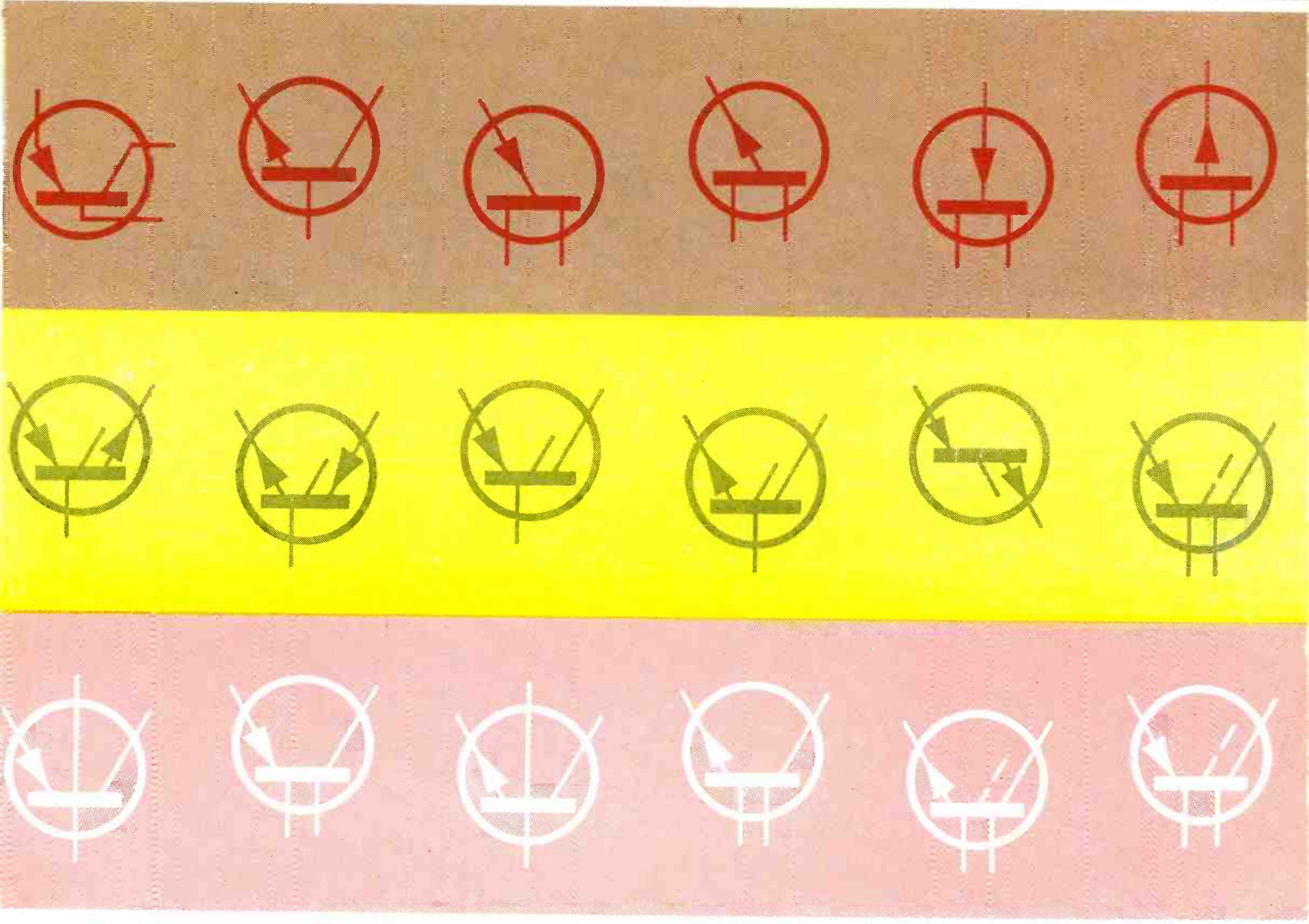
ELECTRONIC INDUSTRIES

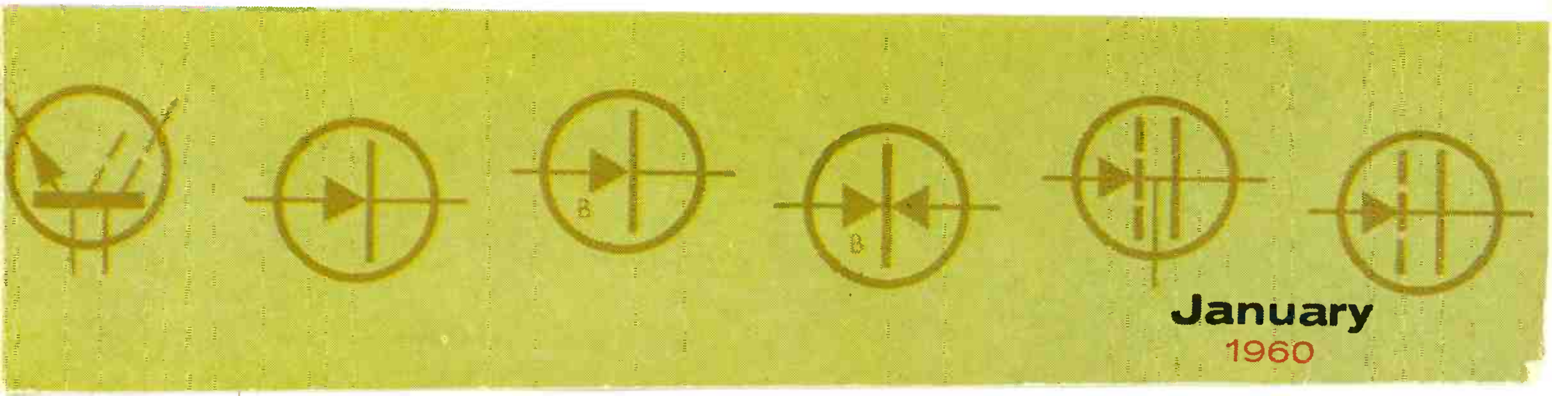
A CHILTON PUBLICATION



In This Issue:

SEMICONDUCTOR SYMBOL STANDARDS

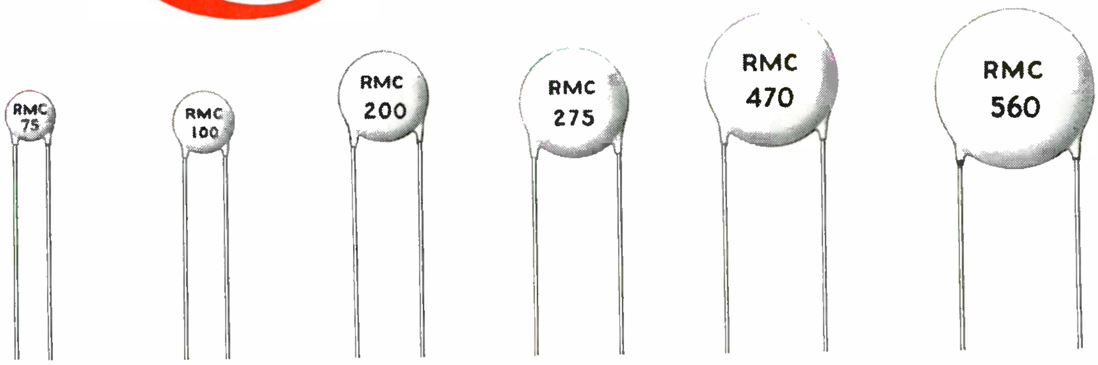
- Spectrum Analyzer Transient Studies
- Measuring Transistor "Y" Parameters



January
1960

PROVED
DESIGN
APPLICATION
PERFORMANCE

TYPE C Temperature Compensating *RMC DISCAPS*



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 5 MMF	6- 10 MMF	11- 20 MMF	—	—	—
NPO	2-15	16- 33	34- 69	70- 85 MMF	86-115 MMF	116-150 MMF
N- 33	2-15	16- 33	34- 69	70- 85	86-115	116-150
N- 75	2-15	16- 33	34- 56	57- 68	69-125	126-150
N- 150	2-15	16- 33	34- 67	68- 75	76-140	141-200
N- 220	3-15	16- 33	34- 75	76-100	101-140	141-200
N- 330	3-15	16- 47	48- 75	76-100	101-150	151-200
N- 470	3-20	21- 51	52- 80	81-120	121-200	201-250
N- 750	5-30	31- 75	76-150	151-220	221-300	301-470
N-1500	10-56	57-120	121-220	220-300	300-470	471-560
N-2200	20-75	76-150	151-200	201-300	301-680	—

Temperature coefficients up to N-5200 available on special order.

SPECIFICATIONS

POWER FACTOR: Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle.
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
CODING: Capacity, tolerance and TC stamped on disc
INSULATION: Durez phenolic-vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
LEADS: No. 22 tinned copper (.026 dia.)
TOLERANCES: ±5% ±10% ±20%

These capacitors conform to the E.I.A. specification for Class 1 ceramic capacitors.

The capacity of these capacitors will not change under voltage.

RMC Type C DISCAPS meet or exceed all specifications of the ETA standard RS-198. Rated at 1000 working volts, Type C DISCAPS provide a higher safety factor than other paper or mica capacitors.

Constant production checks assure that all specifications and temperature characteristics are met. Another phase of complete quality control consists of 100% testing of capacities.

Throughout the years leading manufacturers have relied on RMC for quality of product and maintenance of delivery schedules. Write on your company letterhead for additional information on DISCAPS.

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ELECTRONIC
INDUSTRIES

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

Review & Forecast for 1960

YEAR end 1959 will find the electronic industries forging 10 to 15% ahead on all consumer product fronts as compared to 1958. As yet there have been no repercussions throughout the industries as a result of the steel strike, but this could happen in early 1960 if the strike is resumed for any considerable period. It is gratifying to see such an increase in non-military products, since last year more than 50% of the gross national product (approximately $4 billion) went into government electronic equipment.

During 1959 the industry will have produced approximately 6 million television sets, 15 million radio sets and 3.3 million phonographs. Dollar volume of transistor production exceeds $200 million, more than twice that of last year. More than 9.5 million television picture tubes have been produced along with 430 million receiving tubes. There appear to be no obstacles that will reduce the 1960 production figures under this year's. If anything, figures could increase another 5 to 10% because of population increases, obsolescence of equipment and replacement parts.

Foreign imports continue to act as a limiter in this industry segment. Although foreign products on the American markets emanate largely from United Kingdom, France, West Germany and Japan, there is considerable alarm over the tremendous growth of Japanese activity on American markets in recent years. In the first six months alone, 1959 Japanese exports to the United States totaled approximately $23 million, which exceeds the total for all of 1958 and is nearly three times the total for 1957.

Efforts are being made to stem any further increases, particularly in the transistor and semi-conductor areas, where large volume importation could seriously dislocate our ability to produce. The lower foreign labor rates are in many instances a double threat. The foreign duplicate of an American product has the advantage of not requiring the manufacturer to do the research and development work to produce the product . . . the American firms underwrite this. The foreign manufacturers then have the double advantage of lower priced help to create the machines to mass-produce the product, and the lower priced help to run these machines.

About another 10% rise in factory sales of military and government electronic equipment can also be expected. Total sales for 1960 of the entire industry should approximate $11 billion.

Sales in the industrial electronic market have continued their rise in 1959 to approximately $1.5 billion. Principal segments in this market include computers and data processing $310 million; testing and measuring $240 million; navigational aids $110 million; landmobile, microwave, broadcasting $170 million; industrial controls $170 million; medical and therapeutic $160 million and commercial sound $155 million. During 1960 these figures should swell to approximately $1.7 billion overall. Principal areas for expansion next year will be in computers and data processing, microwave communications and controls, and in nuclear electronic apparatus.

The space electronic area is somewhat unpredictable since more than half the cost of a missile has been reported as being in electronic apparatus and the electronic value then becomes a matter of the number of missiles being produced. Current estimates indicate that 1960 will have approximately $4 billion in missile expenditures.

Watch for a parade of new microwave products in 1960!

In 1959 the tunnel diode as a practical manufacturable semi-conductor device was developed. In 1960 these devices will find greater and greater circuit applications. Parametric amplifiers and maser amplifiers for microwave applications have now also been perfected and will be commercially available.

All in all, electronic 1960 sales, in topping $11 billion, will run about 10 to 15% ahead of 1959 volume.

For additional marketing data please turn to pages 23, 92, 93, 94 and 95.

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ELECTRONIC INDUSTRIES

Vol. 19, No. 1 January, 1960

MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

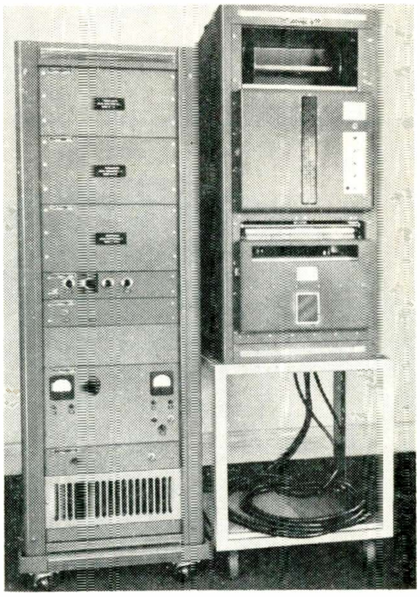
DEPARTMENTS

Highlights

of this issue

Spectrum Analyzer Supplies Permanent Record page 68

Simultaneous operation of many filters and read-out devices eliminates the scanning or commutation required in the earlier equipments. The range of bandwidths and numbers of channels that can be accommodated make this a powerful new technique in signal analysis and search.



Spectrum Analyzer

Nomographs Simplify Electron Tube Re-design page 73

When re-designing a tube for changed electrical characteristics it is usually necessary to modify the internal tube dimensions. These three nomographs make it possible to quickly determine the physical characteristics of the new tube from specs of a tube of the same general class.

Applying Transistor "Y" Parameters page 79

For h-f applications, the transistor can be considered as a linear active two-port network, which can be specified at a particular frequency by a set of four different parameters. One of the most commonly used is the "y" parameter. Described here are means for measuring and applying the "y" parameter along with ideas for designing a single stage amplifier.

Transistor "y" parameters

Calculating Folded-Unipole Antenna Parameters page 96

When antenna tower heights are restricted for low frequency applications, the folded-unipole antenna offers several advantages. These advantages are described and easy methods of calculating system parameters are given.

The Case for DC Restoration page 186

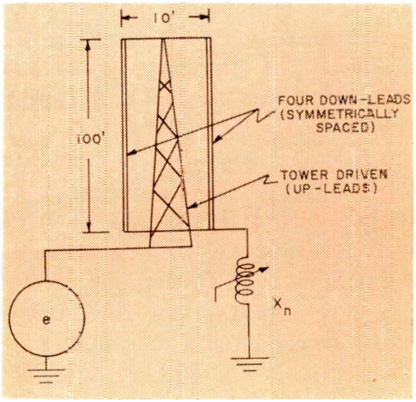
The success of hi-fi reflects appreciation of quality sound. Is it not now the time to return to the public the quality TV picture they enjoyed ten years ago? This 30¢ circuit could do it.

DC Restoration

Semiconductor Symbols page 101

This three-page chart is a complete, illustrative presentation of the symbols, pertinent to semiconductors, which have been adopted as standard by the Institute of Radio Engineers.

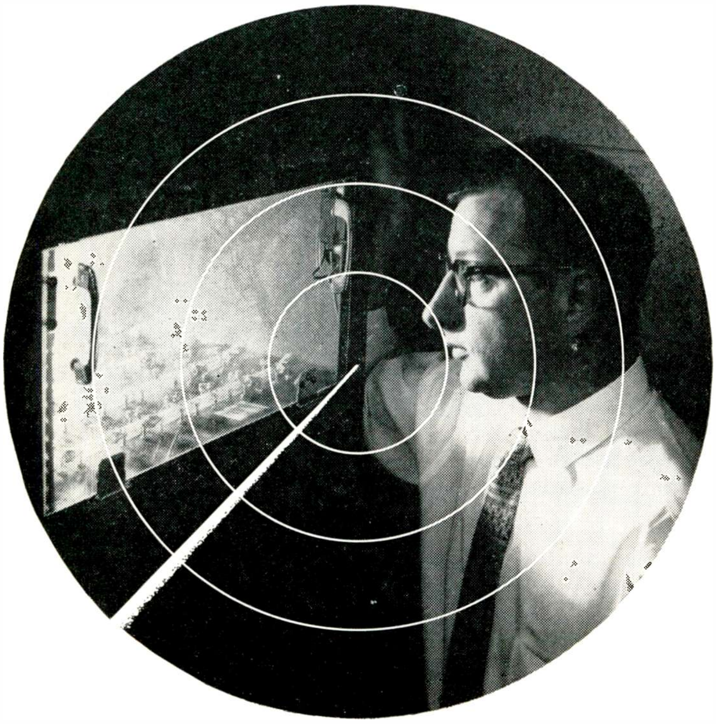
Folded-Unipole Antennas



The Importance of International Standards page 202

In the last thirty years, the electronic industries have grown to a position of prominence in the economy of the United States. The market for electronic equipment, already substantial, is expected to increase not only in the United States but throughout the world. To assure a coninuing place in the international market the U.S. electronic industries must actively participate in establishing international standards.

RADARSCOPE



LIFE TESTING TUBES

Electronic tubes used in missiles such as the Army's LaCrosse undergo a rigid life test at GE's power tube plant in Scranton, Pa. Engineer W. Roscoe checks a group of GL-6299 low-noise microwave triode tubes at maximum power to determine life expectancy.

TRANSISTORIZED TV TUNER will appear early this year. It is expected to show a 7 db gain in noise figure.

FLEXIBLE EPOXY RESINS have greatly simplified the job of meeting military specifications for airborne transformers.

FOREIGN LABOR RATES are about one-fifth that of the USA, points out EIA President, David R. Hull. The most important competitor, Japan, has now captured an estimated 25% of the U. S. transistor radio market. The Japanese government last month announced plans to "control" shipments of transistor radios to the U. S.

FIRST MEXICAN RECEIVING TUBE plant is now in operation. A few thousand miniature 12-volt units have been turned out, and an output of 100,000 per week is planned for 1960. The 100-employee plant is reportedly the most modern of its kind in the Western Hemisphere outside the U. S.

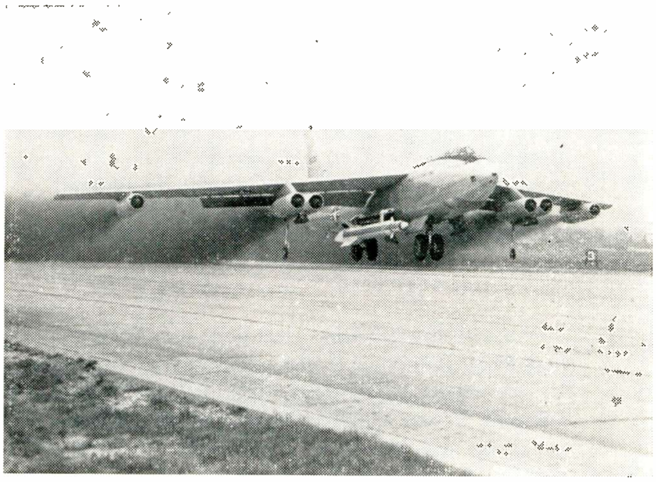
HIGH SPEED RECORDING SYSTEM that "reads" magnetic tapes from electronic computers and instantly puts high quality characters on microfilm has been developed by Eastman Kodak Co. The system, called Dacom (Datascope Computer Output Microfilm), reads magnetic tape and displays corresponding letters on numbers on the face of a cathode ray tube. The system can record 6900 lines or more per minute with a speed of 16,600 characters per second.

THE THERMOMAGNETIC GENERATOR, which transforms heat directly into electricity, is being written off by Navy scientists as impractical. The device needs too much heat and the efficiency is estimated at low $10^{-3}\%$ or less. The researchers conclude "useful development of the thermomagnetic generator does not appear hopeful."

NEW STANDARDS of measuring electrical quantities have been developed at National Bureau of Standards that now provides a highly accurate alternate procedure for checking most electrical measurements. The basis for the new approach is an accurate capacitance measuring bridge and an accompanying calculable standard of capacitance. They provide a highly accurate check on the ohm and the volt as currently maintained by the Bureau. Since all of the other electrical units in use are derived from these two basic units, it is essential that the ohm and the volt be known as accurately as possible.

AIR-LAUNCHED MISSILE

The Martin-built 199B ALBM, 2-stage U.S. Air Force research and development missile, is carried aloft by a B-47, to demonstrate the feasibility of firing ballistic missiles from aircraft. Flight was made at Cape Canaveral to check the guidance system accuracy at exhibit angles approximately the vertical.



Analyzing current developments and trends throughout the electronic industries that will shape tomorrow's research, manufacturing and operation

COOPERATIVE SUPER-CORPORATION has been formed by seven firms in the electronics and allied fields to provide a coordinated entity capable of handling large military procurement contracts. The companies involved are Servo Corp., General Transistor Corp., Blount Bros. Inc., Specialty Electronics Development Corp., Nytronics Group, Technical Research Group Inc., and a management consultant firm, Dade Associates Group. The new company, National and Electronics Facilities Corp. (NEFO), will enter the competitive field of bidding for military contracts, armed with staffs that total more than 4000 workers, total assets of $25 million. Henry Blackstone, President of Servo Corp. of America, is the newly named President of NEFO.

NEW TECHNIQUE for pressing rods of commercially available powdered boron has led to successful floating zone melting of that extremely high melting element. The technique will provide larger crystals for basic research studies of this conductor than had been available before. The technique was developed at Bell Telephone Laboratories.

FIRST JAPANESE nationwide TV networks will be completed by this Spring. Monthly TV production in Japan is expected to reach 300,000 TV receivers monthly, or approximately half the rate of U. S. production by the end of 1960. Total demand is seen at 7.5 million units. One of the handicaps facing Japanese TV manufacturers is the lack of picture tube bulbs. Imports have run into some snags and there seems little possibility of increasing the production capabilities in the country within a reasonable time. In other branches of electronic manufacturing, notably components, the MIL standards of the United States are being used as the standard of quality and a very earnest attempt at standardization is being attempted throughout the Japanese industry.

MICA PRODUCERS are being pinched by a rising demand for high quality mica and a very sharp dip in the demand for low quality mica. This trend, unfortunately, is leading to sizeable accumulations of unsaleable mica because the poorer quality mica is necessarily a part of the mica mining process. Producers have in the past forced this unwanted mica onto importers, causing a great deal of hard feeling. As of the first of the year, new regulations have been set down which limit the desired top quality mica to 50% of the total orders. If the fabricator wants more than 50%, he will have to pay much higher price, possibly in excess of 50% more.

