on their second cycle of founding, building up, and selling companies.

Obviously not all electronic acquisition candidates are young, bootstrap operations. Some are well known, time honored names such as Monroe and Altec, or even Sylvania. The doors of merger in this fast stepping industry are closed to none. Some Wall Street cynics even believe that everything in the electronics industry is for sale—at a price.

At best, it is difficult to tell when a corporation, large or small, is exactly ripe for merger. Several leading investment banking firms, in fact, have specialists who do nothing but counsel and negotiate these mergers. However, we have found that there are a few general guide posts that can be followed in the industry as indicative of a company being more, rather than less

ready to be acquired. Since the factors influencing a large organization usually vary from those of a smaller concern, we will treat each separately with the knowledge that considerable overlapping exists. Some of these factors are listed below.

Large Organizations

- Older management wishing to retire, or a management that is no longer sufficiently effective.
- An existing or potential estate problem on the part of the owners.
- One product dependence, or potential technological obsolescence of existing products.
- Need for an expanded marketing organization, or an opportunity to enter new markets where the company does not have access.
- Too much idle cash in the treasury.
- Lack of sufficient research and development talent.
- Large tax loss carry forward.
- Financial crisis or difficulties.

Small Organizations

- Usually the overall need for the capabilities and capacities of a much larger organization.
- The belief by management and/or owners that they can expedite their corporate growth by joining forces with a larger organization.
- A tight financial condition, or the pressing need for more money than the company is capable of raising without giving up an arm and a leg.
- A need for a stronger marketing organization, particularly for commercial products, or in some cases plain old "high level" pull for large military or industrial jobs.
- A desire on the part of a large customer to purchase his source of supply.
- An urge by the owners to "cash in" or become more liquid by upgrading their equity into that of a more seasoned, traded and perhaps even dividend paying security.
- An excess of research and development talent without sufficient manufacturing and marketing facilities.

Clearly, some if not several of these conditions exist in every organization to varying degrees. In our experience there are two factors which almost always must be right if a merger is to jell, and these are *people* and *timing*.

If the chemistry of the people does not work, the odds are against there being a merger. If events are not really pressing and there is a lack of urgency attached to negotiations then again the odds are against having a deal. Our experience in the electronics industry indicates that the people must have a real desire to complete the merger, and there must be some compelling reason with a time limit attached to make them act.

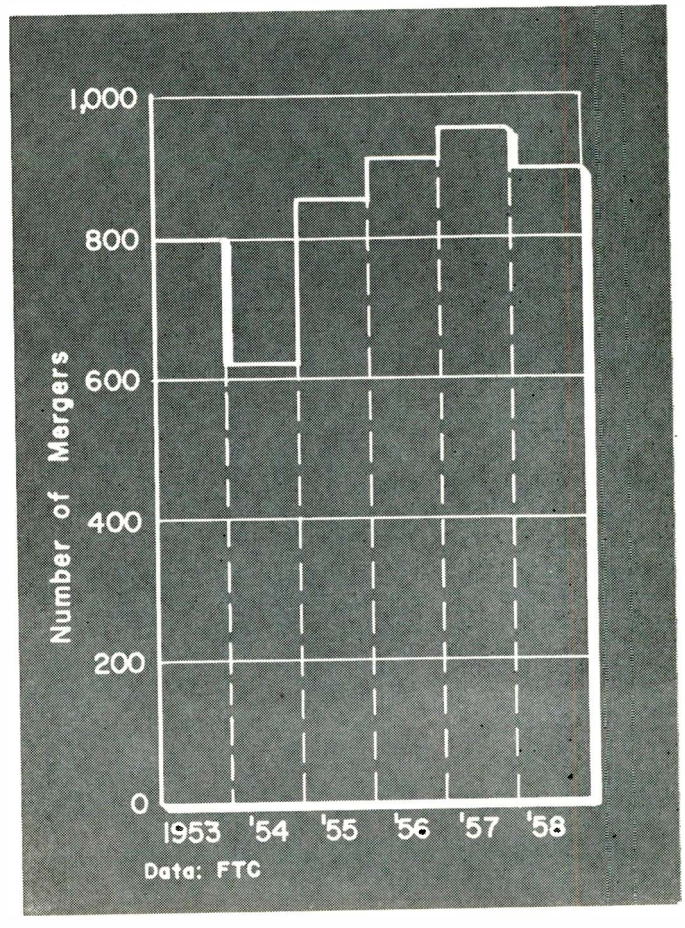
Ways to Merge

The formal procedures for merging companies are subject to the laws of the state wherein the companies are incorporated and to pertinent federal statutes. In general there are three major ways to accomplish a merger:

Statutory merger or consolidation. In this case, the stockholders of both companies must vote and approve the merger—usually a two-thirds majority of both groups of stockholders, with dissenting stockholders frequently entitled to appraisal rights. In general, a statutory merger is a tax free exchange. The recent merger of Sylvania Electric into General Telephone is an example of this type of merger. In the case of each company, the affirmative vote of two-thirds of each class of voting stock was required to approve the merger. Usually this type takes a considerable period of time in view of the necessity of preparing proxy soliciting material, holding a stockholders' meeting, etc.