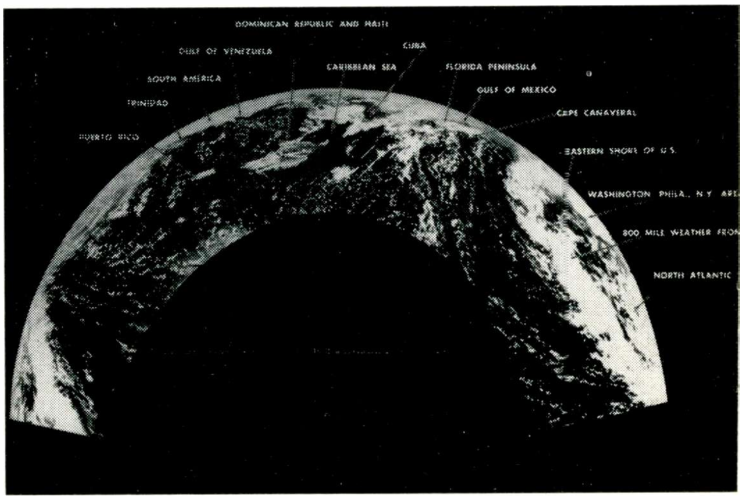
PROPULSION SYSTEM combining electric and magnetic forces, which could power a man space vehicle through the gravity-free stretches of outer space, can be built now, says Lockheed Missile and Space Div. scientist Dr. Sidney W. Kash. A laboratory model of a plasma accelerator has been developed which has achieved propellant velocities of 200,000 miles an hour. The device is called a "colinear electrode plasma accelerator."

DATA PROCESSING SYSTEMS will enable economists to spot unfavorable trends in taking corrective measures early, says RCA's John L. Burns. Rather than relying on spot samplings of selected national indices, professional economists in and out of government will have masses of evaluated and up-to-date information at their command, covering every significant sector of the economy.

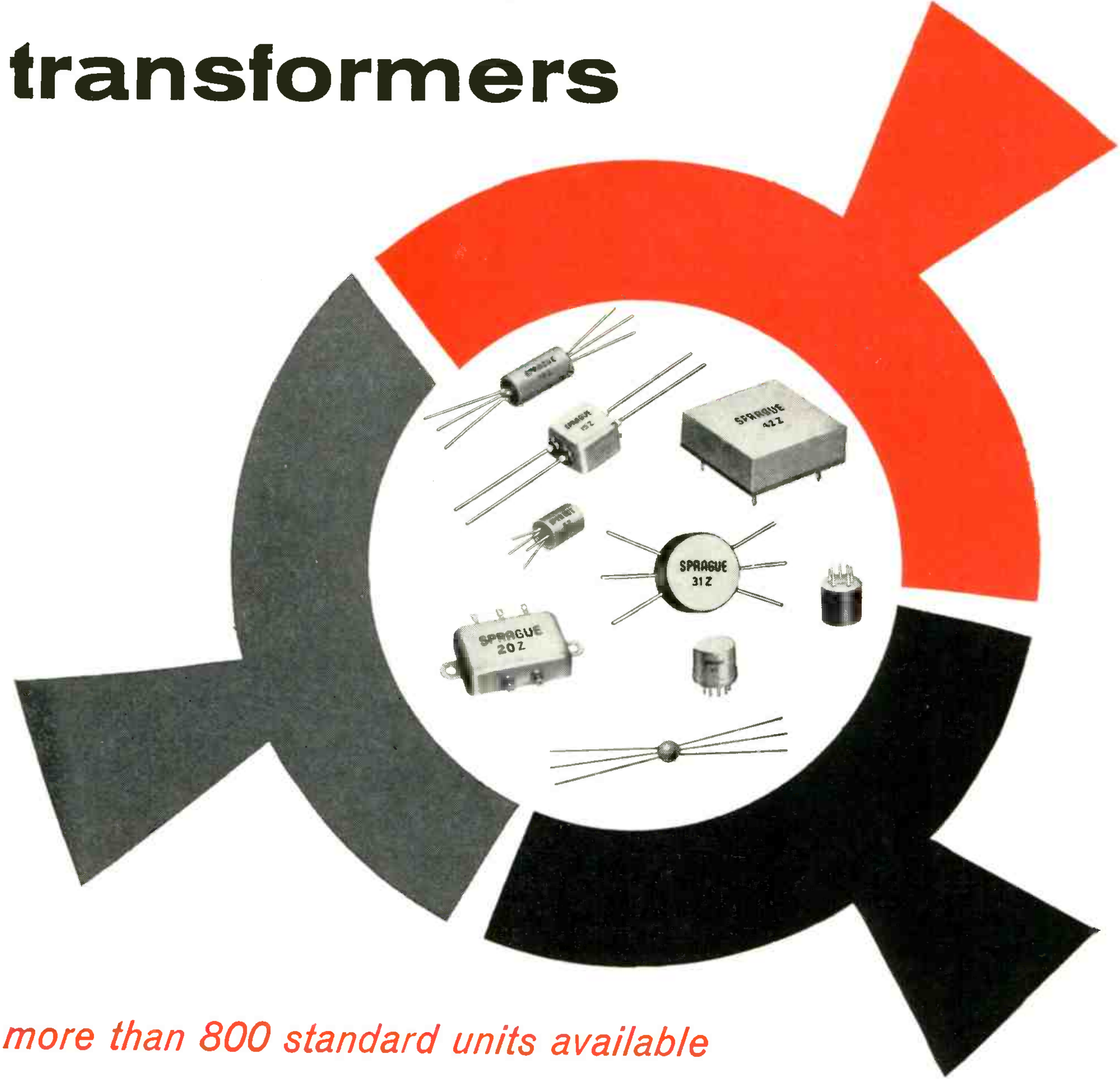
CONCERN is being expressed over the patent provisions of the Space Act passed by Congress in 1958, and there is every likelihood of changes in the near future. The present law provides that inventions made in the performance of contracts with NASA are the exclusive property of the government. The contractor making the invention has no right to it except through a cumbersome and uncertain waiver procedure. This is a drastic departure from DOD regulations which permits contractors to retain title to any patents they take out for inventions made in connection with contracts, but subject to a nonexclusive, royalty free license which gives the government ample protection. Pressure is being applied to change the NASA regulations to conform with those of other government agencies.

SATELLITE WEATHER MAPPING

Mosaic of individual photographs obtained from flight of Atlas nose cone. Using this mosaic scientists are able to synthesize a number of large-scale meteorological features occurring in the mid-Atlantic area. Air photographs have the advantage of pinpointing storm system locations much more accurately.



miniature pulse transformers



more than 800 standard units available

Sprague Miniature Pulse transformers give the circuit designer the flexibility he needs to meet the varied requirements of low-power, high-speed computers. Sprague literature details more than 800 standard units in a wide variety of mounting styles, shapes, and encasements for conventional or printed wiring board assembly. Many special types can also be furnished to match specific circuit and packaging requirements.

Sprague pulse transformers handle pulse widths of 20 millimicroseconds and wider...at repetition rates as high as 10 megacycles . . . with pulse levels ranging from fractions of a volt to several hundred volts.

Typical circuits utilizing Sprague Pulse Transformers include *pulse amplifiers* (for current or voltage step-up, impedance matching, decoupling, pulse inversion and push-pull operation); *pulse shaping and differentiating; blocking oscillators* (in regenerative circuits of the triggered and self-triggered type); *general transistor circuits.*

For application assistance on your pulse transformer problems, write to Manager, Special Products Division, Sprague Electric Company, Union St., North Adams, Mass. A complete series of Engineering Bulletins covering Sprague's standard pulse transformers is available from Technical Literature Section, Sprague Electric Company, 233 Marshall St., North Adams, Mass.

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As We Go To Press . . .

High-Voltage Derived From Heat Sources

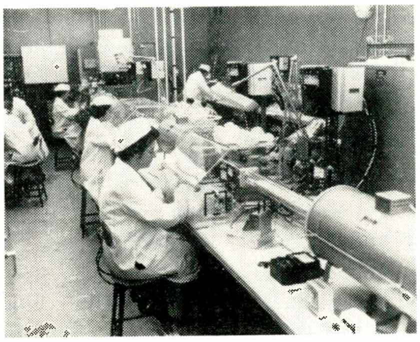
A new device that can produce high-voltage electricity directly from the warming power of a sunbeam or other heat source has been announced by International Telephone and Telegraph Corp.

Called a ferroelectric converter, the device is expected to have far-reaching effects in space communications and space travel. Unlike solar batteries which can supply only direct current at low voltages, the new development supplies both ac and dc current at high voltages. Solar batteries depend on light for their usefulness. The ITT converter may use other heat sources, such as nuclear heat, and, therefore, can operate while in shadows.

The principles behind this type of energy converter hinge on the special characteristics of a family of insulating materials known as ferroelectrics. As these ceramic substances, sandwiched between charged plates, are heated, they transfer their electrical energy to the plates, increasing the voltage. In this fashion heat is converted to electrical energy.

Using a single converter element the size of a dime, outputs of more than 1000 v. already have been obtained directly without need for voltage step-up devices. By arranging elements in series, outputs of 1 million volts are theoretically possible.

TRANSISTORS



Transistors are now being manufactured in this new "controlled conditions" plant of National Semiconductor Corp., Danbury, Conn. The transistors in production are p-n-p silicon alloy "small signal" types for low power level amplification. Other types are planned for future production.

New President Of IRE Elected

Ronald L. McFarlan, Consultant to the DATAmatic Corp. and the Raytheon Mfg. Co., has been elected President for 1960 of the Institute of Radio Engineers. Dr. McFarlan succeeds Ernst Weber, President of the Polytechnic Institute of Brooklyn, as head of the International Society of 76,000 electronic engineers and scientists.

For the first time in its history the IRE will have two Vice Presidents in 1960. One residing in North America and the other from abroad. The Vice President representing overseas countries will be J. A. Ratcliffe, head of radio research at Cavendish Laboratory in Cambridge, England. The Vice President representing North America will be J. N. Dyer, Vice President of the Research and Engineering Div. of Airborne Instruments Lab., Melville, N .Y.

Ronald L. McFarlan, consultant, is elected IRE president for 1960.

Synchro Design and Testing Symposium

The U. S. Navy Bureau of Naval Weapons is sponsoring a Synchro Design and Testing Symposium for the exchange of technical information between representatives of industry and Department of Defense.

Meetings will take place on March 17 and 18 at the Department of Commerce Auditorium in Washington, D. C. Further information may be obtained from U. S. Naval Weapons Plant (751.31).

Thin Ceramic Films Key To High Capacity

The new miniature ceramic dielectric "Cerafil" capacitors being manufactured by Hi-Q Division of Aerovox in expanded facilities at their Olean, N. Y. plant provide extremely high capacity per unit volume through a new method of forming thin films of ceramic.

Ceramic dielectrics are ordinarily difficult to handle in small amounts, due to their brittleness. The "Cerafil" process circumvents this problem, forming thin films of ceramic dielectric on a substrate, which acts both as one of the electrodes and as a support for the film.

The capacitor consists of a single rod element or multiple of the rod element, depending on the capacity value required. Diameter of the rod is 1/32-in. The rod is metallized, then the ceramic film applied, then another metal coat. The metal films act as electrodes. For increased capacitance the rods are bundled to gether.

Standard Cerafil capacitors range in size from .090 in. in dia. by .320 in. long for the 001 mfd unit to .310 in. dia. by .75 in. long for the .1 mfd unit. These units are rated at 100 vdc with max. power factor of 2.5% at 1 KC and a variation of capacity with temperature of approximately +10% — —15% over the range of —55°C. to 85°C. based on 25°C. as reference temperature.

In other applications of the ceramic base technique the Hi-Q division is manufacturing at the Olean plant ceramic base printed circuits and "Cerol" capacitors.

"Cerol" capacitors are produced by rolling an extremely thin ceramic dielectric film upon which a precious metal is deposited. The rolled ceramic film is then fired and the capacitor becomes a compact and monolithic structure capable of withstanding severe environmental conditions.

"Cerol" capacitors range in size from .2 in. dia. by .65 in. long for a .1 mfd unit to .4 in. dia. by 1.4 in. for the 2 mfd unit.

MORE NEWS
ON PAGE 8

Ultra-Reliable Receiver Contract Let

The Air Force has given Sylvania Electric Products Inc. a contract for the development of laboratory techniques for designing an ultra-reliable airborne radio receiver which is adaptable to micro-miniaturization.

The contract calls for delivery of an experimental ultra-high-frequency receiver that will provide 10,000 hrs. (nearly 14 months) continuous operation. The current average time between failures for typical airborne receiver is 450 hr. Circuitry of the experimental receiver also must be adaptable to the incorporation of micro-miniaturized electronic elements.

Air Traffic Automated

The Federal Aviation Agency took another step toward automation in air traffic control. The FAA tied the computer at the Indianapolis Air Route Traffic Control Center with similar equipment in Washington, D. C., Cleveland and Pittsburgh. The IBM 650 RAMAC computer is the first air traffic computer to automatically exchange information with other FAA traffic control centers also equipped with computers.

Such centers are planned to provide automation in the air traffic control of high traffic density areas over the northeastern United States. The agency plans to install electronic computers in some 30 centers throughout the country. Western centers are scheduled to receive theirs within the next two years. The central section of the nation will become computer-equipped by the end of 1965.

NEREM Claims Third Place

The Northeast Electronics Research and Engineering Meeting held at the Commonwealth Armory in Boston from November 17-19, has claimed the title of third largest electronics show in America. More than 75 technical papers were presented by an international collection of engineers and scientists. Exhibitors exceeded 300.

ELECTRONIC SHORTS

▶ The modern technology of electronics has provided the opportunity for a "massive upgrading in the quality of education," according to Pres. John L. Burns of RCA, addressing the National Association of Educational Broadcasters.

▶ An automatic pilot with no moving parts is being developed by the Bendix Aviation Corp. New developments in solid-state electronic circuitry now make it possible to eliminate all electronically actuated mechanical devices between the "input sensors" and or output servos of aircraft flight control systems, according to engineers of the corporation's Eclipse-Pioneer Div.

▶ New instrument requirements for commercial and private pilot certificates have been announced recently by the FAA. All commercial pilots will be required to have a minimum of 10 hours of instrument flight instruction. Private pilots will be required to have dual instruction in the basic control of the aircraft by the use of instruments; demonstrate emergency manual capability in attitude control simulating the loss of visual reference during flight.

▶ Road maps in space are being determined for three of the nation's foremost space agencies by G-E's Missile and Space Vehicle Dept. The Army Ballistic Missile Research Lab wants "a mathematical analysis and computation leading to the development of techniques to determine the orbital parameters of earth satellites using ground-based observational data," the Air Force's Cambridge Research Center, "three-dimensional Lunar and Venusian trajectories for the purpose of predicting future positions of transmitting space vehicles immediately after firing"; and a generalized interplanetary trajectory study for the Air Force's Wright Air Development Center.

▶ A powerful new electronic tube will enable NIKE ZEUS to track oncoming intercontinental ballistic missiles at longer ranges with greater certainty. The tube is one of several types of high-powered klystrons developed by Sperry Gyroscope Co.

▶ Responsibility for the MIDAS, SAMOS, and DISCOVERER programs has been transferred from the Advanced Research Projects Agency to the Department of the Air Force.

▶ Another entry into the silicon rectifier field—the Delco Radio Division. First offerings consist of four models each in two series—rated at 40 and 22 amperes for continuous duty up to ambient temperatures of 150°C. Both series offer a low maximum reverse current of 5.0 ma at maximum rated temperature and peak inverse voltage.

▶ An experimental cockpit panel that integrates all the switching functions for all aircraft radio equipment in high performance aircraft has been developed by Bendix Radio under contract to Wright Air Development Center. The control system is human engineered to enable the pilot to switch his radio equipment without looking at the control panel itself.

▶ The air conditioning system for the Northrop T-38 supersonic jet trainer will be designed and produced by Hamilton Standard. The system is an air cycle type similar to those which have proved so successful on the Lockheed F-104, Convair F-102 and many other high performance aircraft. The temperature control system will be designed and developed by the Electronics Department at Broad Brook.

▶ A thermionic generator, designed to convert the heat of a rocket exhaust directly to electric power to run steering controls of a rocket or guided missile is feasible, according to RCA and the Hunter-Bristol Div. of Thiokol Chemical Corp. The new device, has already produced up to 270 watts of power directly from a high-temperature heat source—an output of nearly 80 watts per pound of its $3\frac{1}{2}$-pound total weight.

▶ The same jet power that's expected to thrust the commercial airlines out of the economic doldrums is having a much less heralded but significant economic impact on the still-young commercial helicopter market, according to a field survey recently completed.

▶ A tiny "hot-box" transistorized amplifier with a power gain of one quarter of a million and a total volume of three cubic inches has been announced by the Special Products Division of Leach Corp. for use in space data recording systems. A thermostatically controlled heating element maintains a stable operating temperature for the transistors and minimizes the effect of variations of ambient temperature.

available from
inventory for
immediate delivery–
silicon transistors with

400 mw POWER DISSIPATION

@25°C
in free
air!

All electrodes completely insulated from the JEDEC-30 package (TO-5)

These Hughes PNP fused junction silicon transistors...which are especially recommended for small signal current gain, DC amplifier and other applications...offer you the following advantages over competitive devices:

• BV_{CBO}, BV_{EBO}, and BV_{CEO} are symmetrical • lower leakage current • controlled gain band • lower saturation resistance • higher operating frequency

You receive still another benefit from these Hughes silicon transistors: proven reliability. Its reliability life tests at maximum operating temperature show a reliability factor of 4 X 10^{-5} or only one failure in 25,000 transistor hours of operating life.

Order today! These Hughes transistors are available from inventory at both the factory and at all Hughes distributors. Just call or write your nearest Hughes Semiconductor Sales office or distributor.

Specifications

Type	BV_{EBO} BV_{CBO} BV_{CEO}	H_{fe}		Max. V_{CE} @ I_C=10ma @ I_B=2ma	Maximum I_{CBO}* and I_{EBO}*	Typ. F α b (MC)
		Min.	Max.			
2N1228	–15V	14	32	–0.2	–0.1μA	1.2
2N1229	–15V	28	65	–0.2	–0.1μA	1.2
2N1230	–35V	14	32	–0.2	–0.1μA	1.2
2N1231	–35V	28	65	–0.2	–0.1μA	1.2
2N1232	–60V	14	32	–0.2	–0.1μA	1.0
2N1233	–60V	28	65	–0.2	–0.1μA	1.0
2N1234	–110V	14	32	–0.2	–0.1μA	0.8

ALSO AVAILABLE WITH 1 WATT POWER DISSIPATION IN COAXIAL PACKAGE

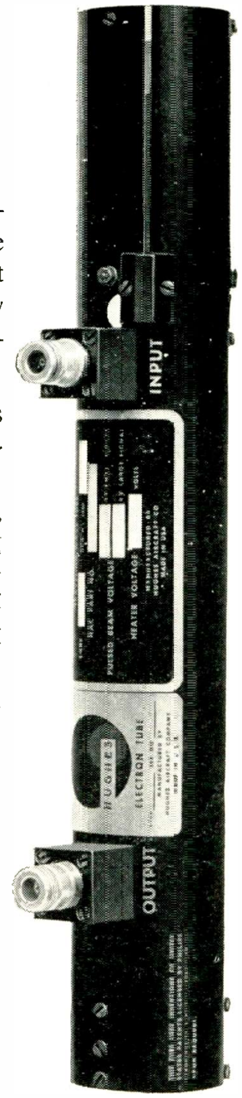
*AT 80% OF MAXIMUM VOLTAGE

SEMICONDUCTOR DIVISION

Creating a new world with ELECTRONICS

HUGHES PRODUCTS

GRIDDED MAS-1 SERIES 1KW S-BAND TWT's NOW AVAILABLE



Hughes Research & Development Laboratories, recognizing the requirement for a *gridded,* S-band traveling-wave amplifier, have developed the periodic, permanent-magnet focused MAS-1E tube. This advanced amplifier is ideally suited for use in today's and tomorrow's more sophisticated electronic systems.

Be sure you get and check the detailed specifications on this new Hughes *gridded* amplifier when your particular microwave application demands:

Periodically focused, pulsed-output power with a rise time in the low millimicrosecond range...high output power with low power input...minimum heat generation...light weight plus compactness...built-in reliability...immediate availability.

For detailed information *on the* MAS-1E *and other Hughes microwave products, write or wire:* HUGHES PRODUCTS, *Electron Tube Division, International Airport Station, Los Angeles 45, California.*

For export information, write: HUGHES INTERNATIONAL, *Culver City, California.*

CHARACTERISTICS
MAS-1E 1KW S-BAND TWT

Power output	1 kw peak, 10 w avg.
Power input	½ w (0.5 mw by cascading)
Frequency range	2.0-4.0 kMc
Saturation gain	33 db
Max. duty cycle	0.01
Beam voltage	7.0 kv
Grid control voltage	−90 v
Grid pulse voltage	+300 v
Weight (tube and magnet)	10 lbs.
Dimensions	15″ long, 3½″ o.d.
Grid capacitance	13 $\mu\mu$f
Environmental	Applicable Mil Specs

ELECTRON TUBE DIVISION

Creating a new world with ELECTRONICS

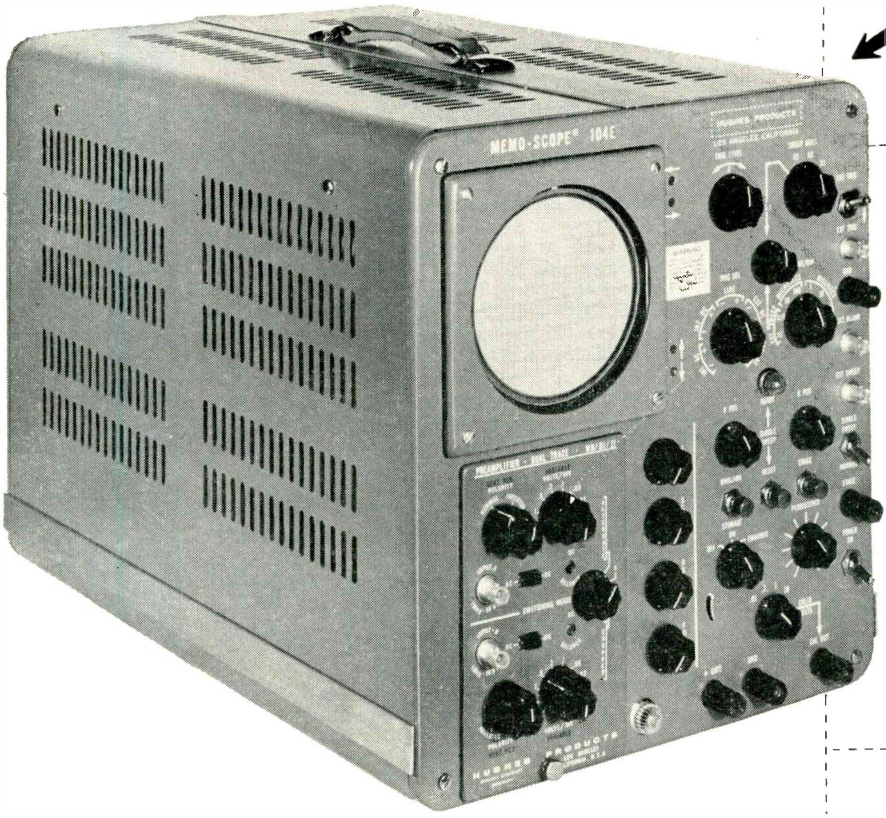
HUGHES PRODUCTS

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

new improved "Memo-Scope®" oscilloscope

Still using "old-fashioned" methods for measuring non-recurring transients? If so, now is the time to investigate the easy way to solve your most difficult transient measurement problems with the latest model Hughes "Memo-Scope" oscilloscope.

Why? Because *new* features, *new* advanced circuitry, *new* panel layout and *new* mechanical design now assure maximum accuracy in all your transient measurements—*plus* higher performance, greater dependability and easier operation!



The Hughes "Memo-Scope" oscilloscope (Model 104E) stores nonrepetitive events for an indefinite period—hours, or days—keeping them available for thorough study until intentionally erased.

new improved features

- Simplified panel layout, redesigned trigger circuit...assure easier operation.
- Advanced mechanical design gives:
  - Better cooling for longer component life.
  - Far greater accessibility for maintenance.
  - Increased ruggedness; resistance to vibration.
- Built-in single-sweep circuit ("1-shot" trigger) at no extra cost.
- Available for either 110 v. or 220 v. operation.

applications

- Data reduction equipment trouble-shooting
- Physical testing: shock, stress, strain
- Ultrasonic flaw detection
- Semiconductor testing
- Ballistics and explosives research ...and many others.

INDUSTRIAL SYSTEMS DIVISION

HUGHES PRODUCTS

For complete information on the new improved Hughes "Memo-Scope" oscilloscope (Model 104E), detailed data sheets and application analysis of your transient measurement problems, write or wire: HUGHES PRODUCTS Industrial Systems Division, International Airport Station, Los Angeles 45, California

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

IN ELECTRONICS . . . AVIONICS . . . ASTRIONICS

STEMCO THERMOSTATS

RANK FIRST
IN
PRECISION TEMPERATURE CONTROL

In today's military and commercial projects, you can't afford to overlook any one of these important areas: Reliability, Size, Availability, Economy.

And because Stevens is in production now on the largest number of different types and styles of bimetal thermostats, all these advantages are yours automatically when you specify Stemco thermostats.

1st in Reliability. Proven designs, latest production techniques, most stringent inspection procedures.

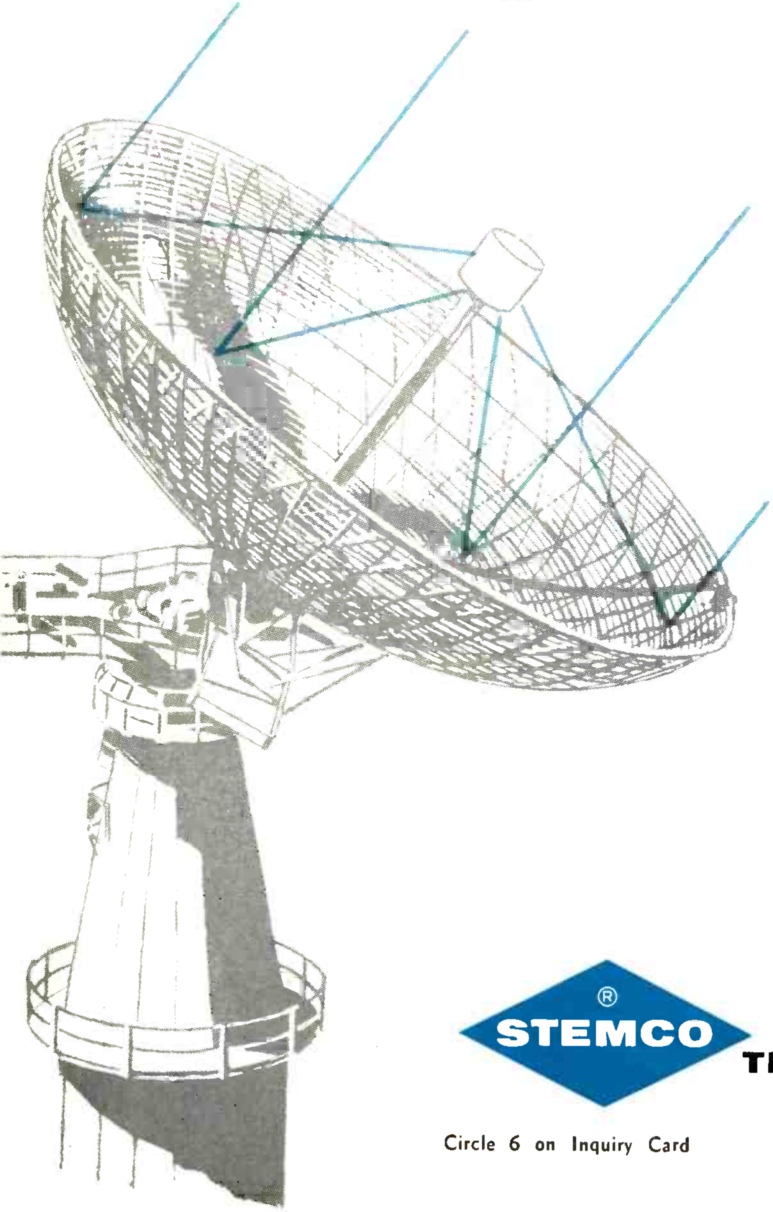
1st in Size. Stemco thermostats score in compactness and lightness without sacrificing performance.

1st in Availability. Tooling for most types is in existence. Flexibility of design cuts lead time on other types.

1st in Economy. Mass production of many standard Stemco types with hundreds of terminal arrangements and mounting brackets cuts your costs.

**Refer to Guide 400EO for U.L. and C.S.A. approved ratings.*

A-891A



TYPE A* semi-enclosed. Bimetal disc type snap action thermostats; give fast response to temperature changes. Can be made to open on rise or close on rise. Single-throw with double make and break contacts. Operation from -20 to 300°F. Lower or higher temperatures on special order. Average non-inductive rating 13.3 amps, 120 VAC; 4 amps, 230 VAC and 28 VDC. Various mountings and terminals available. Bulletin 3000.

TYPE A hermetically sealed. Electrically similar to semi-enclosed Type A. Various mountings, including brackets, available. Bulletin 3000.

TYPE MX hermetically sealed. Snap acting bimetal disc type units to open on temperature rise. 2 to 6°F differentials as standard. 1 to 4°F differentials available on special order. Depending on duty cycle, normal rating 3 amps, 115 VAC and 28 VDC for 250,000 cycles. Various terminals, mountings and brackets available. Bulletin 6100.

TYPE MX semi-enclosed. Construction and rating similar to MX hermetically sealed type. Bulletin 6100.

TYPE M hermetically sealed. Bimetal disc type, snap acting thermostats. Also available in semi-enclosed. Operation from -20 to 300°F. Lower and higher temperatures available on special order. Depending on application, rated non-inductive 10 amps, 120 VAC; 3 amps, 28 VDC. Various terminals, wire leads and brackets available. Bulletin 6000.

TYPE C hermetically sealed. Also semi-enclosed styles. Small, positive acting with electrically independent bimetal strip for operation from -10 to 300°F. Rated at approximately 3 amps, depending on application. Hermetically sealed type can be furnished as double thermostat "alarm" type. Various terminals and mountings. Bulletin 5000.

® STEMCO THERMOSTATS

Circle 6 on Inquiry Card

STEVENS *manufacturing company, inc.*
P.O. Box 1007, Mansfield, Ohio

Coming Events in the electronic industry

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

Jan. 5: Statistical Ideas Useful in Experimentation, Society for Applied Spectroscopy; New Yorker Hotel, N.Y., N.Y.

Jan. 11-13: 6th National Symposium on Reliability & Quality Control, IRE, AIEE, ASQC, EIA; Statler-Hilton Hotel, Washington, D.C.

Jan. 12: Meeting, Association of Electronic Parts & Equipment Manufacturers, Inc.; Chicago, Ill.

Jan. 12: Seminar—Optical Tooling Methods in Manufacturing, ASTE; Phila., Penna.

Jan. 12-16: 16th Annual Technical Conference, Society of Plastics Engineers, Inc.; Conrad Hilton Hotel, Chicago, Ill.

Jan. 13-17: Los Angeles High Fidelity Music Show, Institute of High Fidelity Manufacturers; Pan Pacific Auditorium, Los Angeles, Calif.

Jan. 14-20: 6th Annual Meeting, American Astronautical Society; Statler-Hilton Hotel, New York, N.Y.

Jan. 18-22: 44th Physical Society Exhibition of Scientific Instruments and Apparatus; The Physical Soc. (Brit); London, Eng.

Jan. 19: Monthly Meeting, Radio Club of America; Ben Franklin Hall, New York, N.Y.

Jan. 20: 2nd Conference on Flat Rolled Products, AIME; Del Prodo Hotel, Chicago, Ill.

Jan. 20: Micro-Circuits Symposium—Panel Discussion, IRE; Physical Sciences Bldg., Univ. of Pennsylvania, Phila., Penna.

Jan. 23-26: San Francisco High Fidelity Music Show; Cow Palace, San Francisco, Calif.

Jan. 24-29: Board of Directors Meeting, National Assoc. of Broadcasters; El Mirado Hotel, Palm Springs, Calif.

Jan. 24-29: Western Winter Market, Western Merchandise Mart; San Francisco, Calif.

Jan. 24-Feb. 5: Seminar in Executive Leadership, Univ. of Arizona and Cornell Univ.; Univ. of Ariz., Tucson, Ariz.

Jan. 25-28: Plant Maintenance & Engineering Show; Convention Hall, Philadelphia.

Jan. 25-28: 28th Annual Meeting, Institute of the Aeronautical Sciences; Hotel Astor, New York, N.Y.

Jan. 25-29: Stress Measurement Symposium, Strain Gauge Reading, Arizona State Univ., Arizona.

Jan. 26: Seminar—Numerical Control in Creative Manufacturing, ASTE; Los Angeles, Calif.

Jan. 27-30: Meeting, The American Physical Society; New York, N.Y.

Jan. 28-29: Solid Propellants Conference, American Rocket Society; Princeton Univ., Princeton, N.J.

Jan. 28-29: Seminar—What We Know Today About Metal Cutting, ASTE; San Francisco, Calif.

Jan. 31-Feb. 5: Winter General Meeting, AIEE; Hotel Statler, New York, N.Y.

Feb. 1-4: Instrument-Automation Conference and Exhibit, ISA; Sam Houston Coliseum and Rice Hotel, Houston, Texas.

Feb. 1-4: 2nd Southwest Heating & Air-Conditioning Exposition, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.; Memorial Auditorium, Dallas, Texas.

Feb. 1-5: Committee Week; American Society for Testing Materials; The Sherman Hotel, Chicago, Ill.

Feb. 2: The Handling of Radioactive Samples for Emmission Spectroscopy and Spectroscopic Properties of Photographic Emulsions, Society for Applied Spectroscopy; New Yorker Hotel, New York, N.Y.

Feb. 3-4: 6th Annual Midwest Welding Conference, Armour Research Foundation, American Welding Soc.; Ill. Institute of Technology, Chicago, Ill.

Feb. 3-5: Winter Meeting, IRE (PGMIL); Biltmore Hotel, Los Angeles, Calif.

Feb. 4: Seminar—Automation and Your Production Program, ASTE; Detroit, Mich.

Feb. 5-6: Industrial Management Engineering Conference, Ill. Institute of Tech.; Ill. Institute of Technology, Chicago, Ill.

Feb. 10-12: Solid State Circuits Conference, AIEE, IRE, Univ. of Pennsylvania; Univ. of Penna., Phila., Penna.

Feb. 11-12: Cleveland Electronics Conference, IRE, AIEE, ISA, Cleveland Physics Soc., Case Institute of Tech., Western Reserve Univ.; Engineering and Scientific Center, Cleveland, Ohio.

Feb. 11-12: Winter Meeting, Relay Committee, Pennsylvania Electric Assoc., Bellevue-Stratford Hotel, Phila., Penna.

Feb. 11-13: 1st ERA National Convention, Electronic Representatives Assoc.; Drake Hotel, Chicago, Ill.

Feb. 14-18: Annual Meeting, AIME; Hotels Sheraton-McAlpin and Statler-Hilton, New York, N.Y.

Feb. 16: Monthly Meeting, Radio Club of America; Ben Franklin Hall, New York, N.Y.

Feb. 16: Educational Seminar, Assoc. of Electronic Parts & Equipment Manufacturers, Inc.; Niles, Ill.

Feb. 16-18: 1st National Symposium on Nondestructive Testing of Aircraft and Missile Components, Society for Nondestructive Testing and Southwest Research Inst.; Hilton Hotel, San Antonio, Texas.

Feb. 18-20: Winter Meeting, National Society of Professional Engineers; Broadview Hotel, Wichita, Kansas.

Feb. 18-21: Distributor, Representative, Manufacturer Conference, ERA; El Mirador Hotel, Palm Springs, Calif.

Feb. 19-23: 3rd International Electronic Parts Show, National Federation of French Electronic Industries; Paris, France.

Feb. 20-29: Component Parts and Electronic Tubes International Exhibition; Porte de Versailles, Place Balard, Paris, France.

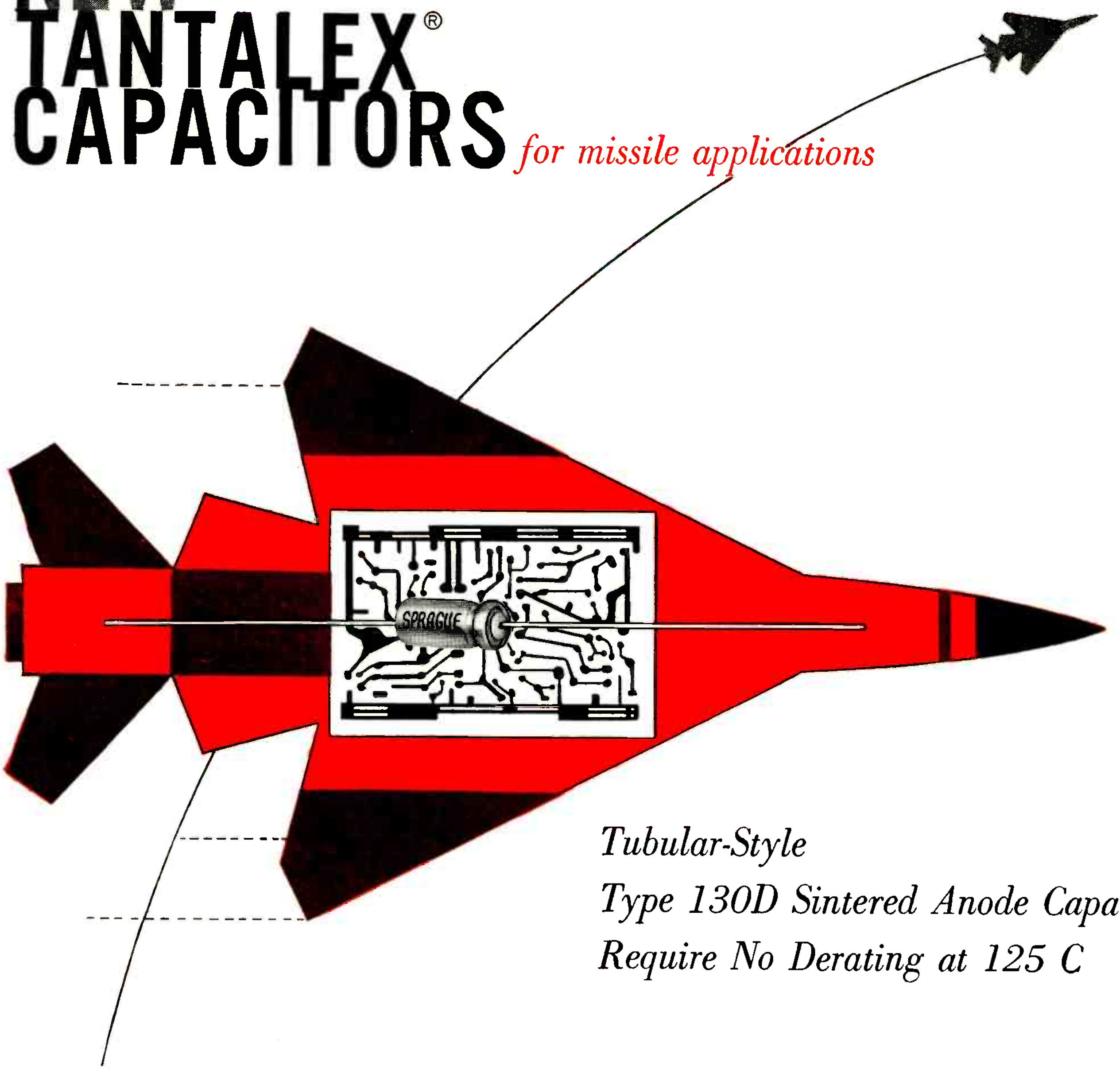
Feb. 24-26: Seminar—Cost Reduction Through Plastic Tooling, ASTE; St. Louis, Missouri.

Feb. 25-26: Scintillation Counter Symposium, IRE, AIEE; Washington, D.C.

Abbreviations

AIEE: American Institute of Electrical Engineers
AIME: American Institute for Metallurgical Engineers
ASME: American Society of Mechanical Engineers
ASQC: American Society for Quality Control
ASTE: American Society of Tool Engineers
EIA: Electronic Industries Association
IRE: Institute of Radio Engineers
ISA: Instrument Society of America

NEW TANTALEX® CAPACITORS *for missile applications*



Tubular-Style
Type 130D Sintered Anode Capacitors
Require No Derating at 125 C

Here is another Sprague first for the military and industrial designer—tubular liquid-electrolyte sintered-anode tantalum capacitors designed specifically for high temperature operation without voltage derating.

● *The remarkable electrical stability* of Type 130D Tantalex Capacitors is the result of (1) special processing for 125 C operation; (2) the chemical inertness of the tantalum oxide film to the specific electrolytes used; and (3) the low diffusion coefficient of Sprague's fully tested and proven TFE-fluorocarbon elastomer seal.

● *The special internal construction* of these capacitors enables them to meet 2000-cycle military missile vibration requirements. Shelf life, too, is excellent.

● *The clean, shoulder-less shape* of Type 130D capacitors simplifies mounting on printed wiring boards. Absence of shoulder permits close stacking of capacitors on printed boards, avoids punching slots in boards or the use of "chairs", and simplifies printed wiring layout.

Get complete specifications on Type 130D Tantalex Capacitors by writing for Bulletin 3701 to Technical Literature Section, Sprague Electric Co., 233 Marshall Street, North Adams, Massachusetts.

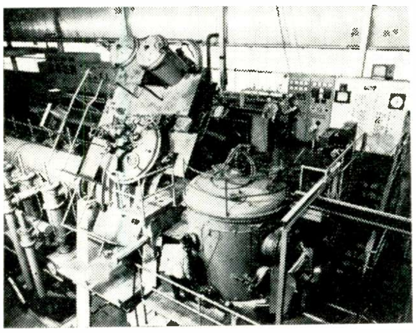
SPRAGUE®
THE MARK OF RELIABILITY

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 . . .

(Continued)

BIGGEST FURNACE



A 5000 lb. high vacuum induction furnace, the only unit of its kind and the world's largest, has been installed by the Metals Div., Kelsey-Hayes, Co., Hartford, N. Y. The entire melting chamber of the furance, designed and built by ASEA, Vasteras, Sweden, tilts to pour. Vacuum is as low as one micron. Ingot size can range from 200 to 5000 lb.

Electro Medical Conference Held

The interaction of non-ionizing radiation with biological matter was the predominant theme of the 12th Annual Conference on Electrical Techniques in Medicine and Biology which was held in Philadelphia, November 10-12, 1959.

As pointed out by Herman P. Schwan, Conference Chairman, "this involves both acoustic and electro magnetic radiation, in the second case extending from radio frequencies to ultraviolet."

It should be pointed out here that these conferences usually concentrate on major themes — usually instrumentational topics for more basic problems. In the past, the former have been usually of primary interest.

Besides those on radiation there was also a cardiovascular session and a general session. The latter always form an important part of the annual conferences in keeping with the tradition of providing a form for presentation of all material in the borderline area between the biomedical and electrophysical fields.

The digest of technical papers, a very sound and informative treatment of those presented at the conference, is priced at $4.00 per copy and may be obtained from H. G. Sparks, the Moore School of Electrical Engineering, University of Pennsylvania, 200 So. 33 Street, Philadelphia 4, Pa. Remittance should be made out to the order of 12th Annual Conference, Electrical Techniques, Medicine and Biology.

New Raytheon System Speeds Parts Delivery

A new concept in distribution which features use of the most modern communications devices, data processing equipment, automatic inventory controls and jet cargo planes was inaugurated by Raytheon Company's Distributor Products Division.

The new Unimarket system provides 24-hr service from factory to distributor, eliminating branch warehouses. Raytheon's 700 distributor customers will be served from one Unicenter, as it is called, in Westwood, Mass.

Newly designed automatic private wire communications equipment by Western Union and fast jet freight shipments by American Airlines have cut order-to-delivery time from an average of seven days to one day. In some instances as much as 13 days have been pared from the time schedule.

Comprehensive cost studies have proved the soundness of the new Unimarket concept wherein the entire nation shrinks to one marketing area. Raytheon will be able to phase out our present components warehouses in Chicago, Los Angeles and Atlanta with resulting savings in building rental costs and overlapping inventories.

The consolidation of these new techniques of communications and full utilization of air freight transportation permits the use of a centralized warehouse with a 100% inventory.

Initially, all 25 district offices of Raytheon's Distributor Products Division will be supplied with Western Union Tel-O-Riginator equipment into which Raytheon's controlled inventory accounting cards can be fed. Ultimately, all major distributors of Raytheon components will use this data transmission equipment in their own offices.

A prepunched Rayci (Raytheon Controlled Inventory) card is inserted in each package of five electron tubes leaving the warehouse. As the merchandise is sold, the distributor collects the cards and places his replacement order without paperwork. He simply sends in the cards which are identified with his account, the type of merchandise and the unit cost.