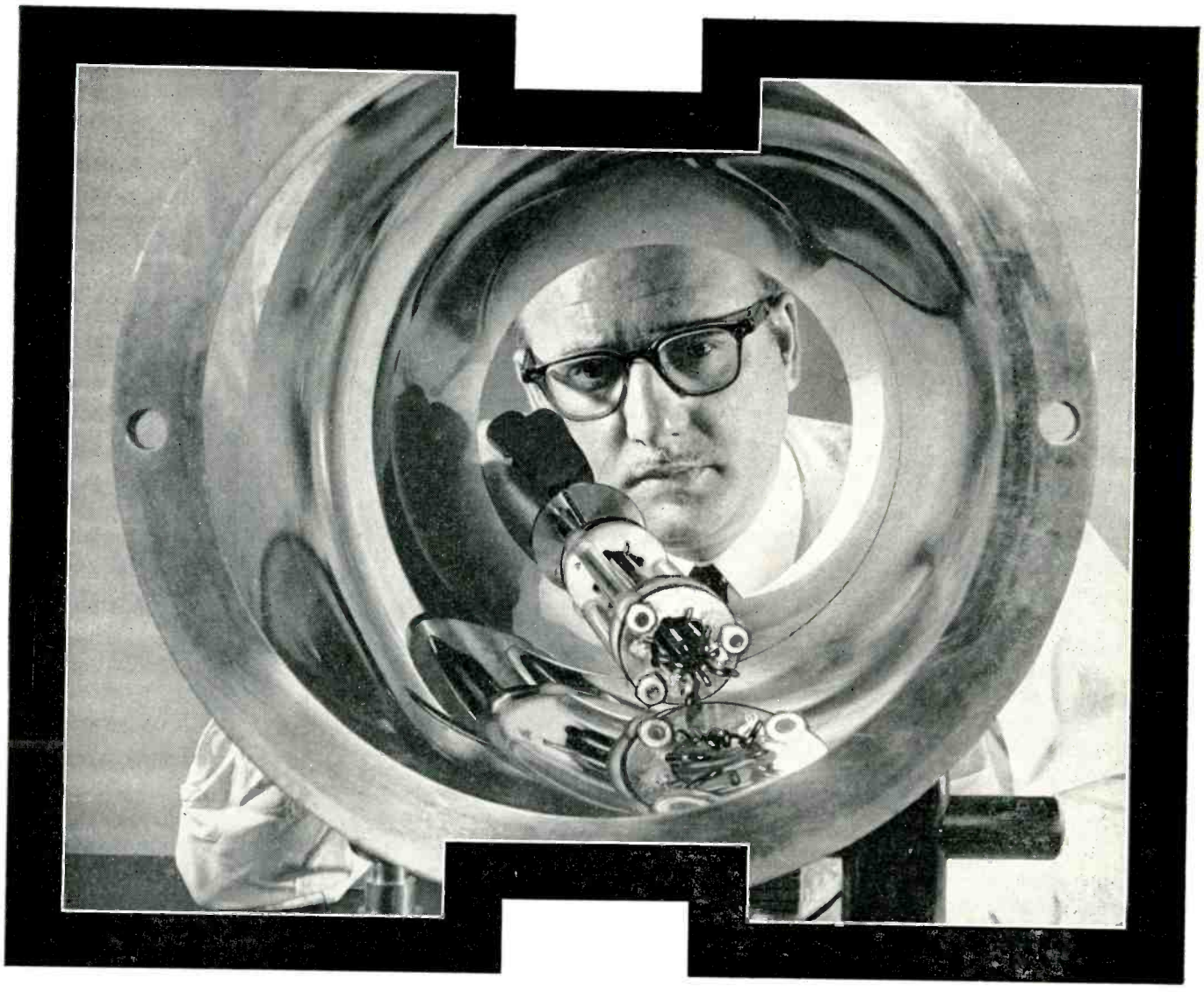
Acquisition by one corporation of the stock of another. Here the acquiring corporation must gain control of at least 80% of the total voting power of all classes of stock of the corporation to be acquired in order for the acquisition to be tax free. Such an exchange usually does not require the approval of stockholders except that in case of a company listed on the New York Stock Exchange, if more than 20% of the stock is involved, stockholders' approval is required. This method is frequently employed by a larger concern acquiring the ownership of a smaller and often privately held company. It may take at least three forms—stock for stock, or cash for stock,

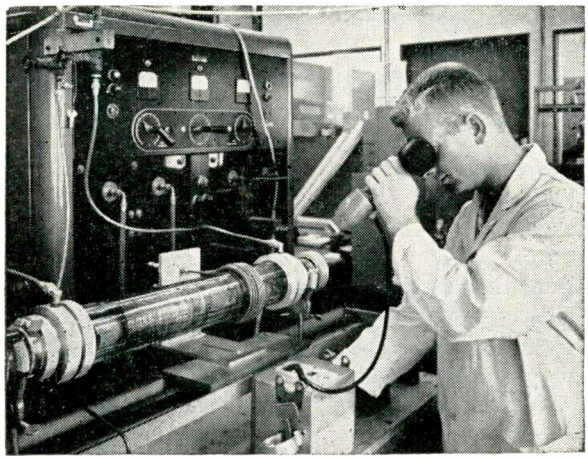
(*Continued on page* 228)



Graph shows the number of mergers that have taken place in the last few years

Checking Einstein with





Purity Plus—*Hughes Products Division engineer checks semiconductor materials to insure purity.*

Exit cones *capable of withstanding temperatures of 6000° F. represent one example of advanced engineering being performed by the Hughes Plastics Laboratory.*

an atomic clock in orbit

To test Einstein's general theory of relativity, scientists at the Hughes research laboratories are developing a thirty pound atomic maser clock *(see photo at left)* under contract to the National Aeronautics and Space Administration. Orbiting in a satellite, a maser clock would be compared with another on the ground to check Einstein's proposition that time flows faster as gravitational pull decreases.