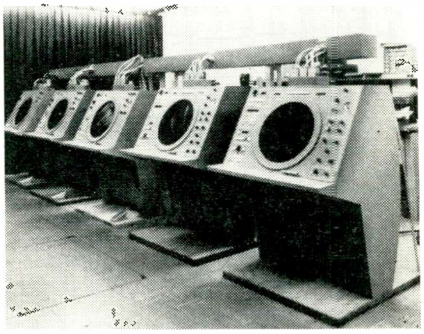
The new Tel-O-Riginators will accept these prepunched cards in the field and instantaneously convert the information into an electronic signal. The transmitted signal duplicates the card at the Westwood division headquarters. There, an invoice and shipping manifest against which the order is filled are automatically prepared.

A typical order of 5,000 various tubes can be received in about 17 minutes, assembled in 90 minutes, and delivered to Boston's Logan Airport in another 45 minutes.

Orders from 3,000 miles away can be delivered routinely within 24 hours, a saving of 13 days in some cases, using the new around-the-clock Unimarket system.

Tactical Data System Delivered To Navy

Delivery of the nation's first Airborne Tactical Data System to the Navy was made by Litton Industries. An electronic early warning and weapon control system was produced under contract with the Air-to-Air Control Branch of the Bureau of Aeronautics.

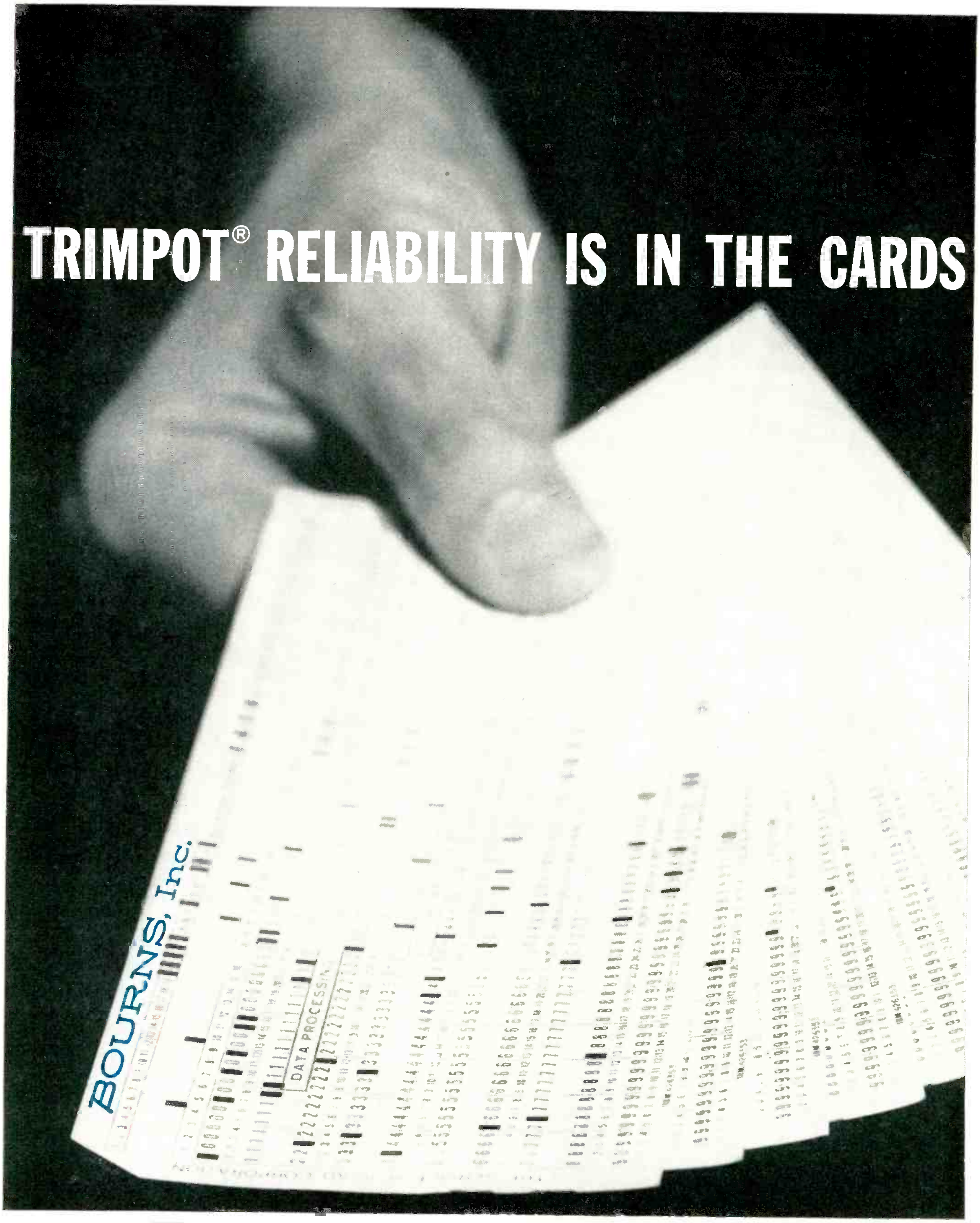


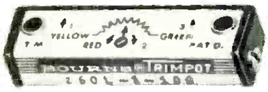
Airborne Tactical Data System consoles are set-up for preshipping tests.

The ATDS comprises digital computers and data processors, information display equipment and communications networks. It was designed to present the process data to a human tactician's senses in forms which will give him immediate understanding and, therefore, the needed time to react with maximum effectiveness. The system was built for installation in land-based aircraft. A smaller, lighter version is under development by Litton for installation in relatively small carrier-based aircraft. Other similar systems are under development for the Marine Corps.

More News on Page 18

TRIMPOT® RELIABILITY IS IN THE CARDS





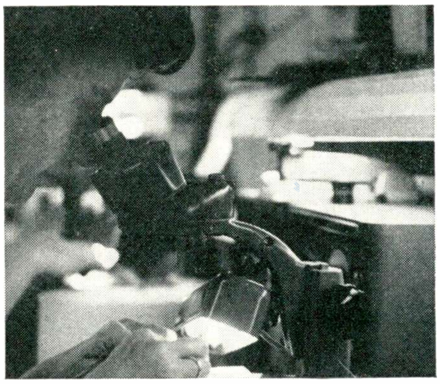
Test information punched in these cards can provide detailed performance reliability statistics on Trimpot production. The cards summarize extensive environmental tests which Bourns regularly conducts above and beyond regular quality control. In Bourns' own Reliability Assurance Laboratory, monthly samples are taken at random from factory stocks and completely tested for conformance to all environmental and electrical specifications on Trimpot catalog sheets. Results can then be fed into IBM computers which analyze performance data with corrective action taken immediately, if required!

This program is the only one of its kind in the industry. Only Trimpot potentiometers are tested so thoroughly, so frequently. In short, Trimpot reliability is a fact—one you can put in your next circuit.

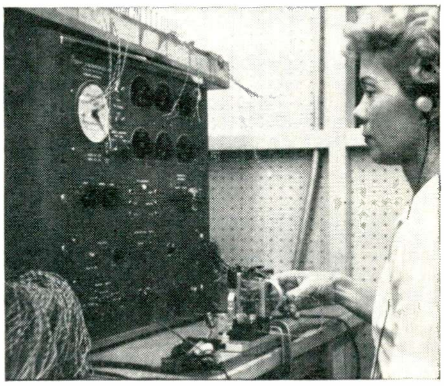
PUNCHED CARDS ARE USED TO TABULATE BOURNS RELIABILITY DATA FROM –

Complete Quality Control Like This...

Trimpot reliability starts at the beginning. Here an incoming lot of potentiometer leadscrews undergoes a dimensional check.

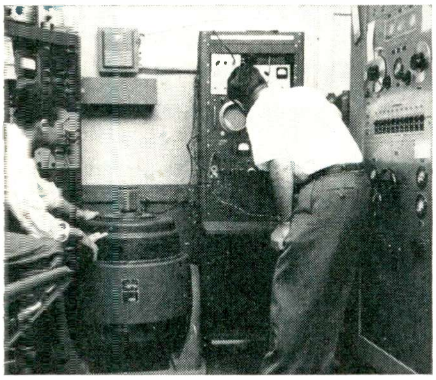


From the time the element is wound until the lid of the potentiometer is installed, in-process inspection monitors quality.

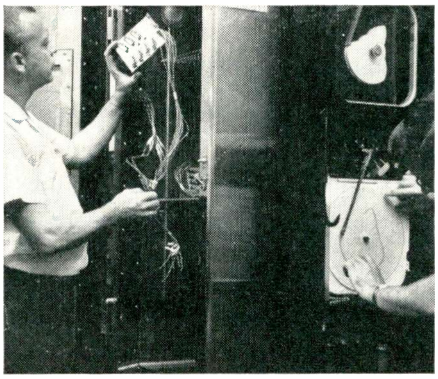


100% final inspection is made possible by this exclusive high-speed system developed by Bourns to test all major electrical characteristics. Critical dimensions of each unit are also checked.

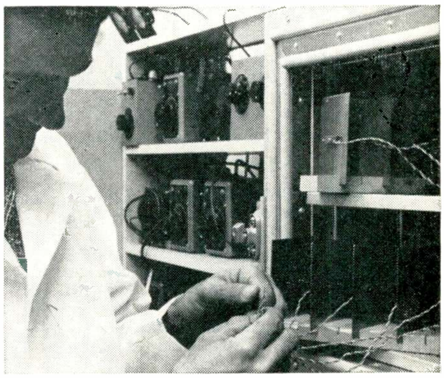
And Reliability Assurance Tests Like These...



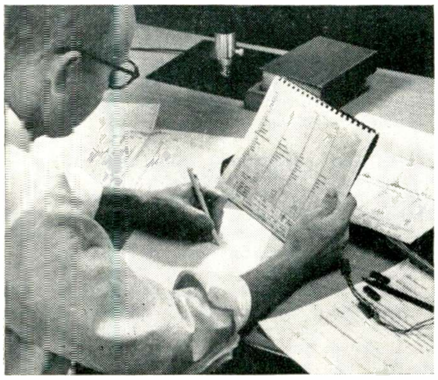
This vibrator for measuring conformance to Mil-Specs is an important part of the extensive equipment in Bourns Reliability Assurance Laboratory.



This chamber subjects potentiometers to standard military tests for humidity, provides important feedback on product performance.



1000-hour load life testing per Mil-R-19A takes place in ovens like this, which hold temperatures at desired levels at full rated power.



When tests are completed and the results tabulated, Bourns engineers plot frequency distribution curves from the steady flow of test results. Analysis of these curves and other data from testing provides a continuing check on all models to see that they meet the most exacting standards of performance. This analysis and the constant flow of information between the Testing and Production departments is your assurance that the Trimpot potentiometers you specify and purchase will meet specifications.

Write for the new 8-page folder describing the Bourns Reliability Assurance Program and a copy of the Trimpot Summary Brochure.

BOURNS
Inc.

P.O. Box 2112R, Riverside, Calif.
Plants: Riverside, California
and Ames, Iowa

Exclusive manufacturers of TRIMPOT®, TRIMIT®. Pioneers in potentiometer transducers for position, pressure and acceleration.

Circle 8 on Inquiry Card

Electronic Industries' News Briefs

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

EAST

MINNEAPOLIS-HONEYWELL REGULATOR CO., Semiconductor Div., will build a $1 million research and development center on a 15-acre tract in Riviera Beach, Fla. It will be one-story and contain 40,000 sq. ft.

POLARAD ELECTRONICS CORP. has won a contract for about $300,000 from the Western Development Labs. of Philco Corp. Contract is for special microwave receivers which have extremely precise calibration.

GENERAL ELECTRIC CO., Missile and Space Vehicle Dept., has started construction of a $14 million center devoted to space technology research and development. The center will be located on a 130-acre site, 17 miles west of Philadelphia near Valley Forge State Park.

STROMBERG-CARLSON, Div. of General Dynamics Corp., has received a $1.2 million contract for the design and development of an advanced, completely transistorized single sideband communication system. Contract was awarded by the U. S. Navy Bureau of Ships.

FAIRCHILD CAMERA & INSTRUMENT CORP. has exercised its option to acquire all of the common stock of Fairchild Semiconductor Corp., Mountain View, Calif. Fairchild Semiconductor will become a wholly-owned subsidiary.

REPUBLIC AVIATION CORP. has been awarded a U. S. Air Force contract for $2,185,000. Contract is for special kits to modify the communication systems of F-84F and RF-84F aircraft and for spare parts.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP., Federal Div., has received a $3.4 million contract for the production of Lacrosse missile guidance units. Award was made by The Martin Co., prime contractor.

THE BURROUGHS CORP. was awarded the Airborne Long Range Inputs contract (ALRI). Award was made by the Air Materiel Command, Wright-Patterson Air Force Base, Ohio. Most of the work under the $35 million contract will be done in the Philadelphia area. The ALRI is a radar station housed in an RC-121 D reconnaissance aircraft to provide a seaward extension of SAGE.

RADIO CORP. OF AMERICA, announced plans to construct a new plant for industrial electronic products in the Washington-Canonsburg, Pa. area.

CLEVITE TRANSISTOR PRODUCTS, Div. of Clevite Corp., has awarded the contract for construction of a new plant in Waltham, Mass. The expansion program will cost $4.1 million.

GENERAL PRECISION EQUIPMENT CORP. has formed a new electronics company known as General Precision, Inc. To form this company they consolidated four principal subsidiaries which are: General Precision Laboratory, Inc.; Kearfott Co., Inc.; Librascope, Inc.; and Link Aviation, Inc. Each of these four companies will become a division of the new operating company.

FORD INSTRUMENT CO., Div. of Sperry Rand Corp., was awarded a U. S. Air Force contract for $1 million. Under the contract they will build and test an experimental model of a radically new airborne inertial navigation system, designated the AJN-7. It will be a no-gimbal or "platformless" system.

LABORATORY FOR ELECTRONICS, INC., has been awarded a $20 million Air Force contract for the production of AN/APN-131 airborne navigation gear. It is being built for installation in the Republic F-105D Thunderchief.

RAYTHEON CO. has announced price reductions on 23 different types of transistors The new prices are 5 to 35% lower than previously.

AEROJET-GENERAL CORP., The Atlantic Div., has dedicated a new $150,000 laboratory and office building in Frederick, Md. This division is actively engaged in the fields of automation, underwater acoustics and airborne instrumentation.

NATIONAL CO., INC., was awarded a contract increase of approximately $2 million. The award, made by the U. S. Navy, Bureau of Ships, is for an additional quantity of ultra stable radio receivers designated as AN/WRR-2.

POTTER INSTRUMENT CO., INC., was awarded a production contract of $202,980 by the Autonetics Div. of the North American Aviation Co. Contract is for punched tape reading equipment to be used in the Air Force's Minuteman Intercontinental Ballistic Missile Program.

PHILCO CORP., Government & Industrial Div., has been awarded a $6,627,092 contract by the U. S. Air Force. Contract is for engineering, furnishing and installing equipment for the "Quick-Fix" phase of AIRCOM.

MID-WEST

AMERICAN MACHINE & FOUNDRY CO.'s Mechanics Research Div. has leased a newly-built 30,000 sq. ft. laboratory building in Niles, Ill. The Division was formerly in Chicago.

THE HICKOK ELECTRICAL INSTRUMENT CO. has broken ground for a 25,000 sq. ft. addition to their Greenwood, Mississippi, plant.

C. P. CLARE & CO., a wholly-owned subsidiary of Universal Controls, Inc., have occupied a new building adjoining their Chicago plant.

GENERAL MOTORS CORP. formed a new activity known as the Defense Systems Div. It will be composed mainly of scientific and engineering personnel. They will be engaged in research and experimentation aimed toward the design and development of weapons systems and related activities.

CROSLEY, Div. of Avco Corp., has received contracts totaling $950,000 for bomber fire control system spare parts. Contracts were awarded by the Warner Robins Air Materiel area of Robins Air Force Base, Ga.

FILTRON CO., INC., has opened a central regional field service office in Dayton, Ohio. They will specialize in radio-frequency interference engineering services in the area.

INDUSTRIAL PATENT RESEARCH CO., Columbus, Ohio, is offering a service especially tailored for management and research and development staffs. The service entails reduction of technical patents to easily understood digests of basic principles. These short summaries of patents, free from legal terminology and redundant detail, can be scanned and understood in a few minutes by scientific personnel.

WEST

TELECOMPUTING CORP. has purchased Monrovia Aviation Corp., which was a wholly-owned subsidiary of Carrier Corp.

GENERAL CONTROLS CO., Electronic Controls Div., has moved into their new $2 million, 70,000 sq. ft. building in Glendale, Calif.

BENDIX AVIATION CORP., Pacific Div., has received a subcontract for research and development work on the Minuteman international ballistic missile weapon systems. Contract was awarded by the Boeing Airplane Co.

HEWLETT-PACKARD CO. has announced plans to establish a manufacturing and research and development facility in Loveland, Colo. They expect construction of the first building to begin early this year.

LIBRASCOPE, INC., has received a $1.8 million contract to produce space guidance computers for Centaur, a space probe missile planned by the National Aeronautics and Space Administration. The contract was awarded by Minneapolis-Honeywell, who will develop the inertial guidance system for Convair Astronautics Div. of General Dnyamics, prime contractor on Centaur.

AMERICAN AVIONICS, INC., has acquired new, large plant facilities in West Los Angeles. The new plant facilities consolidates their operations.

FLITE-TRONICS, INC., Burbank, Calif., has received a contract from Hughes Products Div. of Hughes Aircraft Corp., for the design and manufacture of laboratory test equipment. The contract is valued at $400,000.

BECKMAN INSTRUMENTS, INC., has acquired the assets of Harold Kruger Instruments, San Gabriel, Calif., and Tool-Lab, Inc., of Escondido, Calif.

COORS PORCELAIN CO., Golden, Colo., has opened a new facility for production of dense ceramic parts from beryllium oxide compositions.

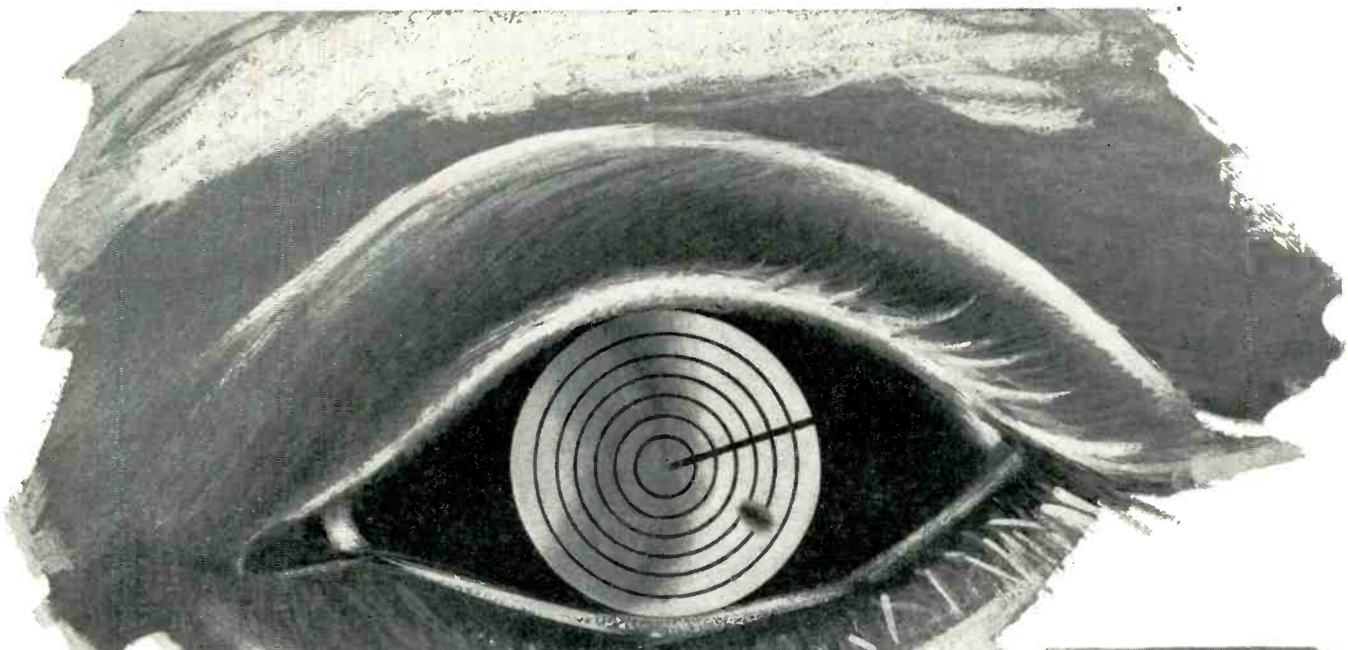
TEXAS INSTRUMENTS, INCORPORATED, has developed the first all solid-state, 440-MC beacon transponder system for long range missile and space vehicle tracking. One unit installed in a Thor-Able missile responsed from 1300 miles in space. Distances much greater than 1300 miles are possible.

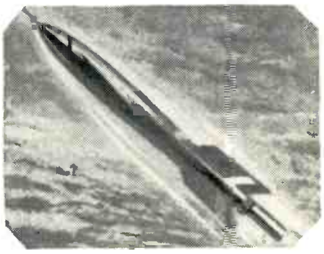
EBEX TECHNICAL INSTITUTE, INC., Orem, Utah, now has an industrial training course in analog computers for technicians, engineers and management. It is conducted entirely by correspondence with a certificate of completion issued for successfully taking the course.

LEACH CORP. has purchased the Electronics Division of Pendar, Inc. This division manufactures static switching, timing and annunciating devices.

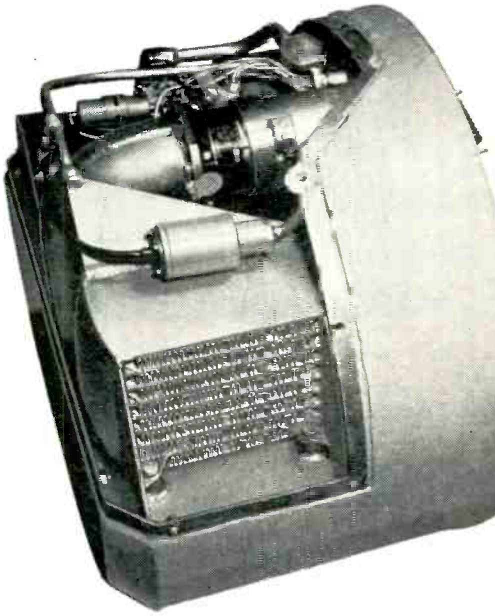
HUGHES AIRCRAFT COMPANY has announced the custom designing of microwave maser amplifiers for advanced systems applications. Recent advances in the maser field have climaxed four years of basic and applied research into quantum physical techniques.

SMITH-FLORENCE, INC., is the name of a new firm located in the Commodore Industrial Park, Seattle, Wash. The new firm will specialize in the manufacture of precision industrial and laboratory electronic test instruments for the military and commercial markets.





When a PIP becomes a PICTURE *UAP* cools the TV tube!