Working from the new research center in Malibu, California, Hughes engineers will develop a MASER (Microwave Amplification through Stimulated Emission of Radiation) clock so accurate that it will neither gain nor lose a single second in 1000 years. This clock, one of three types contracted for by NASA, will measure time directly from the vibrations of the atoms in ammonia molecules.

Before launching, an atomic clock will be synchronized with another on the ground. Each clock would generate a highly stable current with a frequency of billions of cycles per second. Electronic circuitry would reduce the rapid oscillations to a slower rate in order to make precise laboratory measurements. The time "ticks" from the orbiting clock would then be transmitted by radio to compare with the time of the clock on earth. By measuring the difference, scientists will be able to check Einstein's theories.

In other engineering activities at Hughes, research and development work is being performed on such projects as advanced airborne systems, advanced data handling and display systems, global and spatial communications systems, nuclear electronics, advanced radar systems, infrared devices, ballistic missile systems...just to name a few.

The variety and advanced nature of the projects at Hughes provides an ideal environment for the engineer or scientist who wishes to increase his professional stature.

Newly instituted programs at Hughes have created immediate openings for engineers experienced in the following areas:

Communications	Environmental Engineering
Thin Films	Logical Design
Electron Tubes	Radar Circuit Design
Field Engineering	Material & Component Eng.
Semiconductors	Systems Analysis
Test Equipment Eng.	Nuclear Electronics

Write in confidence to Mr. Don Eikner, Hughes General Offices, Bldg. 6-C8, Culver City, Calif.

The West's leader in advanced ELECTRONICS

HUGHES

HUGHES AIRCRAFT COMPANY

Culver City, El Segundo, Fullerton, Newport Beach, Malibu and Los Angeles, California; Tucson, Arizona

Why Do Companies Merge?

(*Continued from page* 225)

or a combination of stock, cash and other securities for stock. The offer of stock for stock seems to have been the most commonly used in the electronics industry. Litton Industries, for example, has traded its shares for those of other companies on various occasions, and the recent merger of Bomac into Varian was a merger of this design. Such an exchange of stock is tax free if the acquirer obtains 80%. Where cash or securities other than voting stock are offered the transaction may be taxable, or taxable in part. This kind of combination requires a prospectus under the 1933 Securities Act, unless the sellers are very limited in number and agree that they will hold any securities they get for investment and will not distribute them.

Purchase of Assets. In this situation, the assets or properties of one company are purchased by another for stock, cash, or notes, or any combination thereof. In many states a favorable vote by a majority of the holders of the selling corporation's voting stock is required, and in some states dissenters have appraisal rights. If substantially all of the assets of a company are acquired exclusively for the voting stock of another corporation, then the exchange is tax free. However, if notes, cash, or non-voting stock are used, the transaction is taxable. This type of transaction is used frequently in the acquisition of smaller privately held companies where the owners wish to realize some cash gain immediately.

In any case we would urge the prospective seller to see his lawyer.

Each of these general procedures have advantages and disadvantages to both parties. In addition, there are serious tax implications in each, and more than likely have a large bearing on the final figure placed on the value of the company to be acquired. We have found that in many cases the amount paid for an acquisition can vary substantially depending upon how the purchase is made. Obviously there are people who think that cold hard cash has a greater value than unregistered stock selling at forty times earnings, or again what financial cynics call "Chinese money."

Steps to Merging

The usual steps in a merger begin in a somewhat similar fashion to marriage. There is the courtship when everyone seems to be wearing a salesman's hat. Then the proposal — where the serious negotiations usually begin. We have found that it is frequently desirable first to arrive at a sound businessman's agreement as to the values or range of values to be exchanged. This can be done by using both quantitative and qualitative measurements. Frequently, investment bankers are called in as financial consultants to evaluate the company to be acquired, both companies or the nature and composition of the transaction. Sometimes the courts will call upon an investment banker as an expert witness

"SYSTEM DEVELOPMENT CORPORATION

is currently seeking scientists and engineers in various skill areas. As part of this effort, I have been given the opportunity to tell you something about our organization.

"Let me begin by giving you some general facts about the Corporation: SDC is a non-profit organization chartered to work in fields pertaining to public welfare, the advancement of science, and national defense. The Corporation's name implies its function—the development of systems. Specifically, we are concerned with large, complex information processing systems with a high degree of automation. Development of these systems is accomplished through the application of knowledge in the areas of applied mathematics, engineering, and psychology, to problems of over-all system design, data processing techniques and optimum man-machine relationships.