A new radar tracking system, developed by Sperry Gyroscope, will pick up and track an object at a considerable distance. When the object comes within equipment range, a television camera, developed by Du Mont Laboratories, can pick up the target and show visually its identity.

Cooling and temperature control for the TV Vidicon tube and associated electronic components was assigned to a UAP mechanical refrigeration system. Components are an aluminum plate type condenser and evaporator, semi-hermetically sealed 400 cycle compressor, blower, controls and chassis. The envelope is 14″ dia. x 10″ long, with half the diameter reserved for the tube circuit. Capacity of the 26-pound package is 275 watts at a maximum ambient of 149° F. The UAP system was designed for shipboard application and to meet necessary MIL environmental requirements.

The pip-to-picture story demonstrates but one of UAP's many capabilities in electronic cooling. Other achievements involve liquid cooling systems, expendable refrigerant systems, and gas-to-gas heat exchanger systems. Get complete information on any of these . . . or submit your application problem today for UAP design study!

Call or write contractual engineering:

CALIFORNIA.................1101 Chestnut St., Burbank, VI 9-5856
NEW YORK..................50 E. 42nd St., New York 17, MU 7-1283
OHIO.....................1116 Bolander Ave., Dayton, BA 4-3841
CANADA.............United Aircraft Products, Ltd., 147 Hymus Blvd., Pointe Claire, P.Q., Phone Montreal: OX 7-0810

UAP
UNITED AIRCRAFT PRODUCTS, INC. ®

a famous family of aircraft essentials since 1929

UNITED AIRCRAFT PRODUCTS, INC.

1116 BOLANDER AVENUE, DAYTON, OHIO

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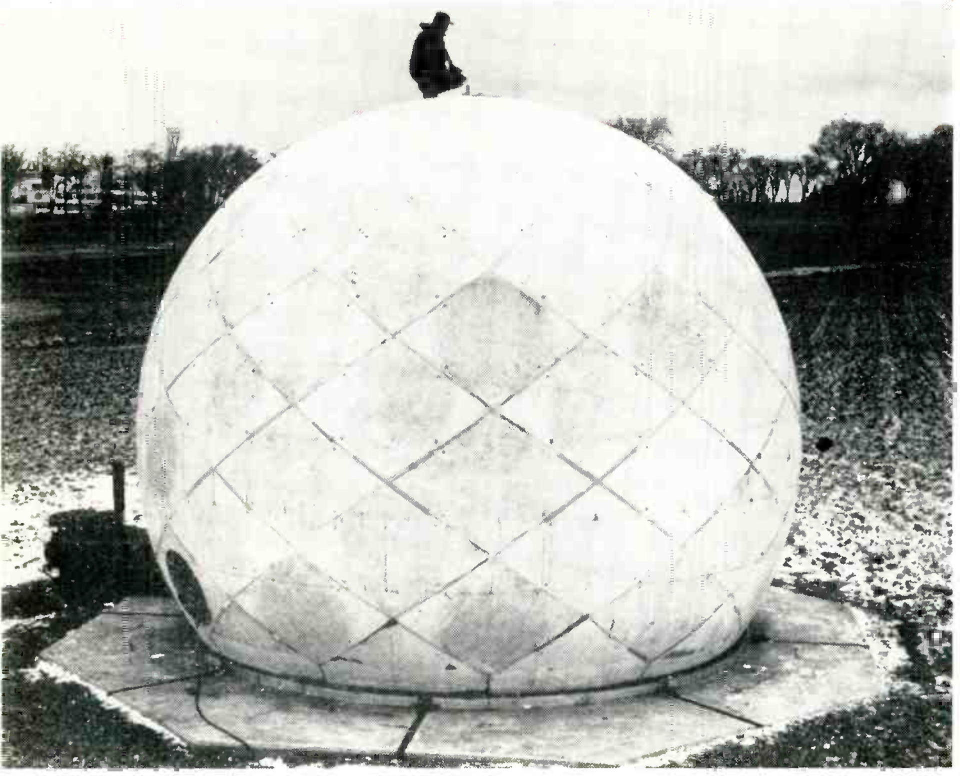


FOAM RADOME

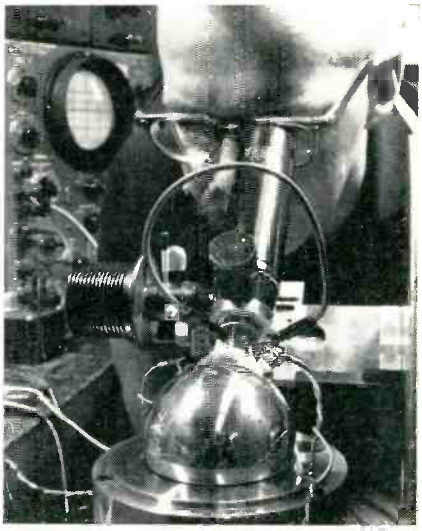
World's first polyurethane foam radome, erected at Ottawa, Ont., by Canada's National Research Council, is constructed entirely of foam, even to the joints. With an equatorial diameter of 26½ ft., it consists of 115 rigid premolded fire resistant panels of foamed resin.

DENTAL PROBE

New TV probe, consisting of fingertip-size lens system and a small bundle of 3 ft. long glass fibers leading to CCTV camera, projects magnified view of teeth onto monitor. Device is being developed by Avco Corp.

SPACE BALL

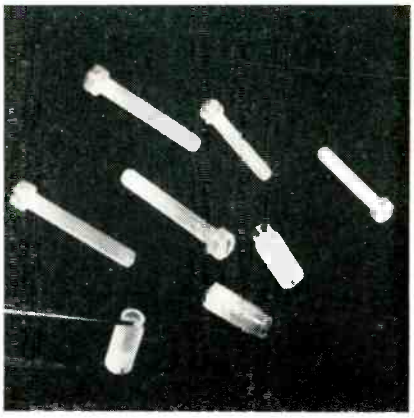
This shiny ball is the heart of a new gyroscope for space vehicles being developed at Minneapolis-Honeywell. It is designed to spin at high speeds while held in position, in a vacuum, by electrical forces.



Snapshots . . . of the Electronic Industries

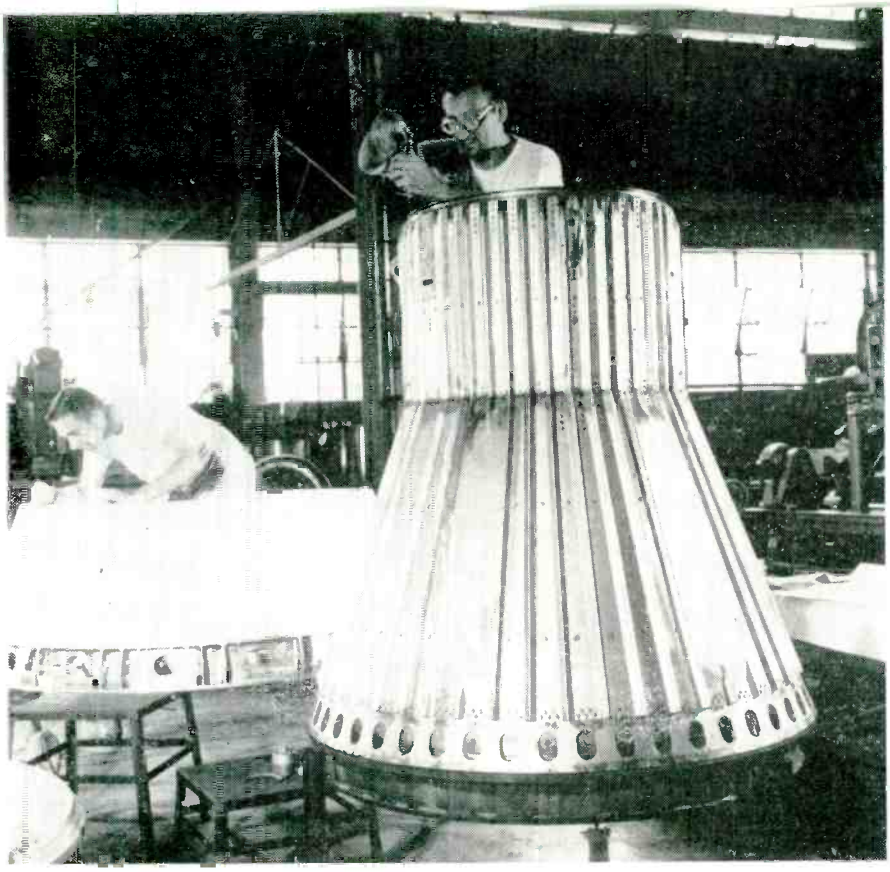
MOLDED NYLON FASTENERS

Precision nylon screws, sizes #0-80, #1-72, and #4-90, made by Gries Reproducer Corp., provided with a jewel socket, are ideal for use in meters and wherever precise adjustments are needed. Other sizes also available.



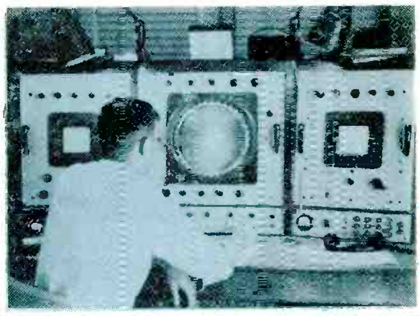
RESERVATIONS READOUT

A new reservations system — SABRE — developed by IBM for American Airlines will link 61 cities with central computer in New York. By pushing a few buttons, agents get instant answers on flights and complete passenger data.



LITTLE JOE'S SHIELD

The heat resistant shield for the Little Joe capsule is made from fiberglass-reinforced Hetron 72, a heat-retardant resin produced by the Durez Plastic Div., Hooker Chemical Corp.



WEATHER RADAR

Control console is nerve center for new storm-finding radar at Miami, Fla., Weather Bureau. Antenna system supplied by I-T-E Circuit Breaker Co. Range is 250 miles.

PRODUCTION MILESTONE

The 20-millionth picture tube to come off the production line at Sylvania Electronic Tubes was a safety panel bonded to face plate—23-inch, aluminized, "bonded shield" model. This features the safety panel bonded to the face plate.

SOUND TESTING LABORATORY

Noise output of a blower in a commercial space heater is being measured in this semi-anechoic chamber of Torrington Mfg. Co.'s new Sound Laboratory in Torrington, Conn. Sound reflection is minimized by the 600 glass-fiber wedges on three walls and the ceiling.

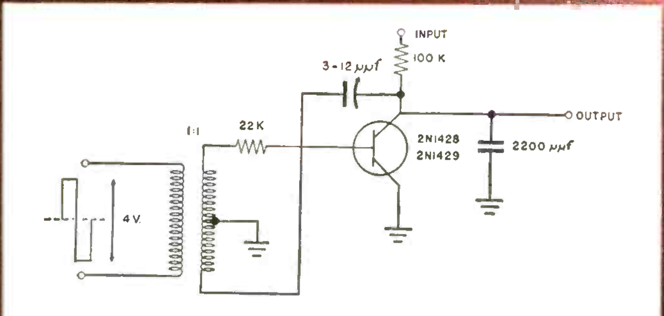
PHILCO ANNOUNCES...

HIGHER FREQUENCY...HIGHER BETA

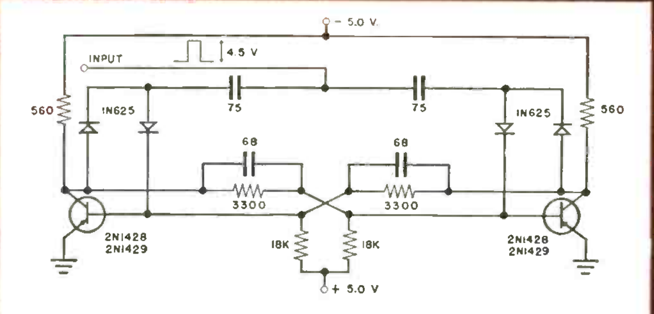
with Extremely Low I_{CO} in 2 New SILICON TRANSISTORS

SAT* 2N1428 . . . 2N1429

Stable at Temperatures up to 140° C



LOW LEVEL (<1MV) CHOPPER



1 MC BINARY STAGE (−55°C TO +125°C)

These two new Philco PNP Silicon Surface Alloy Transistors are designed for general purpose high frequency amplifying and switching applications. They offer extremely low saturation resistance (approaching that of germanium transistors) . . . high f_T . . . low leakage current . . . good inverse Beta . . . low offset voltage . . . and excellent frequency response. The combination of high Beta and low I_{CO} makes these transistors excellent for use in DC amplifiers, low level choppers and other critical control circuits. They are suitable for:

. . . high speed switches, operating at speeds up to 5 mc.
. . . general purpose high frequency amplifiers.
. . . DC amplifiers.
. . . high input impedance low frequency amplifiers and choppers.

These two transistors are electrical equivalents, but offer a choice of packages . . . the popular small TO-1 package and the standard TO-5 package. Designers of industrial control and test equipment will find that they deliver excellent performance at high ambient temperatures. **Write Dept. EI - 160 for complete information and application data.**

*SAT . . . trademark PHILCO Corporation for Surface Alloy Transistor

Absolute Maximum Ratings

Storage Temperature	—65 to +140° C
Junction Temperature	+140° C
Collector to Base Voltage, V_{CB}	—6 volts
Collector to Emitter Voltage, V_{CEO}	—6 volts
Collector Current, I_C	—50 ma
Total Device Dissipation at 25° C (Note 2)	100 mw

Immediately Available in Production Quantities . . . and from 1 to 99 from your local Philco Industrial Semiconductor Distributor.

PHILCO®

LANSDALE DIVISION • LANSDALE, PENNSYLVANIA

TRANSISTOR CENTER U.S.A.®

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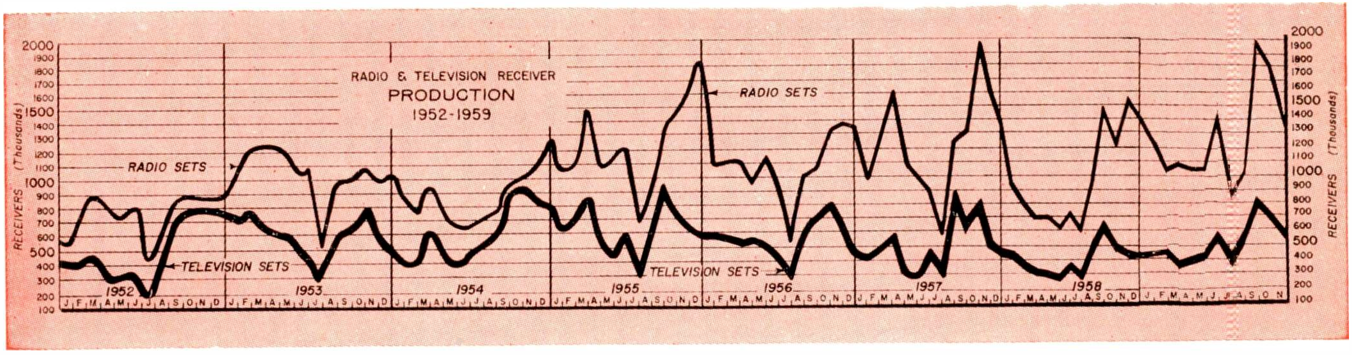
Facts and Figures Round-up
January, 1960

ELECTRONIC INDUSTRIES TOTALS



ELECTRON TUBES

(Estimated Shipments in Millions of Dollars[1])

	1954	1955	1956	1957	1958
POWER & SPECIAL PURPOSE TUBES, TOTAL	152	148	161	185	214
High vacuum tubes	30	31	37	37	39
Gas and vapor tubes	18	17	17	17	18
Klystrons	14	16	21	25	29
Magnetrons	51	42	42	44	50
Forward and backward wave tubes	—	1	2	6	17
Duplexers	7	6	5	6	7
UHF Planar (lighthouse)	6	6	7	13	13
Cathode ray light emitting, storage and camera tubes, excluding TV picture tubes	15	17	19	23	25
Miscellaneous[2]	11	12	11	14	16
RECEIVING TUBES, TOTAL	300	380	390	400	355
TV PICTURE TUBES, TOTAL	239	237	240	231	217
TOTAL, ALL TUBES	691	765	791	816	786

[1] Includes intra-plant and inter-plant transfers.

[2] Includes photo tubes; photo cells; radiation detection tubes; spark gaps; beam deflection tubes; decade counters; electronic switches; mechanical transducers; orbital beam tubes; and vacuum capacitors, switches, and gauges. Excludes X-ray tubes.

—*Electronics Division, Business and Defense Services Administration U. S. Department of Commerce*

ELECTRONICS OUTPUT IN SPECIFIED YEARS, 1914-1959 [1]

(Value in millions of dollars)

Year	Home-type radio and television receivers, and related products [2]	All other electronic equipment except tubes and components	Electron tubes	Semiconductor devices [3]	Electronic components other than tubes and semiconductors
1959	1,700 e	4,000 e	900 e	300 e	1,600 e
1958	1,350	3,250	790	210	1,340
1957	1,500	3,100	820	150	1,450
1956	1,470	2,800	790	90	1,360
1955	1,500	2,500	770	40	1,360
1954	1,420	2,470	690	25	1,275
1953	1,593	2,503	734	25	1,445
1952	1,340	2,330	690	20	1,110
1951	1,296	843	473		788
1950	1,687	473	443		697
1947	810	469	122		349
1939	186	40	39		75
1937	182	54	43		71
1935	135	31	32		42
1933	73	14	27		21
1931	125	30	29		36
1929	275 [4]	8	82		100

e—Estimate

[1] Data cover manufacturers' shipments in 1947 and later years, and production in 1939 and earlier years. The totals represent the factory value of production or shipments (output) of electronic products, whether incorporated in other products or used in maintenance and repair of end equipment.

[2] Does not include payments on research and development contracts.

[3] Data for years prior to 1952 are included in "Electronic components other than tubes and semiconductors."

[4] Includes all radio receivers, commercial as well as home-type.

Electronics Division, Business and Defense Services Administration,
U. S. Department of Commerce, August 11, 1959

SALES OF HIGH FIDELITY COMPONENTS

Market Potential: Conservative estimate—about $750,000,000.

Industry Sales Dollar Volume.
1957—$200,000,000
1958— 260,000,000
1959— 300,000,000 (estimated)

These figures refer only to the component market, not package goods, and are quoted at full retail prices.

Source—Institute of High Fidelity Manufacturers, Inc.

DISTRIBUTOR SALES

Percent of Sales by Product Line in '59

Tubes	
Receiving	29.5
Picture	12.4
Industrial	4.3
Total	46.2
Parts	
Capacitors	3.9
Coils	1.2
Controls	1.9
Resistors	2.1
Speakers	2.1
Transformers	4.1
Connectors, Relays, etc.	7.4
Total	22.7
Accessories	
Antennas	6.1
Hardware	4.9
Books, etc.	1.2
Total	12.2
Other	
Batteries	4.0
Test Equipment	2.3
Magnetic Tape	1.2
Hi-Fi, Radio, Phono, etc.	9.9
Total	17.4

Source—National Electronic Distributors Assoc.

Summary of December's Govt. Contract Awards, which would normally be published this month in EI, will appear in the February issue.

More Statistics on Page 92

EI's International News

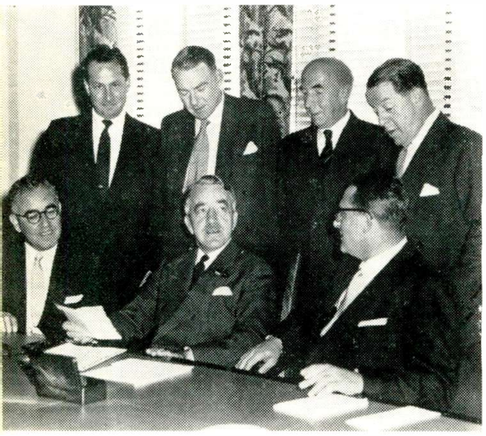
SOUTH AMERICA

Visit Electronics Plant

A group of Brazilian government and press officials, headed by Dr. Geraldo Starling Soares, Minister of Brazil's high labor court, visited the Jersey City, N. J., plant of Emerson Radio and Phonograph Corp. The delegation inspected the TV chassis and cabinet assembly lines and observed the production operation of the Emerson 911 Eldorado, a 9-transistor pocket radio. Also inspected were the printed circuit and automation installations.

Included in the party were Dr. Joao Nogueira, Dr. Saldanha Dezi, Dr. Milton Brandao, and Mr. Canor Simoes Coelho. Stanley Roberts, Schlesses Corp., and Joseph Kattan, Vice President of Emerson Radio Export Corp., acted as guides and interpreters.

JOINT UK-US FIRM



Representatives of Burndy Corp., Norwalk, Conn., and BICC, England, sign contract in London forming the new firm BICC-Burndy, Ltd. in London. Stanley Loomis, Burndy VP (finance), is at the left standing. Seated are (l to r) Sidney Wolberg, Burndy VP (overseas operation) and W. H. McFadzean and R. M. Fairchild, BICC executives.

EUROPE

New Belgium Plant

Burndy Electra S. A., European subsidiary of Burndy Corp., Norwalk, Conn., is building a new electrical connector plant in Malines, Belgium. The plant will serve customers in the Common Market nations. Offices served will include: Antwerp, Zurich, Cologne, Rotterdam, Stockholm, Oslo, Copenhagen, Hamburg, Berlin, Karlsruhe, Nurnberg, Milan and Turin.

Form Swiss Corporation

General Controls Co., Los Angeles, has formed a new Swiss subsidiary, General Controls Societe Anonyme (S. A.) at Firbourg, Switzerland. The new subsidiary will handle all international operations (except North America) for the company, which manufactures automatic controls for military, commercial, and industrial operations.

Howard Railey, Paris, France, has been chosen director and officer of General Controls, S.A. Remy H. Ludwig is director of the international division. The company also has British and German subsidiaries.

Buy Air Navigation Units

The Royal Swedish Air Board has bought aviation communication and navigation equipment from Bendix Radio Div., Bendix Aviation Corp. The equipment, "Advanced Design" 21 series, includes an automatic directional system and four other major devices. It will be installed in the Royal Swedish Air Force fleet of Pembrokes and other aircraft.

The fully airborne direction finder provides both visual and aural navigation aid facilities. The other devices include an ultra-high-frequency glide slope receiver for instrument landing system operation, a transistorized very-high-frequency receiver for communications, a radio unit to receive signals on both on course and for landing approaches, a transistorized airborne navigation unit to provide manual visual-omni-range and localizer course information.

UNITED KINGDOM

Expand Facilities

A. Kearfott Co., Inc., licensee, Ferranti Ltd. has added 17,400 sq. ft. to

(*Continued on Page 26*)

U.S.S.R.

Russian Power Experts Tour U.S.