"Our work is system-oriented, rather than concerned with the design or manufacture of hardware components. As a result of this type of specialization, we have assumed major responsibilities in the development of systems such as the SAGE (Semi-Automatic Ground Environment) Air Defense System and the world-wide Strategic Air Command Control System, and in the integration of the functional responsibilities of these systems with other military electronic support systems.

"Because the scope of our activities is rapidly increasing, we are expanding our staff. In this message I am specifically addressing young engineers with advanced training and proved analytical ability in the areas of weapons system analysis, noise and information theory, ECM, electromagnetic intelligence and allied fields. If you are qualified, and our corporate activities sound interesting to you, we would like to hear from you. Address inquiries regarding our Santa Monica, California facility to Mr. R. W. Frost, 2428 Colorado Avenue, Santa Monica, California. Inquiries regarding our Lodi, New Jersey facility should be addressed to Mr. R. L. Obrey, Box 2651, Grand Central Station, New York 17, N.Y. These gentlemen will see that your letter receives prompt attention and confidential treatment."

David Green

David Green, Assistant Director for Plans, Operations and Management Research Directorate

11-116

SDC

SYSTEM DEVELOPMENT CORPORATION

SANTA MONICA, CALIFORNIA · LODI, NEW JERSEY

Continued from page 228)

in such a transaction. The chief benefit is a third party's objective point of view. This system of employing financial consultants is frequently the fairest to both parties and can help to keep horse trading and haggling to a minimum.

Once the values have been agreed upon, then both parties should call upon the most talented corporation lawyers, tax lawyers, and accountants to work out the details. This period of processing can take from one week to over three months depending upon the complexity of the transaction and also whether stockholders' approval is required.

Wherever possible we have found it of primary importance to keep the management of the corporation which is acquired. The nature of the electronics industry makes this factor even more important since in most acquisitions, particularly of smaller companies, the key men's brains and know-how are the "go-no-go" factors in the success of the operation. If after the merger, one or two top flight individuals become dissatisfied and leave, the acquiring corporation — no matter how well organized—is usually in for some trouble with its new acquisition.

Mergers can be very healthy things, can offer enormous marketing advantages and manufacturing efficiencies, and can expedite corporate growth by providing adequate financial backing as well as other benefits. Great companies such as RCA, General Motors and General Dynamics have been built on these principles, and smaller companies such as Varian, Ling and Aeronca are making progress by this means. We think that the pattern of consolidation will continue in the electronics industry as it grows. However, we urge caution in corporate merger—size for size alone is not enough. Two plus two must equal more than four, or as the chemists say there must be a synergistic action. Above all, the people coming together are the most important factor, and for a valuable and successful corporate consolidation, the two groups of individuals must have a high degree of willingness to work together towards common goals.

NEW PROGRAM

Raytheon enters new weapons systems program and offers advancement opportunities for both Junior and Senior electronics engineers with experience in the following fields:

- Microwave engineers—component and antenna design
- Communications systems
- Guidance systems
- Computer systems
- Radar systems
- Inertial reference systems
- Feed-back control
- Auto-pilot
- Ground support
- Electronic packaging engineers
- Radar systems engineers (project management)
- Electromechanical engineer for missile control and auto-pilot design (project management)
- Mechanical engineer experienced in ground handling of large missile systems (project management)

You and your family will enjoy the many advantages of living in the metropolitan Boston area. Relocation assistance and modern benefits.

Please forward resume to:

Mr. W. F. O'Melia
Employment Manager
Raytheon Company
Bedford, Mass.

or call collect:

Crestview 4-7100
Extension 473

RAYTHEON MISSILE SYSTEMS DIVISION

Excellence in Electronics

News of Reps

Mid-Eastern Electronics, Inc., has appointed the Telesco International Corp., New York, N. Y. sales rep for all countries except the U. S. and Italy.

Telerad Mfg. Corp., New York, has appointed 3 new reps. They are: G. B. Ellis Sales Co., Palo Alto, Calif., for Northern California and Northern Nevada areas; Wallace & Wallace, Los Angeles, for the Southern California area; and Premmco of Arizona, Scottsdale, Arizona, for Arizona, New Mexico and Utah areas.

A new electronics manufacturers rep organization has been formed by David Muir to operate under his name, with headquarters at 612 E. Colman St., Altadena, Calif. Principle activities will be directed to electronic components and equipment, sold through distributors in Southern California and Arizona.

The following reps have been appointed by Vis-U-All Products Co., Grand Rapids, Mich: Northwestern Sales Co., Seattle, Washington, for Oregon, Northern Idaho, Northern Montana, Alaska & British Columbia; and Dresser E-E Ltd., Montreal, for Canada.

NO. 100

Norman Neely (left), President of Neely Enterprises, and Robert L. Boniface (right), VP and Gen. Mgr., greet George Combs, the 100th employee of the Western Rep firm. Main offices are in Hollywood, Calif.

Ben Friedman, formerly Sales Manager of Mitronics Inc., 1290 Central Ave., Hillside, N. J., has formed a new type of rep organization for the New York, New Jersey and Connecticut area specializing in sub-component lines for the electronic industry. Mr. Friedman may be contacted at Mitronics, Inc.

A. Friedman & Assoc., Jamaica, N. Y., has been appointed by Wyco Metal Products, North Hollywood, Calif. to handle the company's line in New York City and Northern New Jersey.

News of Reps

Paston-Hunter Co., Syracuse, is now rep for the upper New York state area for Triad Transformer Corp., div. of Litton Industries.

Control Electronics Co., Inc., has appointed 4 new reps. They are: The Col-Ins-Co., Orlando, Fla., for Florida, Georgia, Alabama, Mississippi, Tennessee, North and South Carolina; Malcolm Ross & Co., Los Angeles, for Arizona, Nevada and Southern California; Ernest E. Whittaker, Ottawa, Ontario, for Canada, and Southern Industrial Electronics, Inc., Dallas, for Texas, Oklahoma, Arkansas and Louisiana.

"REP OF THE YEAR"

Ray B. McMartin (left), President of Continental Manufacturing, Inc., Omaha, presents TV set to Dan Rudat of Rudat and Ewing. The Palo Alto rep firm won the Company's "Rep of the Year" title.

Cozzens and Cudahy, Inc., have been appointed reps in Chicago for the Instrument Div., Thomas A. Edison Industries of McGraw-Edison Co.

Balco Research Laboratories, Inc., Newark, N. J., has appointed Electro-sources, Inc., Palo Alto, Calif., as rep for the Northern California-Nevada territory.

McCarthy Associates, Pasadena, Calif., have been appointed rep for Daytronic Corp., Dayton, Ohio, and Larson Instrument Co., Tarrytown, N. Y., in California, Arizona and Nevada.

Servonic Instruments, Inc., has appointed George F. Bohman, Orlando, Fla., as sales rep for Florida, Georgia and Alabama.

Burcaw-Cowan & Co., Detroit, has been appointed rep in Michigan for JB Electronic Transformers, Inc.

David G. De Haas Co., San Diego, Calif., is now sales rep for the Polytechnical Research & Development Co., Inc., Brooklyn, N. Y.

Personals

James O. Seamans has been named Sparrow III Program Manager for the Missile Systems Div. of Raytheon Co.

Hi-G, Inc., has announced the appointment of **J. A. Garratt** as Chief Engineer. He was formerly with Thomas A. Edison Co.

Norman O. Bender, Jr., has been promoted to the newly created position of Operations Manager for Transac computers, Philco Corporation's Government & Industrial Div., Phila., Pa.

Walter E. Carpenter has been appointed Chief Engineer at the Hudson Lamp Co. He was formerly with the Lamp Div., Westinghouse Electric Corp.

Dr. Samuel B. Batdorf is now Director of Research at Lockheed Electronics and Avionics Div.

S. Batdorf

A. Phillips

Alvin B. Phillips has been appointed Chief Engineer, Mesa transistor product line, at Motorola's Semiconductor Products Div., Phoenix, Ariz.

Dr. David M. Heinz, former Physicist for General Electric Co.'s Instrument Dept. in West Lynn, Mass., has joined Hoffman Electronic Corporation's new Science Center in Santa Barbara, Calif., as Sr. Scientist.

Transval Electronics Corp. has appointed **Jack Campbell** Director of Government Contracts. He was formerly with Hayes Aircraft, Birmingham, Ala.

Arthur V. Sommer, formerly Division Manager, Chicago Div., American Bosch Arma Corp., is now Chief Engineer, Arma Div.

Lawrence Saper has been appointed Director of Engineering for the Eastern Div. of Acoustica Associates, Inc. He was previously associated with Bogue Electric Mfg. Co.

Thomas A. Combellick is now Chief Engineer at the Military Div., Lenkurt Electric Co.

Charles R. Wilson is now Production Manager for the West Coast Div. of the Military Electronic Operations of Allen B. Du Mont Labs., Inc.

Dr. J. Earl Thomas, Jr., has been appointed to the newly created post of Director of Research & Engineering for the Semiconductor Div., Sylvania Electric Products Inc.

James M. Dill has been appointed Vice-President and General Manager of Ratigan Electronics, Inc., Glendale, Calif. He was formerly Sr. Research Engineer.

Charles Nater is now Chief Engineer at the Instrument Div., Beckman & Whitley, Inc., San Carlos, Calif.

Morris Levin has been appointed Manager of the Ground Systems Section at Tele-Dynamics, Inc., Phila., Pa. He was formerly measurements engineer, systems engineer, and Supervisor of the Ground Systems Section's Electrical Design Group.

Nuclear Corp. of America has appointed 3 scientists to the staff of the company's Isotopes Specialties Div. in Burbank, Calif. **Alfred J. Moses** is Manager of Radioactive Laboratory Operations; **John D. Vaden** is Health Physics Officer, and **Nyle Schafhauser** will run Isotopes Specialties' experimental shop.