A team of twelve power specialists from the Soviet Union are touring electric power systems and equipment manufacturing plants in the U. S. The Russians are guests of the Edison Electric Institute and the Association of Edison Illuminating Companies. They will visit conventional steam and hydroelectric facilities, the nuclear project of the Yankee Atomic Electric Company at Rowe, Mass., the Enrico Fermi Atomic Plant at Monroe, Mich., and plants manufacturing heavy electrical equipment in Schenectady, Pittsburgh, and Milwaukee. Ten U. S. electrical industry executives recently visited Siberia, the Urals, Armenia and European Russia.

K. D. Lavrenenko, First Deputy Minister of Electric Power Station Construction heads the Russian team. Others in the group are: A. Alekseev, Dir., Institute of Thermal Electric Projects; V. S. Belousov, Dir., Cherepet Thermal Electric Power Station; S. E. Berezin, Ch. Engr., Kharkov Turbine Plant; G. S. Bolshakov, Ch. Engr., State Science and Technical Committee; G. I. Ermakov, Ch. Engr., Dept. of Construction of Electric Power Stations; N. P. Galochkin, Ch. Engr., Foreign Dept., Ministry of Power Station Construction; D. G. Kotelevsky, Ch. Engr., USSR Planning Commission; K. F. Potekhin, Ch. Engr., Novosibirsk Turbine Plant; V. G. Pribytkov Interpreter, N. V. Shchukin, Dir., Ural Electric Apparatus Plant; and N. Y. Turchin, Ch. Engr., Electrical Dept., Ministry of Power Station Construction.

JAPANESE REP?

Bud Minnick, Promotion Manager, Instrument Soc. of America, tells Susan Yamatsu that the ISA's automation and instrument exhibition in Chicago drew over 20,000 visitors. They came from the U. S., Russia, Japan, Germany, Italy, Czechoslovakia, England, France, Switzerland, Belgium, Sweden, and Latin America. She represented Toshiba, a large Japanese electronics firm.

TOBE
SURE

Specify the Finest Digital Voltmeter Made

NLS SERIES 20

WHEN THE COMBINATION OF RELIABILITY, SPEED AND ACCURACY is of uncompromising importance — you can't afford to gamble on "second best" digital measuring equipment! NLS Series 20 instruments are field-proven in the most critical applications — missile and electronic systems checkout, automatic process monitoring, sophisticated laboratory research. Be sure — specify NLS Series 20, the instruments selected by major missile manufacturers after thousands of hours of competitive life testing.

Features: M24 measures DC voltage, voltage ratio or resistance in a third of a second, V24 measures DC voltage and voltage ratio at same speed . . . both instruments feature advanced transistorized circuitry and mercury-wetted relays with life in excess of 3 billion readings . . . ±one digit accuracy on DC voltage and voltage ratio . . . completely automatic operation . . . plug-in modular construction . . . AC or low level measurements with plug-in accessories . . . output connectors for continuous data logging. Ranges: DC voltage ±.0001 to ±999.9; DC voltage ratio to ±.9999; resistance .1 ohm to 1 megohm. M24, complete: $5,650.00. V24, complete: $4,950.00. Write today for complete data.

Originator of the Digital Voltmeter
non-linear systems, inc.
DEL MAR (SAN DIEGO), CALIFORNIA

NLS — The Digital Voltmeter That Works . . . And Works . . . And Works!

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OFF THE SHELF DELIVERY
FROM STOCK!
delivered in 24 hours

SILICON RECTIFIER
Power Supply

Circuitry Primary 105/115/125 Volts**.
Hermetic sealed to MIL-T-27A
See Catalog for additional information.

Part Number	Secondary A.C. Volts	Rectifier Circuit R.M.S. Amperes	C.T.** Full Wave	F.W.** Bridge
M8018*	18.5 C.T.	1	7 V.	14 V.
M8019*	18.5 C.T.	3	7	14
M8020*	35 C.T.	3	14.5	29
M8021*	70 C.T.	1	30	60
M8022†	18.5 C.T.	3	7	14
M8023†	35 C.T.	3	14.5	29
M8024†	70 C.T.	1	30	60

*380-1600 Cy.
+50-60 Cy.
**DC output volts stated are for resistive or inductive loads. Capacitor imput may be used if RMS AMPS is not exceeded.

ULTRA MINIATURE TRANSISTOR

Open-frame (-F)* Wt. .08 oz. size ⅜" x ⅜" x ¹¹⁄₃₂"
Molded (-M)* Wt. .14 oz. size ½" x ½" dia.
Nylon Bobbin, Nickel-Alloy Core.

NEW

Part Number	Application	Primary Impedance (D. C.)	Secondary Impedance
UM 21*	Input	100,000	1,000
UM 22*	Driver	20,000	1,000
UM 23*	Driver	20,000	1,200 C.T.
UM 24*	Output	1,000	50
UM 25*	Output	400	50
UM 26*	Output	400	11
UM 27*	Output	.400 C.T.	11
UM 28*	Choke	10 Hy. (0 dc)	8 Hy (.5 ma) 650

*Add either -F or -M lo designate construction. See catalog.

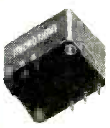
MINIATURE TRANSISTOR

Available in 8 case types.
Hermetic(-H) ¹⁵⁄₁₆" x 1⅜", Wt. 1¾ oz.
Molded (-M) ⅞" x ⅞" x 1¹⁵⁄₃₂", Wt. 1¾ oz.
Open Frame (-F) ¾" x 1" x ¹³⁄₁₆", Wt. 1 oz.

Part Number	Application	Pri. Imp.	Sec. Imp.
MT1*	Line to Emit.	600	600
MT7*	Coll. to P.P. Emit.	25,000	1,200 C.T.
MT8*	P.P. Coll. to P.P. Emit.	25,000	1,200 C.T.
MT9*	Line to P.P. Emit.	600 C.T.	1,200 C.T.
MT11*	P.P. Coll. to P.P. Emit.	4,000 C.T.	600 C.T.
MT13*	P.P. Coll. to Speaker	4,000 C.T.	3.4
MT14*	Coll. to Speaker 2N179	400	10
MT15*	P.P. Servo Output 2N57	500 C.T.	210
MT18*	P.P. Coll. to P.P. Emit.	25,000 C.T.	1,200 C.T.
MT23*	P.P. Coll. to Servo	250 C.T.	1,000

Add either -AG, -H, -M, -FB, -FPB, -A, or -P to Part Number to designate construction. See catalog for detailed information.

TRANSISTOR DRIVER



Designed specifically for
transistor, servo
and audio

Frequency response 70-20K

Size AF mill through AH Hermetically sealed to MIL-T-27A.

EPOXY MOLDED See catalog for exact sizes and weights.

ON SPECIAL ORDER ONLY

Part Number	Application	Pri. Imp.	Sec. Imp.	Pri. D.C. Unbal Ma.	Level Watts
M8002*	Coll. to P.P. Emit.	560	400 C.T.	18	.15
M8003*	Coll. to P.P. Emit.	625	100 C.T.	20	1.5
M8004	Coll. to P.P. Emit.	5,400	600 C.T.	15	.075
M8005	Coll. to P.P. Emit.	7,000	320 C.T.	7	.040
M8006	Coll. to P.P. Emit.	10,000	6,500 C.T.	.75	.005

*Bi-Filar wound to minimize switching transients.

FRANCHISED STOCKING DISTRIBUTORS immediate delivery from stock at

CALIFORNIA, INGLEWOOD
Newark Electric Company
CALIFORNIA, LOS ANGELES
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Connex Corporation
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Telrad Electronic Supply Co.
CALIFORNIA, SAN JOSE
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CANADA, MONTREAL 9, QUEBEC
Atlas Wholesale Radio Inc.
CONNECTICUT, NEW HAVEN
Radio Shack Corp. of Conn.
COLORADO, DENVER
Ward Terry & Company
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Electronic Industrial Sales, Inc.
ILLINOIS, CHICAGO
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MARYLAND, BALTIMORE
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Sager Electrical Supply Co.
MINNESOTA, MINNEAPOLIS
Stark Electronics Supply Co.
NEW YORK, JAMAICA
Harrison Radio
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NEW YORK, MINEOLA
Arrow Electronics, Inc.
NEW YORK, NEW YORK CITY
Harrison Radio
NEW YORK, SCHENECTADY
Schenectady Electronics
NEW YORK, UTICA
Valley Electronic Labs., Inc.
OHIO, CINCINNATI
United Radio, Inc.
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Main Line Cleveland, Inc.
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145 E. MINEOLA AVE., VALLEY STREAM, N. Y.

International News

its inertial navigation instruments lab at Crew Toll, Edinburgh, Scotland. Ferranti Ltd., a British firm, has been licensed by Kearfott Co. to manufacture certain of the latter's patented floated rate integrating gyros.

Russia Buys British Computer

The Russian Government has placed an order for a National-Elliott 802 Computer from Elliott-Automation Ltd., 34 Portland Place, London. The 802 is a medium sized, transistorized, general-purpose computer which is particularly suited to scientific work. Orders for National-Elliott 802 and 803 computers have also been received from the U. S.

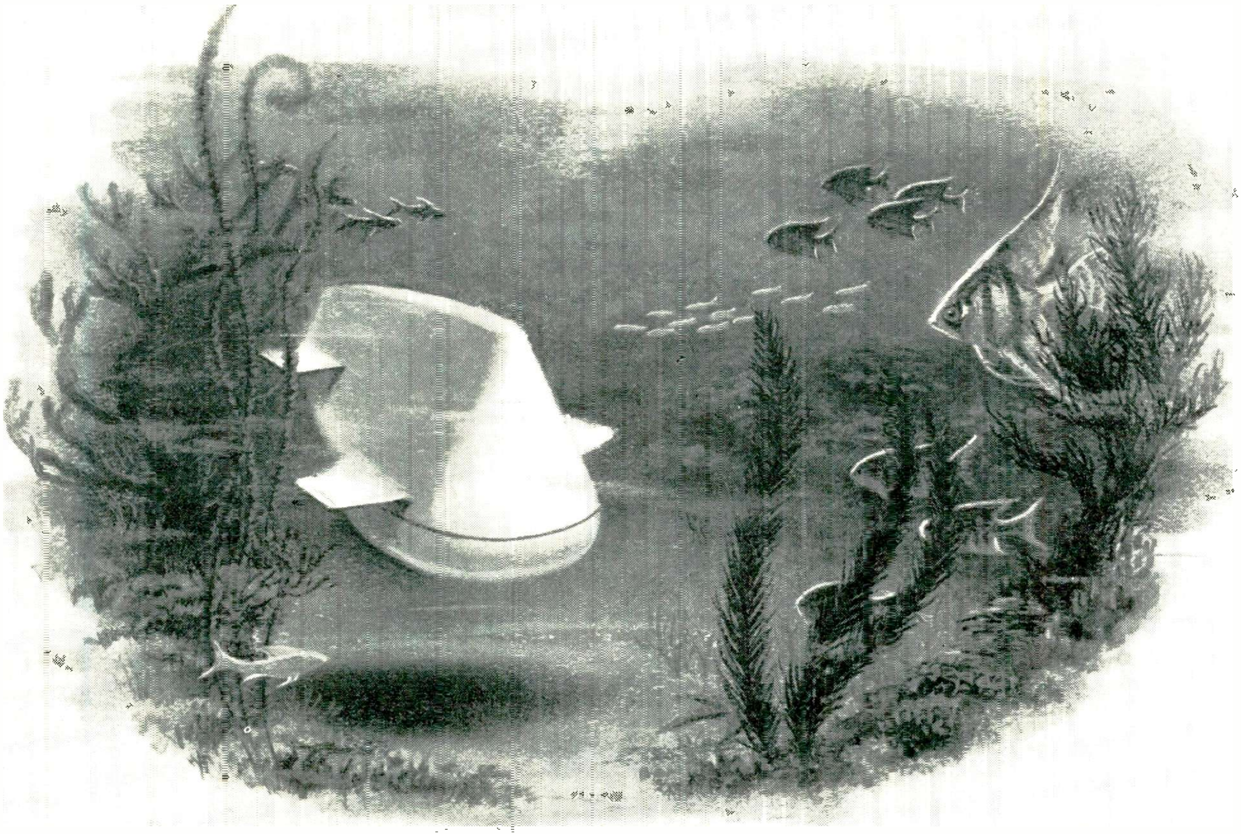
VISIT U. S. FIRMS

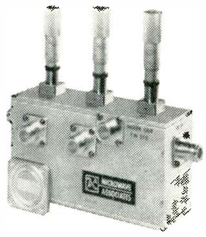
Edward Gillette (Right), Pres., Allied Control Co., New York, N. Y., welcomes group of engineers from Switzerland and West Germany. Group is touring industrial centers. Ralph Ferry, Dir. of Test Engineering explains equipment to (Left to Right) Iris Marquardt, Fritz Hollmann and Jacob Marquardt.

Translate Russian Journals

The Instrument Society of America, 313 6th Ave., Pittsburgh 22, Penna., has been awarded a grant by the National Science Foundation to continue the translation and publication of the 1959 issues of four leading Russian technical journals.

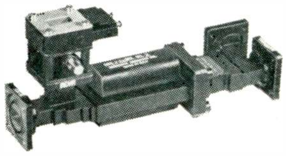
The four publications are: "Measurement Techniques" (Izmeritelnaia Tekhnika) which deals with the application of fundamental measurement; "Instruments and Experimental Techniques" (Pribory i Tekhnika Eksperimenta), which concerns the function, construction, application, and operation of instruments in experimentation; "Automation and Remote Control" (Avtomatika i Telemekhanika), on automatic control theories and techniques; and "Industrial Laboratory" (Zavodskaya Laboratoriya), dealing with instrumentation for analytical chemistry and physical and mechanical methods of material research and testing.



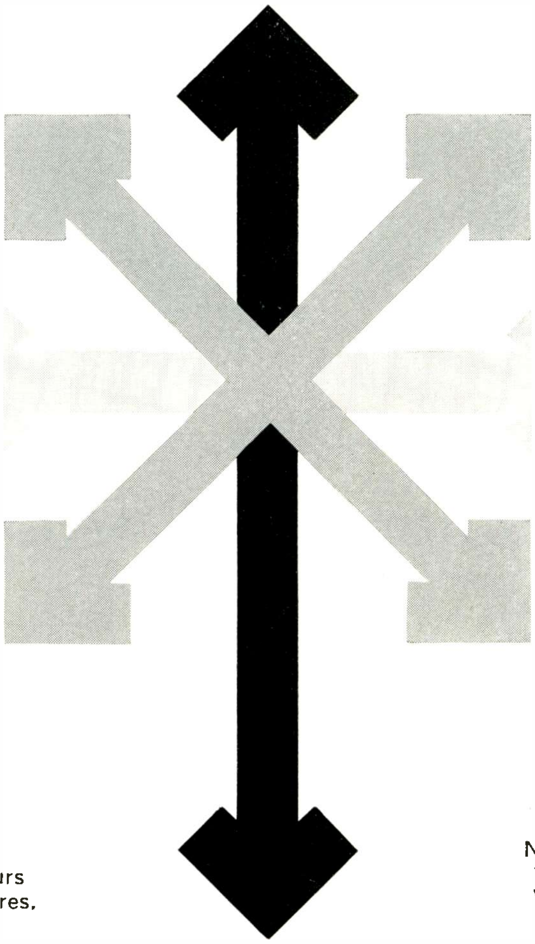


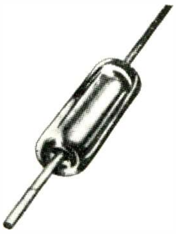
New parametric amplifiers
for 4 to 14 db improvement
in receivers operating within
the 100-1500 mc range.

New ruggedized magnetrons
for increased reliability
of air-borne systems.



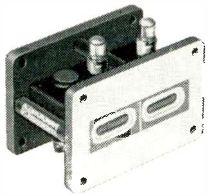
New ferrite duplexers,
isolators and circulators
for advanced systems.





New computer diodes
with recovery times
lower than 4 mμ secs.

New Varactor diodes
that reduce receiver
noise to as low as 1 db.



New duplexer tubes
that guarantee crystal
protection up to 1000 hours
and at elevated temperatures.

New solid-state limiters
that protect receivers
without external bias.

PROGRESS AT MICROWAVE

has a unique 12-month pattern . . .

This pattern of progress at Microwave Associates during the past 12 months reveals a unique combination of solid state and microwave competence. It shows a new-development pace unmatched by any other single source in the microwave field. It promises that your own microwave system planning can benefit from close cooperation with our skilled team of physicists, metallurgists and engineers. Let's move ahead *faster . . . together!*

For data and prices on any of these new products . . . or for engineering cooperation in developing systems components for your specialized needs, write or call:

MICROWAVE μA ASSOCIATES, INC.
BURLINGTON, MASS. BRowning 2-3000

Circle 13 on Inquiry Card

MOBIDIC COMPUTER

Sylvania Electric Products Inc. and General Telephone & Electronics Corp. officials inspect cut-away model of MOBIDIC, high-speed transistorized digital computer built for the Sig. Corps. (L to R) R. E. Lewis, Pres., Sylvania; Don G. Mitchell, Pres., General Telephone and Sylvania Board Chairman; Eugene J. Vigneron, Gen. Mgr., Data Systems, Sylvania; and H. Lehne, a Senior Vice Pres. of Sylvania.

New Airborne Radar Undergoing Tests

The nation's first integrated, all-mode, multi-purpose production radar for fighter-bomber aircraft is currently undergoing flight evaluation in the Air Force's supersonic, all-weather F-105D Thunderchief. Developed, designed and produced at Autonetics, a div. of North American Aviation, Inc., this radar provides all the information essential to directing the 105's armament control and bombing-navigation equipment. For tactical missions, it offers such operational modes as air-to-air search and auto-tracking; air-to-air ranging for armament control; air-to-air blind acquisition and attack; air-to-air visual acquisition and attack and air-to-ground ranging.

The production version gives the fighter-bomber low-altitude-attack capability by detecting terrain obstacles, presenting an adequate pilot's display and providing continuous information about obstacles along the flight path, their location and distance.

Some Tunnel Diodes Are Available

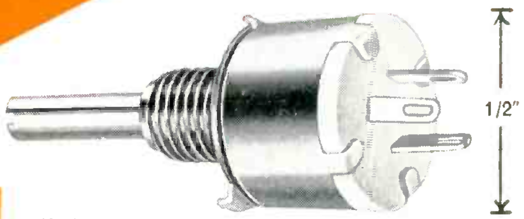
Tunnel diodes for experimental purposes have been made available by the Radio Corp. of America.

The tiny germanium device is no bigger than the head of a match. It is expected to form important electronic functions in missile control and guidance systems. These diodes can accomplish many tasks not possible with any other present day electronic devices.

Circle 14 on Inquiry Card →

STABILITY & HEAT BARRIER BROKEN

with Metal-Ceramic Variable Resistor



HIGH

RELIABILITY
STABILITY
TEMPERATURE

Miniature

CERATROLS

with new metal-ceramic element

CeraTrolS' rugged, hard-surfaced metal-ceramic element, having been fired at temperatures exceeding 600°C, meets temperatures up to 500°C with high safety factors at ratings listed below.

New Series 600 Characteristics:

- Infinite resolution.
- 100 ohms thru 5 meghoms (linear taper) resistance range.
- ½" diameter; interchangeable with Style RV6 MIL-R-94B.
- Power ratings: ¾ watt @ 85°C, ½ watt @ 125°C, zero load @ 175°C.

CTS®

COMPARATIVE TEST DATA: No carbonaceous variable resistors (either film or molded) can equal Series 600 performance. Ideal for critical applications requiring high stability and reliability. Far exceeds MIL-R-94B.

Tests	MIL-R-94B (Style RV6, Char. Y) Requirement	Series 600 CTS Maximum	Series 600 CTS Average
Load life 1000 hrs.			
½ watt @ 125°C, 350 V max.	±10% @ 70°C	±7% @ 125°C	±4% @ 125°C
¾ watt @ 85°C			
Thermal Stability (1000 hrs. @ 175°C no load)	No test in MIL-R-94B	±5%	±3%
Temperature Co-eff.* (Room to −63°C; room to +175°C)	No test in MIL-R-94B		
25K and over		±250 PPM/°C	±150 PPM/°C
under 25K		±500 PPM/°C	±300 PPM/°C
Moisture Resistance	± 6% avg. ±10% max.	± 2% avg. ± 4% max.	±1.3%
Low Temp. Storage	±2%	±1%	±.5%
Low Temp. Operation	±3%	±2%	± 1%
Thermal Cycling	±6%	±3%	±2%
Voltage Co-efficient	No test in MIL-R-94B	±.01%/volt	±.005%/volt
Rotational Life	±10% (after 25,000 cycles)	±10%	±7.5%
Acceleration	±3%	±2%	±1%
High Freq. Vibration	±2%	±2%	±1%
Shock	±2%	±2%	±1%

* Lower temperature coefficient can be developed for specific applications.

Note Exceptional Stability. Note extent that MIL-R-94B is exceeded.

Newly developed 500°C Metal-Ceramic Resistance Element is separately available for other applications than variable resistors. Because the element is very stable to 500°C, it is extremely reliable at the elevated temperatures currently demanded <u>and anticipated</u> in military requirements. Ceramic bases can be made in a wide variety of shapes and sizes; the metal resistance film can be made to cover an entire surface or an accurately defined pattern. Consult CTS engineers on your requirements.

Complete Series 600 CeraTrolS electrical and mechanical specs and dimensional drawings will be sent upon request.

CTS manufactures a complete line of composition and wirewound variable resistors for military, industrial and commercial applications. CTS specialists are willing to help solve your variable resistor problems. Contact your nearest CTS office today.

Burton Browne Advertising

Founded CTS 1896

CHICAGO TELEPHONE SUPPLY
Corporation

ELKHART • INDIANA

Factories in Elkhart & Berne, Indiana, South Pasadena, California, Asheville, No. Carolina and Streetsville, Ontario. Sales Offices and Representatives conveniently located throughout the world.

Circle 16 on Inquiry Card

COME TO THE COLISEUM...

the place to look for

NEW IDEAS IN RADIO-ELECTRONICS

1960!

Here, in New York City's Coliseum, is where you'll find the very latest information about the giant, radio-electronics industry's plans for the future.

Here, you'll rub shoulders with over 60,000 of your fellow radio-electronics engineers. Here, you'll see 950 exhibits, representative of 80% of your industry's productive capacity, covering equipment, component parts, instruments and production. Here, you'll hear your choice of more than 200 papers to be given during the CONVENTION.