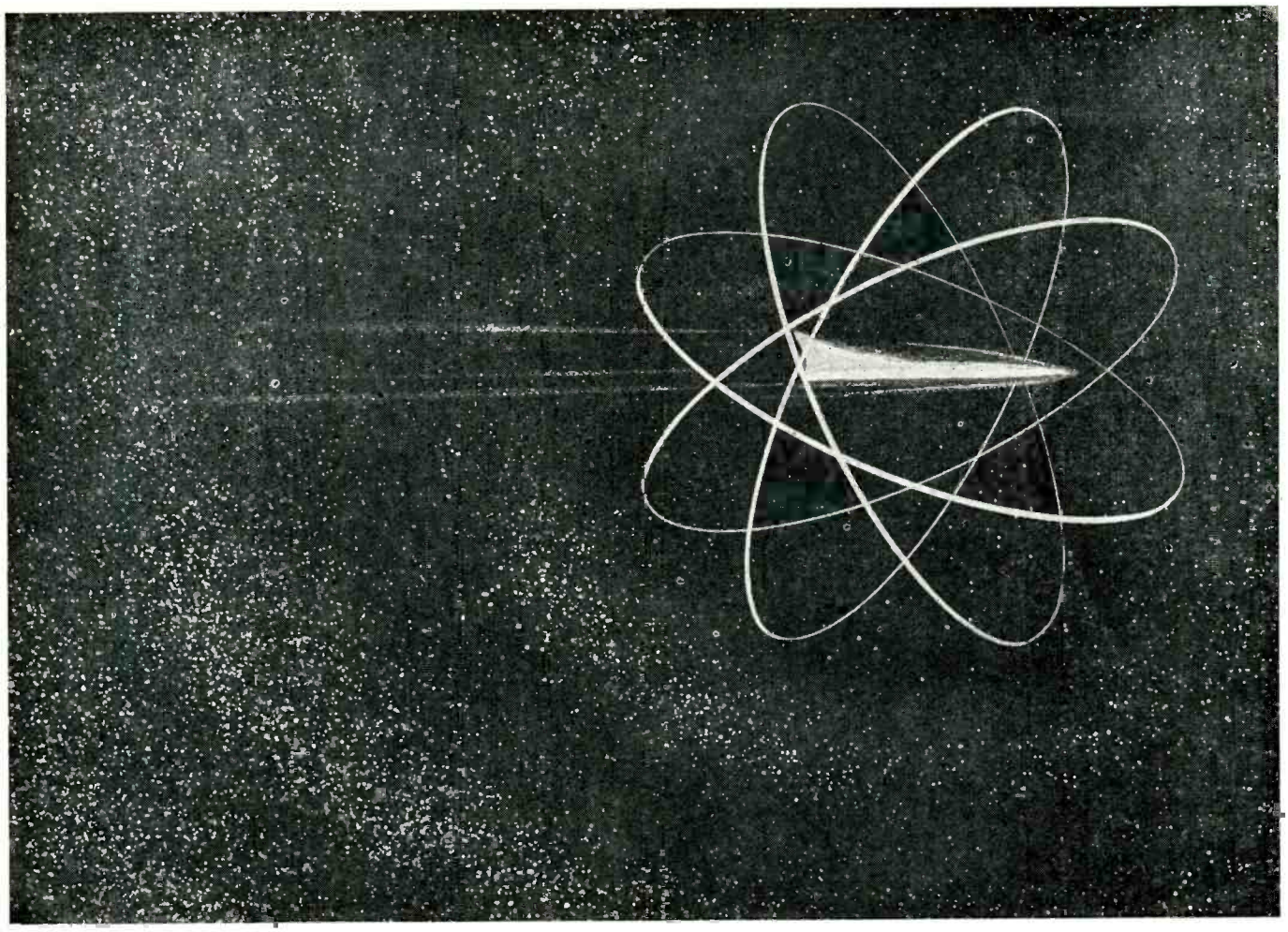
Harry M. Stephey has been named Manager of Defense Requirements in the Missile and Space Vehicle Dept. of the General Electric Co. He had been Manager of Advanced Sales, Defense Systems Dept.

Charles E. Shinn has been named Director of Research and Development for Royal McBee Corp. He was formerly Engineering Administration Manager in the Royal McBee Research & Development Div.

Robert E. Wesslund has been appointed Director of Research, New Products Developments at Transistor Electronics Corp. Prior to this appointment he was Project Engineer in charge of Remington Rand Univac's New Computer Development.

Raymond F. Guy, Haworth, N. J., Sr. Staff Engineer, National Broadcasting Co., N. Y., has been made a Fellow of the American Institute of Electrical Engineers. He was cited "for Contributions to the technical development of radio and television network broadcasting."

Ray Destabelle, formerly in charge of transducer design and development for Technology Instrument Corp. of Calif. has been appointed Chief Engineer for the firm.



a fence in the sky

The Westinghouse Air Arm Division has been selected to develop and build a fence in the sky . . . an electronic defense system to shield the Air Force's 2000 mph B-70 Valkyrie.

This defense system will be a new dimension in electronic counter-measures, employing electro-magnetic and other techniques to delay, confuse and distort enemy intelligence. With its advanced technical developments, this system will greatly increase the manned aircraft's capacity for self defense.

The program, including advanced development and design work, will offer unique career development opportunities for engineers desirous of pioneering in the following fields:

AIRBORNE ELECTRONIC COUNTER-MEASURES

Systems Engineers
Broad Band Amplifiers
Signal Analysis
Digital Computer Design
Microwave Tube Design
Antenna Design

CONTROLS & DISPLAYS

Circuit Design
Experimental Psychologists

GROUND SUPPORT EQUIPMENT

Automatic Check-out and Fault Isolation

FERRET RECONNAISSANCE
ELECTRONICS INSTRUCTORS
COMMUNICATIONS CIRCUITRY
FIELD ENGINEERING
TECHNICAL WRITING
ELECTRONIC PACKAGING

FOR DETAILS . . . and a copy of the informative brochure "New Dimensions", send a resume of your education and experience to: Mr. A. M. Johnston, Dept. 942 Westinghouse Electric Corporation, P. O. Box 746, Baltimore 3, Maryland.

Westinghouse
BALTIMORE

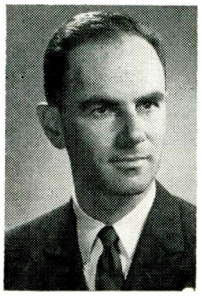
Circle 507 on "Opportunities" Inquiry Card

Industry News

Monroe Seligman, President of Tenney Engineering, Inc., has been elected Director of the Environmental Equipment Institute, an organization of designers and builders of test chambers and other facilities used to simulate extreme altitude, heat, cold and other conditions.

Walter Hasenzahl has been appointed to the new management position of Director of Manufacturing Engineering at the Crosley Div., Avco Corp.

Dr. Herbert F. York, Director of Research and Engineering, Dept. of Defense, has appointed **John H. Rubel** as Assistant Director, Defense Research and Engineering (strategic weapons). He is on leave of absence from Hughes Aircraft Co., Culver City, Calif., where he has been Director of Airborne Systems Labs.



J. Rubel

G. Danch

Gabriel C. Danch has been named Manager, Washington Office, U. S. Industries, Inc. He was formerly associated with Ryan Aeronautical Co.

Atohm Electronics, Sun Valley, Calif. has appointed **R. H. Engstrom** to the post of V.P./Sales. He has been associated with atohm in sales management through Engstrom Associates, Inc.

Oliver Berliner has been named a Director of Studio Electronics Corp. He will serve as Sales Manager and Advertising Director of the firm.

A. Richard Robertson has been appointed Director of Sales Promotion and Merchandising by KRON-TV, San Francisco. He was formerly Promotion Director of KTVU, Oakland.

Kenneth R. Eldredge is now Assistant to the President, Arnoux Corp. He had previously been associated with Stanford Research Institute as Assistant Director in Engineering.

Industry News

Harold B. Nicholas has been appointed Sales Manager at the Instrument Div. of Humphrey, Inc., San Diego. He was formerly Chief Design Engineer for Cubic Corp., San Diego.

Monogram Precision Industries, Inc., has named **Victor Gehrig** and **Robert A. Lehman** as Sr. Vice Presidents. Gehrig was formerly Vice President - Production. Lehman was General Manager of the Electronics Div. in Los Gatos, Calif.

Franklyn E. Dailey, Jr. has been appointed Manager of Planning for Stromberg-Carlson, San Diego.

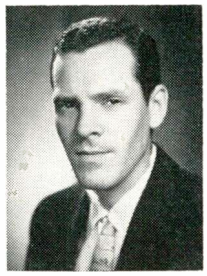
Norman L. Lingeman has been appointed President of the recently created Superior Resistor & Electronics Corp. at Frankfort, Ind. He was formerly with Model Engineering, Tru-Ohm Div. **Gilbert E. Stokes** is Vice-President. He was formerly in Production and Material Control with P. R. Mallory & Co., Inc.

James A. Schaefer is now Manager of the Houston, Tex. branch of Central Scientific Co., Chicago. He was formerly Pittsburgh rep for the company.

Howard Hoffman is now Factory Manager for the Commercial Products Div. of Lenkurt Electric Co., San Carlos, Calif.

C. Robert Lane has been promoted to the position of Sales Manager of Andrew Corp., designers and manufacturers of antenna systems.

C. Lane



J. Palmere

James R. Palmere has been appointed Electronic Fabrication Group Sales Manager at Foto-Video Laboratories, Inc. He was formerly purchasing agent.

William J. Gagnon has been appointed Vice President of Bradley Semiconductor Corp. He had been General Sales Manager of the firm.

Industry News

John J. Rooney, Sub-contract Purchasing Agent at Melpar, Inc., has been elected to the Presidency of the Purchasing Agents Assoc. of Washington, D. C.

The appointment of Dr. **John W. McNall** as Director of Research at the Westinghouse Lamp Div. has been announced. He was formerly Assistant Director of Research.

Dr. **Earl L. Steele** has been appointed Assistant Manager of the development laboratory for the Semiconductor Div. of Hughes Aircraft Company's Products Group. Dr. **Michael Waldner** has joined the Device Research Dept.

Robert B. Buchele has been elected Vice President of Corporate Development and Administration of American Electronics. He was formerly Assistant to the President.

R. Buchele

W. Kennedy

General Controls Co. has appointed **William R. Kennedy** as Sales Manager of its Hammel-Dahl Div.

George Canova has joined Datex Corp. as Sr. Project Engineer in the Systems Group. He was formerly an Electronic Engineer with Burroughs ElectroData Div.

The election of **John D. Weber** to Vice President of the Swartwout Co., Cleveland, Ohio, and Manager of the AutroniC Control Div., has been announced. He was formerly Manager of Marketing and Manufacturing.

Walter A. Clements has been appointed to the position of Vice President in Charge of Distributor Sales and Advertising, at Littlefuse, Inc.