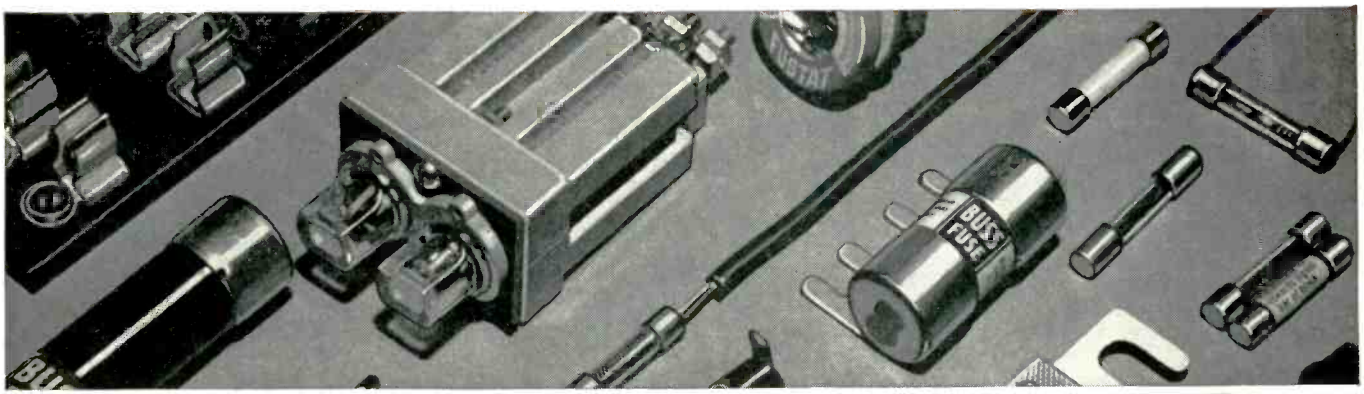
Yes, here — and only here — is your once-a-year chance to see and profit by all the NEW IDEAS IN RADIO-ELECTRONICS, 1960 gathered in one place. Attend the IRE NATIONAL CONVENTION AND RADIO ENGINEERING SHOW. Come to the Coliseum!

The IRE NATIONAL CONVENTION
Waldorf-Astoria Hotel
and
The RADIO ENGINEERING SHOW
Coliseum, New York City

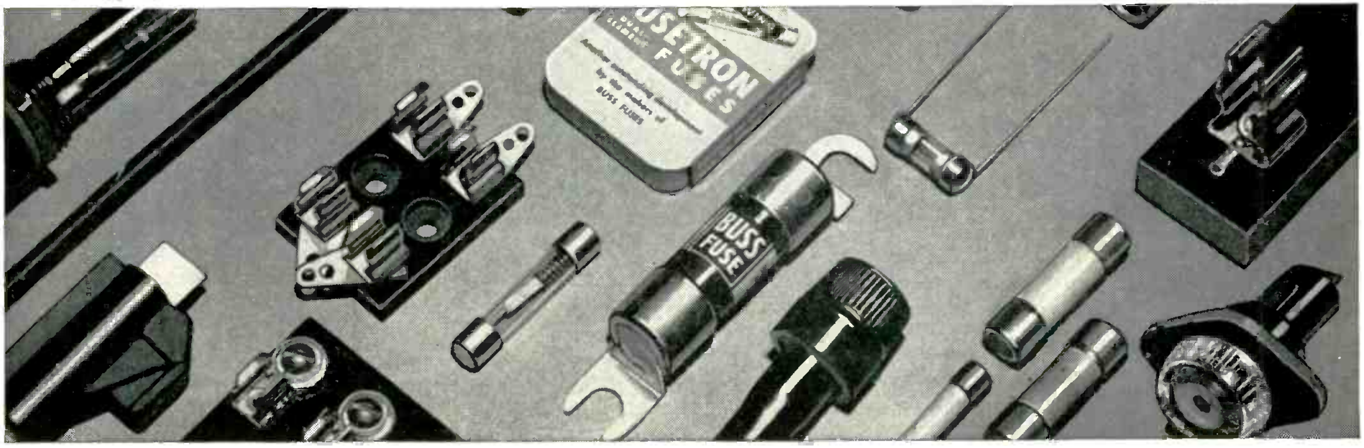
MARCH 21, 22, 23, 24

The Institute of Radio Engineers
1 East 79th St., New York 21, N. Y.

Circle 17 on Inquiry Card



Specify BUSS Fuses!



Because there's a BUSS or FUSETRON fuse to fit Your Every Electrical Protection Need.

With the world's largest fuse research laboratory plus 44 years of experience in solving electrical protection problems — it isn't surprising that BUSS has the most complete line of fuses in the industry.

The BUSS and FUSETRON fuse lines includes:

Single-element fuses for circuits where quick-blowing is needed, such as for instrument protection.

Single-element fuses for normal circuit protection.

Dual-element, slow-blowing fuses for circuits where harmless current surges occur.

Indicating fuses where signal must be given when fuses open, or to activate an alarm.

BUSS and FUSETRON fuses range in size from 1/500 amperes up — and there's a companion line of fuse clips, blocks and holders. Whatever your fuse requirements, the chances are more than good there's a BUSS or FUSETRON fuse to satisfy them.

If you have a special protection problem . . . extensive BUSS laboratory facilities and a large engineering staff are at your disposal to help you save money and engineering time.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write today for BUSS bulletin SFB.

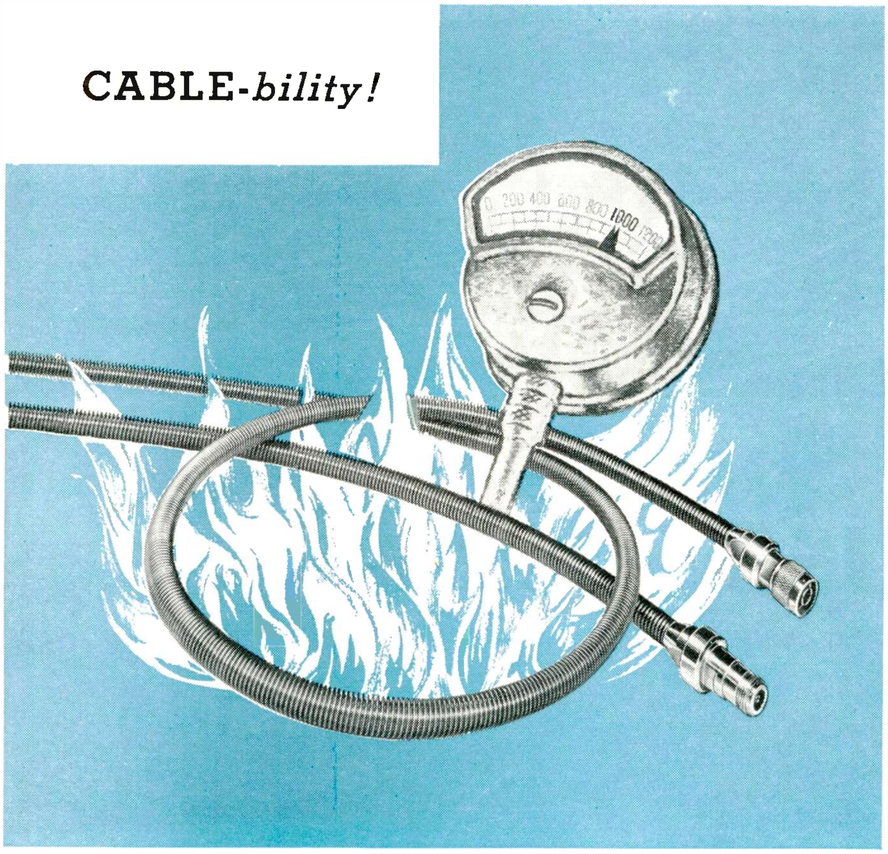
BUSSMANN MFG. DIVISION,
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

160

BUSS fuses are made to protect - not to blow, needlessly.
BUSS makes a complete line of fuses for home, farm, commercial, electronic, electrical, automotive and industrial use.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

McGRAW EDISON



Tap-Proof Telephone Cable Developed

Companies using TV, telephone, or wire photos in internal communications networks, can be sure that their lines are free of eavesdroppers by means of a tap-proof, tamper-proof cable just made available to private industry.

The patented cable, made by Mosler Research Products, Inc., provides absolute protection against tapping by direct contact or induction. In the event that an attempt to connect into the cable is made, an alarm is automatically sounded without the intruder being aware of it.

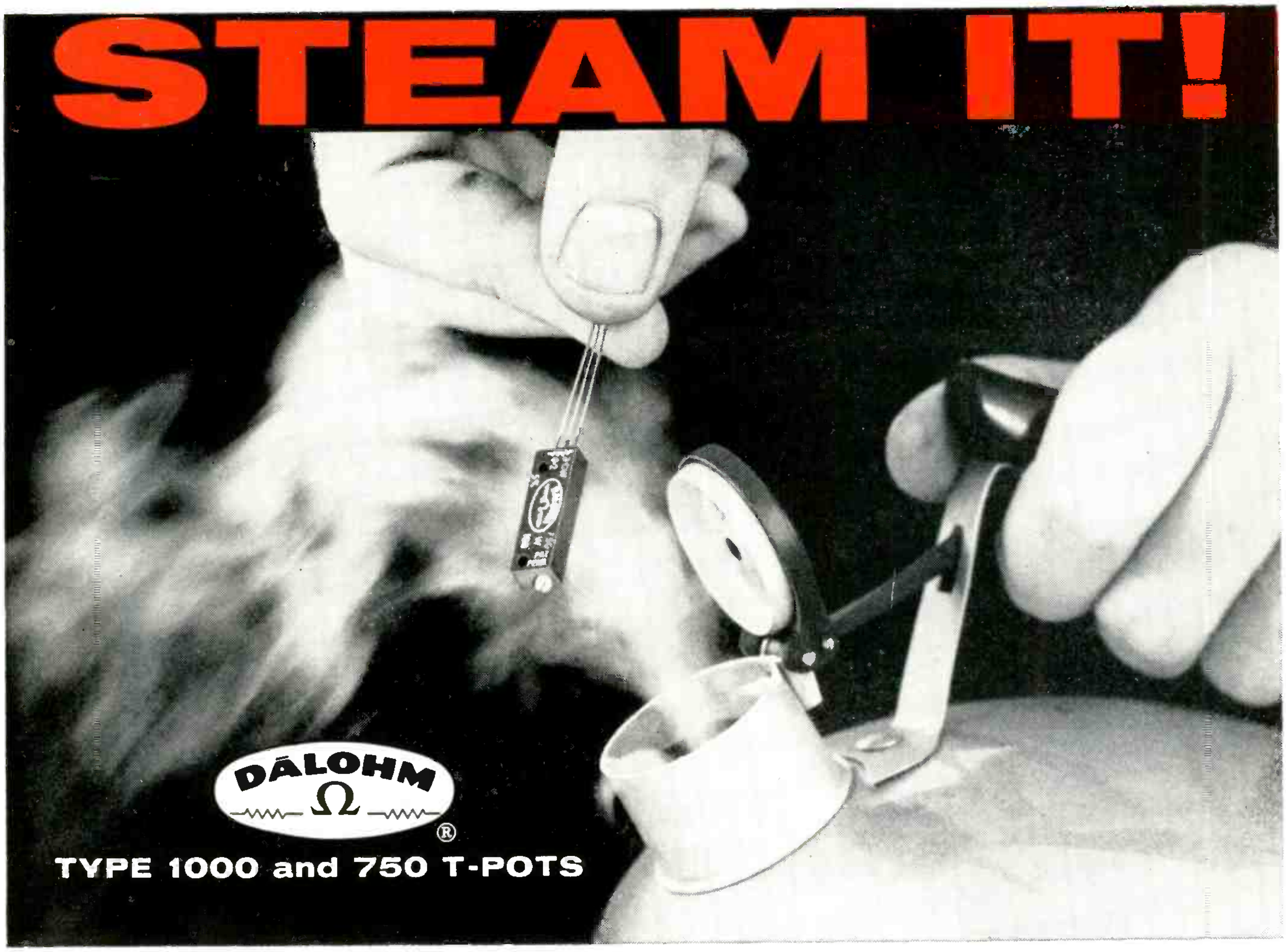
The communications circuits are covered by successive layers of foil sheathed in plastic and connected to a highly sensitive relay apparatus which responds to changes in electrical current as low as two-one millionths of an ampere.

Attempts to tap the wire activate a relay causing an alarm to sound at a control point. The insertion of even a pin into the cable will trip the sensitive alarm.

Additional protection against inductive tapping is provided by a noise generator which transmits a signal many times greater than the amplitude of a conversation carried in the cable. The noise covers the complete audio frequency range and cannot be eliminated by filters or other means, thus making an induction tap impossible.

4,000,000 PRINTED CIRCUITS

John D. Maxwell (left) President of Photocircuits Corp., Glen Cove, N. Y. presents to E. R. Lee, Manager, Polaris Program Purchasing, Ord., Dept., General Electric Co., Pittsfield, Mass. a replica of the 4,000,000th "plated thru hole" circuit board manufactured by the company's facility in Glen Cove.



INHERENT STABILITY

Assured in a DALOHM 750 or 1000 Trimmer Potentiometer

The ability to perform reliably under extreme conditions of heat and humidity is only one mark of the inherent stability that is standard in Dalohm trimmer potentiometers.

Stored on the shelf for months . . . or placed under continuous load . . . operating in severe environmental, shock, vibration and humidity conditions . . . Dalohm precision trimmer potentiometers retain their stability because it has been "firmly infixed" by Dalohm design and methods of manufacture.

For all applications demanding trimmer potentiometers that meet or surpass MIL specifications, you can depend on Dalohm.

WIRE WOUND • SEALED • HIGH POWER • DALOHM TYPE 750 and 1000 TRIMMER POTENTIOMETERS

Miniature and standard sizes with completely sealed cases. Three terminal configurations provide the solutions for demanding design problems.

	750	1000
Rated at	...2 watts	2.5 watts
Resistance range	......10 ohms to 30K ohms	10 ohms to 50K ohms
Standard tolerance	...± 5%	± 5%
Size	.......180" x .300" x 1.000"	.180" x .300" x 1.25"
Screw adjustment	..17 ± 2 revolutions	25 ± 2 revolutions
Weight	.....2 grams	2.5 grams

- Completely sealed
- Meets humidity requirements of MIL-STD-202A, Method 106A or MIL-E-5272A, Procedure 1
- End resistance is 3%, maximum
- Nominal resolution is from 0.1% to 1.2%
- Temperature coefficient is 50 PPM/° C.
- Meets load life requirements of MIL-R-19A
- Surpasses applicable paragraphs of MIL-R-12934A

Write for Bulletins R-41A and R-44, with handy cross-reference file cards.

SPECIAL PROBLEMS?

You can depend on DALOHM, too, for help in solving any special problem in the realm of development, engineering, design and production. Chances are you can find the answer in our standard line of precision resistors (wire wound, metal film and deposited carbon); trimmer potentiometers; resistor networks; collet-fitting knobs; and hysteresis motors. If not, just outline your specific situation.

from **DALOHM**
Better things in smaller packages
DALE PRODUCTS, INC.
1304 28th Ave., Columbus, Nebr.

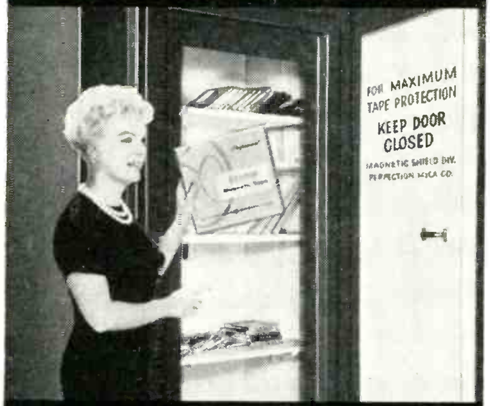
Circle 22 on Inquiry Card

THE RECORDING THAT WASN'T

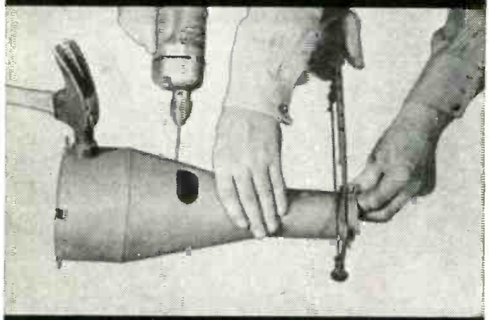
. . . it's happened to lots of magnetic tape users

Burton browne advertising

Test factually demonstrates shielding effectiveness of Netic alloy material and enclosure design. Instrumentation used: magnetic field radiating source, AC vacuum tube voltmeter, Variac, pickup probe and Netic Tape Data Preserver. For complete test details and results, request Data Sheet 142.



For safe, distortion-free storage of large quantities of vital magnetic tapes. Designed for Military Establishments, Radio & TV Broadcasters, Automated Plants, Libraries, Laboratories, Gov't. Agencies, etc.



Composite photo demonstrating that magnetic shielding qualities of NETIC alloy material are not affected by vibration, shock (including dropping) etc. Furthermore, NETIC does not retain residual magnetism nor require periodic annealing.

Maybe you've been one of these unfortunates . . . who've spent thousands of dollars . . . plus many man hours . . . to record valuable information on magnetic tapes . . . only to find the data useless from accidental distortion or erasure.

Unexpected exposure to an unpredicted magnetic field, and presto!—your valuable data is filled with irritating odd noises. Distortions may result in virtual data erasure.

Unprepared tape users never realize the danger of loss until it's too late.

Such losses have become increasingly common from damaging magnetic fields during transportation or storage. These fields may be produced by airplane radar or generating equipment or other power accessories. Also by generators, power lines, power supplies, motors, transformers, welding machines, magnetic tables on surface grinders, magnetic chucks, degaussers, solenoids, etc.

Since 1956, many military and commercial tape users successfully avoid such unpleasant surprises. Their solution is shipping and storing valuable tapes in sturdy NETIC Tape Data Preservers.

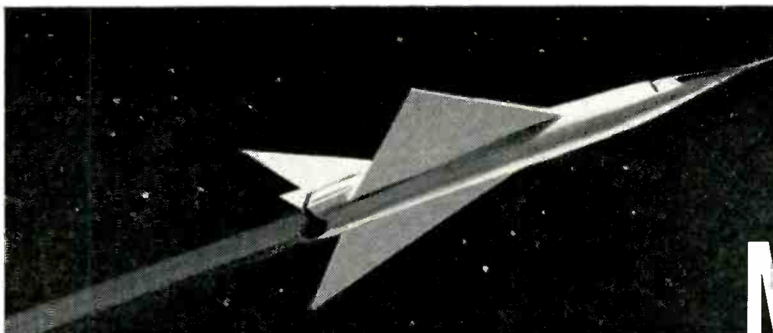
Data remains clear, distinct and distortion-free in NETIC Preservers. Original recorded fidelity is permanently maintained.

Don't take chances with *your* valuable magnetic tapes. Keep them *permanently clear* and *distinct* for *every* year of their useful life in dependable NETIC Preservers. Can be supplied in virtually any size and shape to your requirement. Write for further details today.

For complete, distortion-free protection of valuable tapes during transportation or storage. Single or multiple containers available in many convenient sizes or shapes.

MAGNETIC SHIELD DIVISION PERFECTION MICA CO.

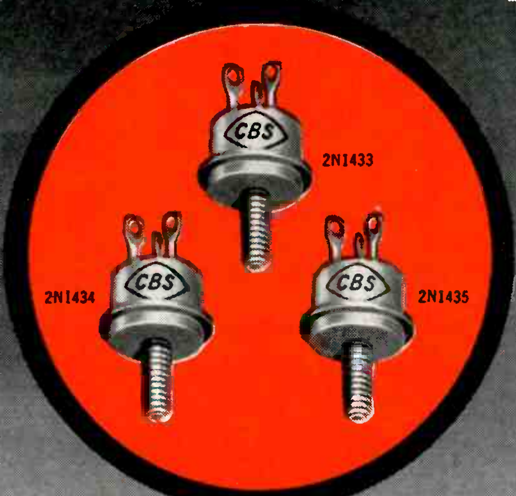
1322 No. Elston Avenue, Chicago 22, Illinois
Originators of Permanently Effective Netic Co-Netic Magnetic Shielding

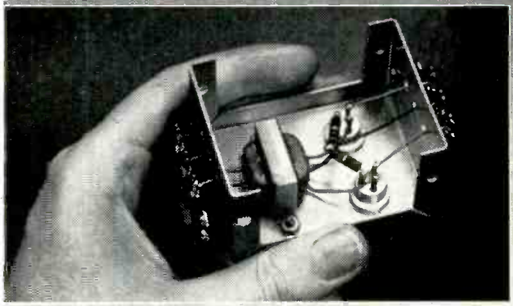


For Airborne Equipment

MORE POWER LESS WEIGHT LESS SPACE

with new CBS PNP Power Transistors





Compact, lightweight servo amplifier employing CBS 2N1434 10-watt push-pull output stage.

In a typical servo amplifier, a pair of these CBS PNP germanium power transistors delivers 10 watts output. Yet each transistor weighs less than 5 grams . . . and requires only ⅓ square inch of chassis space. Put the compact CBS 2N1433, 2N1434, 2N1435 to work in your military or industrial equipment — airborne, mobile or portable. Check advantages and basic data. Write for complete technical bulletin E-370. Order from your Manufacturers Warehousing Distributor.

NOTE THE ADVANTAGES

These improved versions of the 2N538, 2N539A and 2N540 offer:

- Single, sturdy 10-32 mounting stud
- Compact male-industrial TO-10 welded package
- High dissipation with minimum size
- High collector-to-base voltage
- High collector-emitter breakdown voltage
- Wide range of operating and storage temperatures

CHECK THE CHARACTERISTICS

Type	Max. W Diss.*	Max. V_{CBO}	Min. BV_{CBO}	h_{FE} ($I_C=2A$, $V_{CE}=-2V$) Min.	Max.	V_{BE} ($I_C=2A$, $V_{CE}=-2V$) Min.	Max.	Max. Thermal Res. °C/W
2N1433	35	−80	−50	20	50	—	3.3	2
2N1434	35	−80	−50	45	115	—	1.8	2
2N1435	35	−80	−50	30	75	1.0	2.5	2

All types have: Max. collector current, 3.5 amps; junction temperature, −65 to +95°C; max. saturation voltage, 0.6 volts ($I_C=2A$, $I_B=200$ mA). Minimum alpha cutoff frequency is 200 KC ($I_C=100$ mA, $V_{CE}=-4$ volts).

*25°C base mounting temperature.

More reliable products
through Advanced Engineering

CBS® **semiconductors**

CBS ELECTRONICS, Semiconductor Operations • A Division of Columbia Broadcasting System, Inc.