William J. Werheim has joined International Resistance Co. as Sales Manager for precision resistor products. Before joining IRC, he was Eastern District Representative of Guardian Electric Mfg. Co.

Industry News

Dr. A. W. Wortham, Manager of the Quality Assurance Dept. of the Semiconductor - Components Div., Texas Instruments Incorporated, has been elected as an Executive Director of the American Society for Quality Control.

H. W. Shepard has been appointed to the newly-created position of Administrator of Color TV Market Development at RCA Victor Home Instruments. He was formerly General Manager of WAMP and WFMP, Pittsburgh radio stations.

H. Shepard

W. Sargent

The appointment of Walter E. Sargent as Supervisor of Production Engineering at Stromberg-Carlson, San Diego, has been announced. He was recently Assistant Chief Production Engineer for Zenith Radio Corp.

International Electronic Research Corp., Burbank, Calif. has recently added 2 men to its management staff. Edgar O. Mattsson joins the Company as controller, and Orren M. Turner as Assistant to the President.

Richard W. Griffiths has been appointed General Sales Manager for the Semiconductor Div., Hoffman Electronics Corp. He succeeds Henry F. Schoemehl, who has been promoted to the new position of Director of Product Marketing.

George S. Hanson is now Director of Sales and Contracts for the Computer Div. of Control Data Corp. He was formerly Chief Engineer for Military Systems for Remington Rand Univac Div.

Concurrent with the formation of a new Advanced Systems Engineering Operation in the General Electric Company's Missile and Space Vehicle Dept. was the announcement of the appointment of 6 Sub-operations Managers. The Managers are: Robert L. Francisco, C. Frank Hix, Jr., Richard A. Passman, Robert R. Reid, Stanley C. Tracz, and L. W. Warzecha.

Industry News

Three major new assignments for key executives of Delco-Remy Div. have been announced. Named to a newly created post as Divisional Director of Product Reliability is **J. H. Bolles**, formerly the Division's Director of Sales and Engineering. Succeeding Mr. Bolles as Director of Sales and Engineering will be **H. G. Riggs** formerly Divisional Works Manager. **Robert L. Kessler**, former manufacturing Manager for starting, lighting and ignition equipment, will move into the Works Manager assignment.

Anthony C. Cuomo has been promoted to Assistant Manager of the Missile Support Laboratory of Allen B. DuMont Labs., Inc.

C. Robert Shaeffer has been elected to the position of Secretary-Treasurer of American Electronics Labs., Inc.

Frederick J. Lautenschlaeger is now Plant Manager at Harrison and **William B. Brown** is Plant Manager at Woodbridge, N. J. for Receiving Tube Operations, RCA Electron Tube Div.

ELECTRONIC INDUSTRIES Advertisers — August 1959

(*Continued on Page 242*)

Advertiser's Index

(Continued from Page 241)

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Circle 2 on Inquiry Card

10 Mc "flip-flop" circuit utilizing either a pair of RCA-2N1300 or RCA-2N1301 Mesa Transistors.

RCA-2N1300 and 2N1301

LOW-COST MESA COMPUTER TRANSISTORS

Now in quantity production . . . and available!

RCA-2N1300 and 2N1301 Germanium P-N-P Mesa Transistors offer these 10 major benefits to designers of switching circuits. And they're ready for you now!

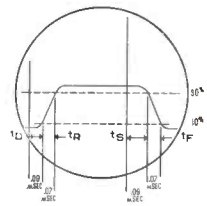
- rugged Mesa structure—permits extremely small base width to insure top performance at high frequencies
- fast switching times with low values of base input current—made possible by high frequency response and low total stored charge
- high current gain—permits high fan-out ratios (number of paralleled similar circuits per driver-stage output)
- high breakdown voltage and punch-through voltage ratings—the result of the diffusion process
- high power dissipation—150 milliwatts at 25°C—aids in the design of reliable circuits
- high current ratings—improve overall system speed
- rugged overall design—units have unusual capabilities to withstand severe drop tests and electrical overloads
- electrical uniformity—a result of the diffused-junction process used by RCA in the manufacture of Mesa Transistors
- especially well suited for use at pulse repetition rates up to 20 Mc
- exceptionally well suited to applications in saturation-type switching circuits.

Information on RCA-2N1300 and 2N1301 Low-Cost Mesa Transistors is available from your RCA Field Representative. For technical data, write RCA Commercial Engineering, Section H-50-NN, Somerville, N. J.

RCA TYPE	Maximum Ratings* Absolute-Maximum Values						Characteristics: Common-Emitter Circuit, Base Input Ambient Temperature of 25° C		
	Collector-to-Base Volts	Emitter-to-Base Volts	Collector Milli-amperes	Transistor Dissipation—mw			Minimum DC Current Gain		Gain Bandwidth Product• Mc
				at 25°C	at 55°C	at 71°C	at collector ma = −10	at collector ma = −40	
2N1300	−13	−1	−100	150	75	35	30	–	40
2N1301	−13	−4	−100	150	75	35	30	40	60

*Maximum collector-to-emitter voltage rating = −12 volts

• For collector ma = −10 and collector-to-emitter volts = −3.



Oscilloscope wave form shows typical delay, rise, storage, and fall times achieved with 10-ma inverter circuit utilizing the RCA-2N1301 MESA TRANSISTOR.

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