Sales Offices: **Lowell, Mass.,** 900 Chelmsford St., GLenview 4-0446 • **Newark, N. J.,** 32 Green St., MArket 3-5832
Melrose Park, Ill., 1990 N. Mannheim Rd., EStebrook 9-2100 • **Los Angeles, Calif.,** 2120 So. Garfield Ave., RAymond 3-9081

Circle 24 on Inquiry Card

SHIP WITHOUT AN OCEAN

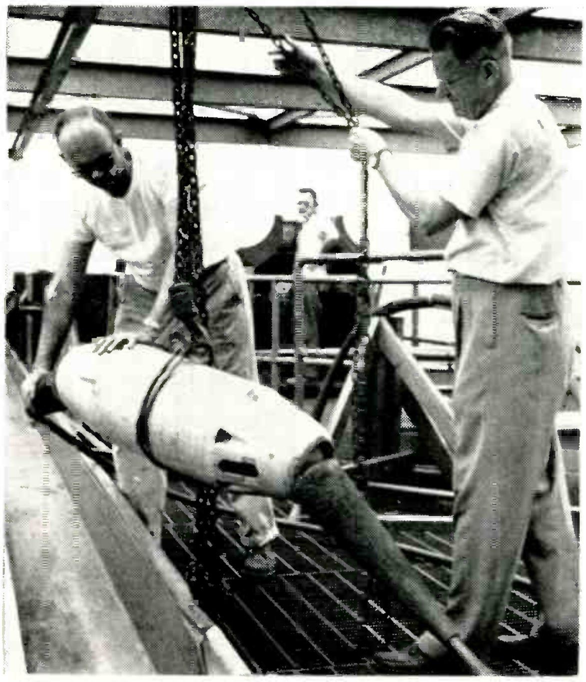
How do you lay a cable on the ocean floor—a cable that is connected to scores of large, heavy amplifiers? How do you "overboard" such a system in a continuous operation, without once halting the cable ship?

Bell Telephone Laboratories engineers must answer these questions in order to lay a new deep-sea telephone system designed to carry many more simultaneous conversations. They're experimenting on dry land because it is easier and more economical than on a ship. Ideas that couldn't even be attempted at sea are safely tested and evaluated.

In one experiment, they use a mock-up of the storage tank area of a cable ship (above). Here, they learn how amplifiers (see photo right), too rigid and heavy to be stored with the cable coils *below* decks, must be positioned *on* deck for trouble-free handling and overboarding.

Elsewhere in the Laboratories, engineers learn how best to grip the cable and control its speed, what happens as the cable with its amplifiers falls through the sea, and how fast it must be payed out to snugly fit the ocean floor. Oceanographic studies reveal the hills and valleys which will be encountered. Studies with naval architects show how the findings can be best put to work in actual cable ships.

This work is typical of the research and development effort that goes on at Bell Laboratories to bring you more and better communications services.

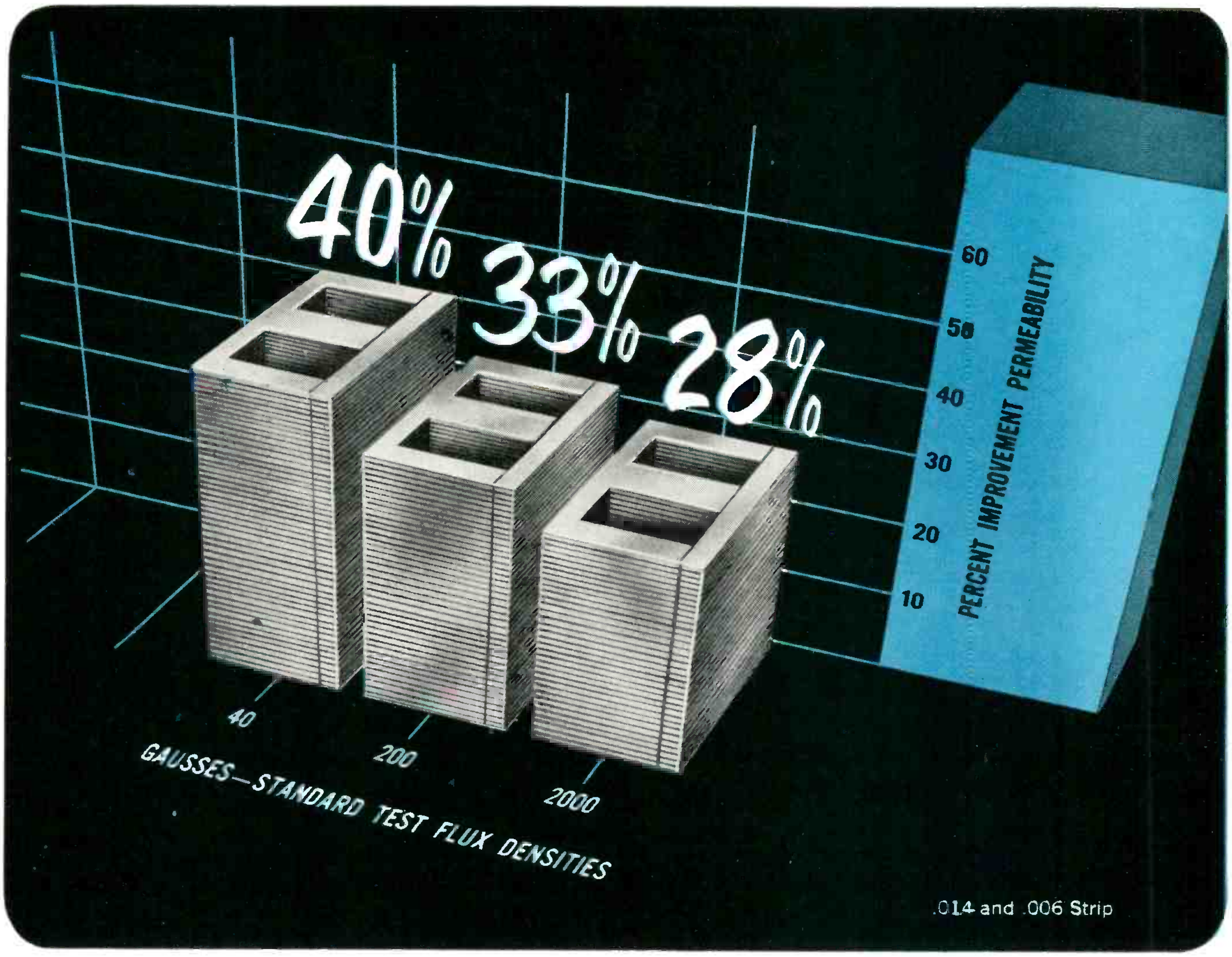


Experimental amplifier about to be "launched" from "cable ship." Like a giant string of beads, amplifiers and connecting cable must be overboarded without stopping the ship.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

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



Higher permeability values now guaranteed for Allegheny Ludlum's Moly Permalloy

Means new, consistent and predictable magnetic core performance

Molybdenum Permalloy nickel-iron strip is now available from Allegheny Ludlum, with higher guaranteed permeability values than former typical values. For the buyer, this new high quality means greater uniformity . . . more consistent and predictable magnetic core performance.

This higher permeability is the result of Allegheny Ludlum's intensive research on nickel-bearing electrical alloys. A similar improvement has been made in AL-4750 strip steel. A-L continues its research on silicon steels, including Silectron, well-known grain-oriented silicon steel, and other magnetic alloys.

Complete facilities for the fabrication and heat treatment of laminations are available from Allegheny Ludlum. In addition, you can be assured of close gage tolerance, uniformity of gage throughout the coil, and minimum spread of gage across the coil-width.

If you have a problem relating to electrical steels, laminations or magnetic materials, call A-L. Prompt technical assistance will be yours. And write for more information on Moly Permalloy. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

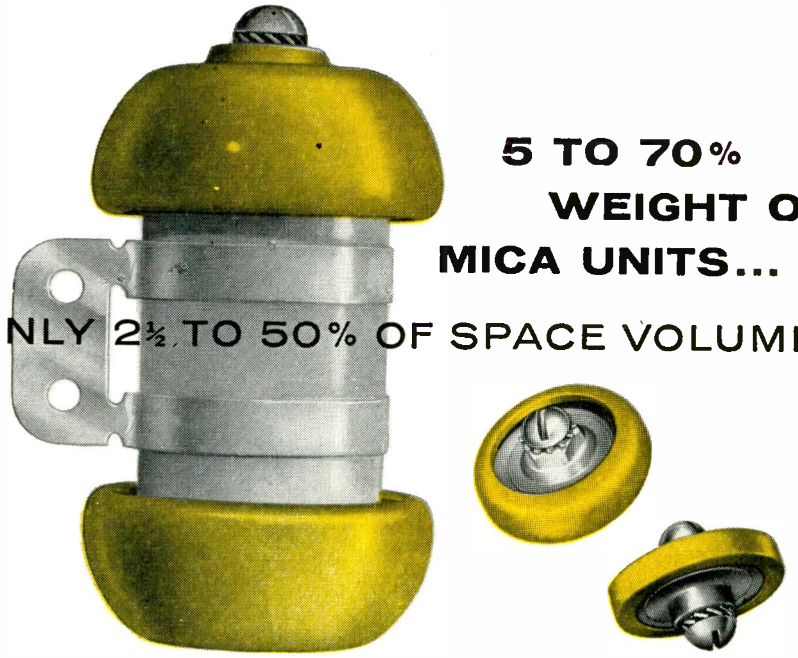
Address Dept. EI-25

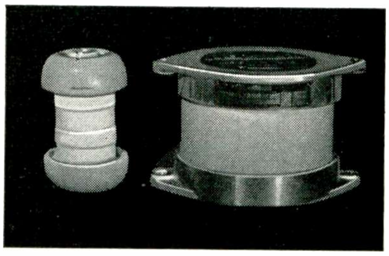
WSW 7490

ALLEGHENY LUDLUM

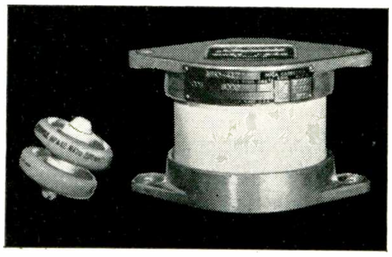
STEELMAKERS TO THE ELECTRICAL INDUSTRY

Export distribution, Electrical Materials: AIRCO INTERNATIONAL INC., NYC 17
Export distribution, Laminations: AD. AURIEMA, NYC 4





A size reduction is dramatically illustrated when comparing an HPD rated at 25 amps with a conventional CM85 mica capacitor.



Connecting two HPA units in series still affords remarkable savings in size and weight when compared with a CM80 mica capacitor.

Tele-Tips

SECURITY-CONSCIOUS Air Force installations are sporting new signs taken from a certain well-known comedian: "Say the Secret Word and get 20 Years."

BASEBALL COMPUTER is being designed at Univ. of California that will decide baseball strategy for a given situation. An IBM 709 has been instructed how to "play" individual innings. Thirteen possible plays are available, and the desirability of each is weighed against the composite batting averages of a typical major league team.

ELECTRONIC principles are often difficult to explain to the layman. One of our friends recently found this out. He we trying to explain to his wife that electrical pulses travel faster over wire than sound does in air. He started, "Suppose I was talking on the phone to a friend in California. And you were standing 20 ft. away from me."

She objected, "But you don't have a friend in California."

"Well, just suppose—and you're 20 ft. away from me."

"Why should I be 20 ft. away?"

"Just assume that you're 20 ft. away from me.—Now, my friend in California will hear what I say before you do. Do you know why that is?"

His wife beamed triumphantly, "Yes. The time out there is three hours earlier."

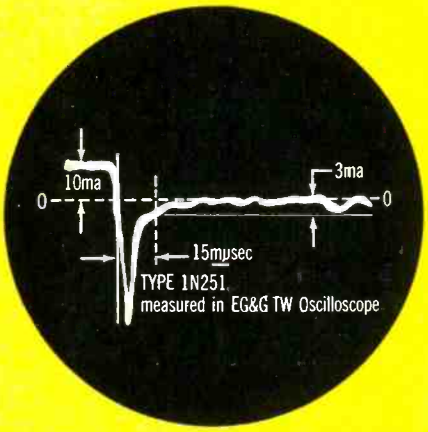
ELECTRONIC MFR. found written in heavy letters on one order —MIL-TDD-41. The unfamiliar spec puzzled him, and he reached for the book on Military Specifications. Nothing! He checked with Engineering, then Research. Still no luck. Reluctantly he cabled the customer: what were the requirements of MIL-TDD-41? The answer came back: Make It Like The D—— Drawing — For Once!

RUSSIAN ASTRONOMERS lost a minor skirmish with a group of talented California high school science students. As a group project the youngsters set out to to plot the orbit of "9-Metis," one of the minor planets in our Solar

(*Continued on page* 42)

JAN 1N251

(MIL-E-1/1023)



FOR HIGHEST SPEED

Transitron is in volume production of the FASTEST silicon diode meeting military specifications. Typical recovery time: 15 mμsec measured with the EG & G scope. Their excellent high frequency properties make them particularly useful in detector, discriminator, and pulse circuitry.

For further information write for PB-66.

NOW

AVAILABLE FROM Transitron

NEW

WIDE RANGE OF

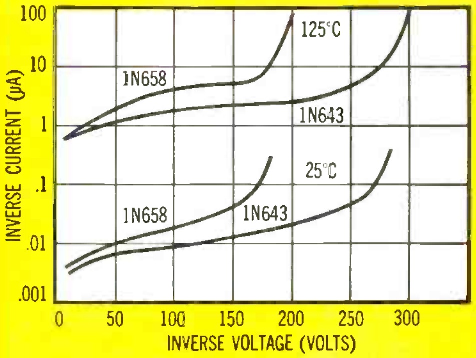
JAN

SEMICONDUCTOR

TYPES!

SIGNAL CORPS TYPES

USA 1N643 (MIL-E-1/1171)
USA 1N658 (MIL-E-1/1160)
USA 1N662 (MIL-E-1/1139)
USA 1N663 (MIL-E-1/1140)



FOR HIGH CONDUCTANCE, HIGH VOLTAGE AND HIGH SPEED . . .

These fast-switching silicon diodes are designed to meet the very latest military specifications . . . Diffused junction construction permits the combination of HIGH CONDUCTANCE (100 mA @ 1 volt), HIGH VOLTAGE (100 volts), and FAST-SWITCHING (0.3 μsec) characteristics in ONE diode.

For further information write for PB-66.

JAN 1N457	(MIL-E-1/1026)
JAN 1N458	(MIL-E-1/1027)
JAN 1N459	(MIL-E-1/1028)

FOR LOW LEAKAGE AT HIGH TEMPERATURE

Low inverse leakage; low capacitance. Excellent inverse characteristics at 150°C.

See PB-66.

JAN 2N118	(MIL-T-19500/2)
USN 2N117	(MIL-T-19500/35)
USN 2N119	(MIL-T-19500/35)

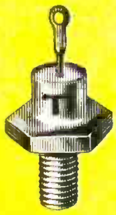
See TE-1353P.

SILICON TRANSISTORS

FIRST JAN silicon transistor on the market! And more types coming!

USN 2N332	(MIL-T-19500/37A)
USN 2N333	(MIL-T-19500/37A)
USN 2N334	(MIL-T-19500/37A)
USN 2N335	(MIL-T-19500/37A)

See TE-1353F, 1353G



JAN 1N253	(MIL-E-1/1024)
JAN 1N254	(MIL-E-1/989A)
JAN 1N255	(MIL-E-1/990A)
JAN 1N256	(MIL-E-1/991A)

See TE-1336.

SILICON RECTIFIERS

Identical except for Peak Recurrent Inverse Voltage.

JAN 1N538	(MIL-E-1/1084A)
JAN 1N540	(MIL-E-1/1085A)
JAN 1N547	(MIL-E-1/1083A)

See TE-1351-M-1

JAN 1N126A	(MIL-E-1/156C)
JAN 1N127A	(MIL-E-1/157C)
JAN 1N128	(MIL-E-1/158B)
JAN 1N198	(MIL-E-1/700)
JAN 1N270	(MIL-E-1/992A)
JAN 1N276	(MIL-E-1/1025)
JAN 1N277	(MIL-E-1/993A)
JAN 1N281	(MIL-E-1/961)
USN 1N63	(MIL-E-1/376B)
USN 1N145	(MIL-E-1/811)

GERMANIUM DIODES

SUBMINIATURE
GLASS TRANSPARENT

Reliable under the most severe operating conditions. Rugged construction and 100% testing of electrical and mechanical characteristics insure excellent performance and long life.

See TE-1319A.

Transitron

electronic corporation • wakefield, massachusetts

"Leadership in semiconductors" SEE YOUR LOCAL AUTHORIZED TRANSITRON DISTRIBUTOR FOR QUANTITIES FROM 1-999.

Tele-Tips

(*Continued from page* 40)

System. Basic text was the Russian scientific reference tables "Ephemyerdi Mahlikh Planyet," a world-renowned astronomical work. The youngsters took telescopic photographs, calculated the orbit and compared the data with the Russian tables. There was a discrepancy of 350,000 miles between the two. Subsequent checks by the Univ. of California—Berkeley substantiated the youngsters' discovery.

ELECTRONIC FIRM that teenagers would most like to work for is G. E., according to a recent survey of 5,000 high school students.

RADAR can be a mighty effective fish-finder, particularly for large fish swimming on the surface. One small boat skipper cruising the New York waters uses his Lavoie radar to pinpoint swordfish, sailfish and makos. He's still in the process of learning how to differentiate the returns from fish and debris.

ELECTRONIC COOKING, which has been knocking at the door for a number of years, is now considered ready for a big breakthrough in public acceptance. Kaiser Aluminum & Chemical Corp., aluminum foil manufacturer, is working on specially designed packages for frozen foods that will make the best use of electronic ovens. By varying the size of a thermoplastic window in the container they will be able to control the rate of cooking.

MISSILE-SPACE AGE is creating a new jargon. Here are some samples:

A "greenhouse" is a check station where simulated flights are conducted.

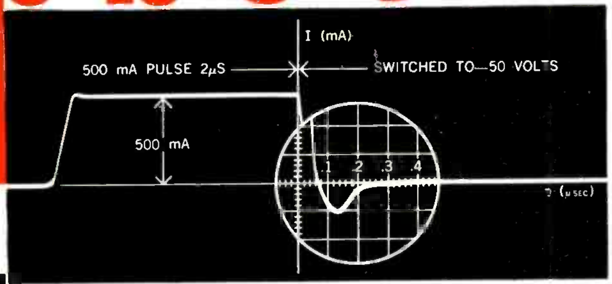
A "doghouse" is a protrusion that houses instruments on the rocket's otherwise smooth skin.

"Elephant ears" are thick plates that reinforce hatches and holes in the missile's body.

'Tranquilizers" are the instruments used to stabilize the missile's guidance system.

Fastest recovery yet...

0.5 0.4 0.3 µsec



½ AMPERE SILICON SWITCHING DIODES

. . . in a high-current silicon switching diode. The 1N920-1N923 series is the latest result of Sperry Semiconductor's unique developments for the computer field.

The most advanced addition to the industry's most complete line of high conduction fast recovery diodes, this series meets the severe requirements of high current pulse circuits for high speed computer switching, pulse clamping, gating, blocking, and diode logic circuits.

Designed for high temperature operation (to 175° C), the 1N920 series features high forward conductance (500mA at 1.0V.) and low leakage (50µA at 150° C). Peak dissipation is 800 mw.

All units feature a maximum recovery time of 0.3 microseconds to return to 10K ohms when switched from a forward current 2 microsecond pulse of 500mA to a reverse voltage of —50 volts (—30 V for 1N920), with a loop impedance of 1K ohms. Faster switching speeds are obtained at lower currents.

TENTATIVE DATA

Type	Working Inv. DC Voltage (Volts)	Max. Forward Voltage Drop at 25°C (V.)	Max. Inverse Current (µA) 25°C	150°C	Min. Saturation Voltage at 100µA 25°C	Max.* Recovery Time µsec.
1N920	36	1.0 at 500mA	.25	50 @ 30V.	40	0.3
1N921	70	1.0 at 500mA	.25	50 @ 60V.	80	0.3
1N922	100	1.0 at 500mA	.25	50 @ 90V.	120	0.3
1N923	130	1.0 at 500mA	.25	50 @ 120V.	150	0.3

*Refer to Sperry Bulletin No. 2103

SPECIAL SAMPLE OFFER

Order a sample lot for your own application at the special price of only $50 for a lot of 10 1N921 diodes. Direct your order to the So. Norwalk plant or the nearest Sperry sales office as listed below.

SPERRY

SPERRY SEMICONDUCTOR DIVISION, *SPERRY RAND CORPORATION, SOUTH NORWALK, CONN.*
Call or write: *Sperry Semiconductor, Wilson Avenue, SOUTH NORWALK, Conn., VOlunteer 6-1641; in NEW YORK PLaza 2-0885; / 3555 W. Peterson Ave., CHICAGO 45, Ill., KEystone 9-1776; 2200 East Imperial Highway, EL SEGUNDO, Calif., ORegon 8-6226.*

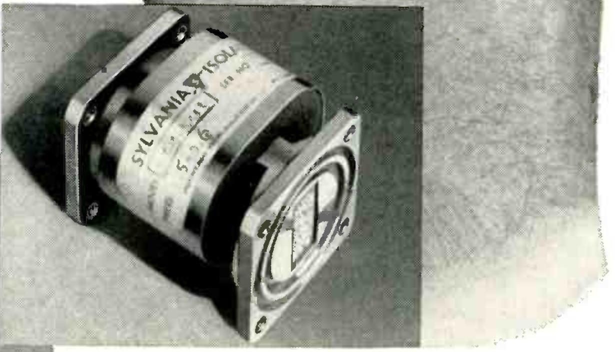
Circle 29 on Inquiry Card

Microwave Component News
from SYLVANIA

22 TYPES OF FERRITE DEVICES NOW IN FULL PRODUCTION AT SYLVANIA

COMPETITIVELY PRICED

Tee Circulator—FD-TC531—typical of Sylvania's tee circulator and isolator line is this model, which operates at 24 KMC, weighs only three ounces and is 1½" x 1½" x ¾". It is less expensive than conventional phase shift circulators. The line covers from 5.4 to 26 KMC.



Waveguide Isolator—FD-5213A—this miniature X-band isolator is representative of Sylvania's success in miniaturizing these important components. Units from 2.6 to 26 KMC are available.

Coaxial Isolator—FD-151P—representative of Sylvania's coaxial line, it gives octave coverage. The units in this line exhibit unequalled electrical performance and cover the range from 1 through 11 KMC.

EXPANDED facilities now make it possible for Sylvania to offer 22 different ferrite devices as full production items at competitive prices. These production units represent over one-third of the types now in Sylvania's growing line of ferrite devices.

Modifications of Sylvania ferrite devices can be provided within three weeks. In addition, new types developed to meet your special requirements can be delivered in as little as 60 days, and we can be in full production on these new items within 60 days after design approval.

All ferrite devices in the line are made to Sylvania's recognized high standards and have these characteristics:

FREQUENCIES from 1 to 26 KMC
ISOLATION up to 80 db
INSERTION LOSS as low as 0.2 db

SYLVANIA GENERAL SYSTEM
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS
Sylvania Electric Products Inc.
Special Tube Operations
500 Evelyn Ave., Mountain View, Calif.

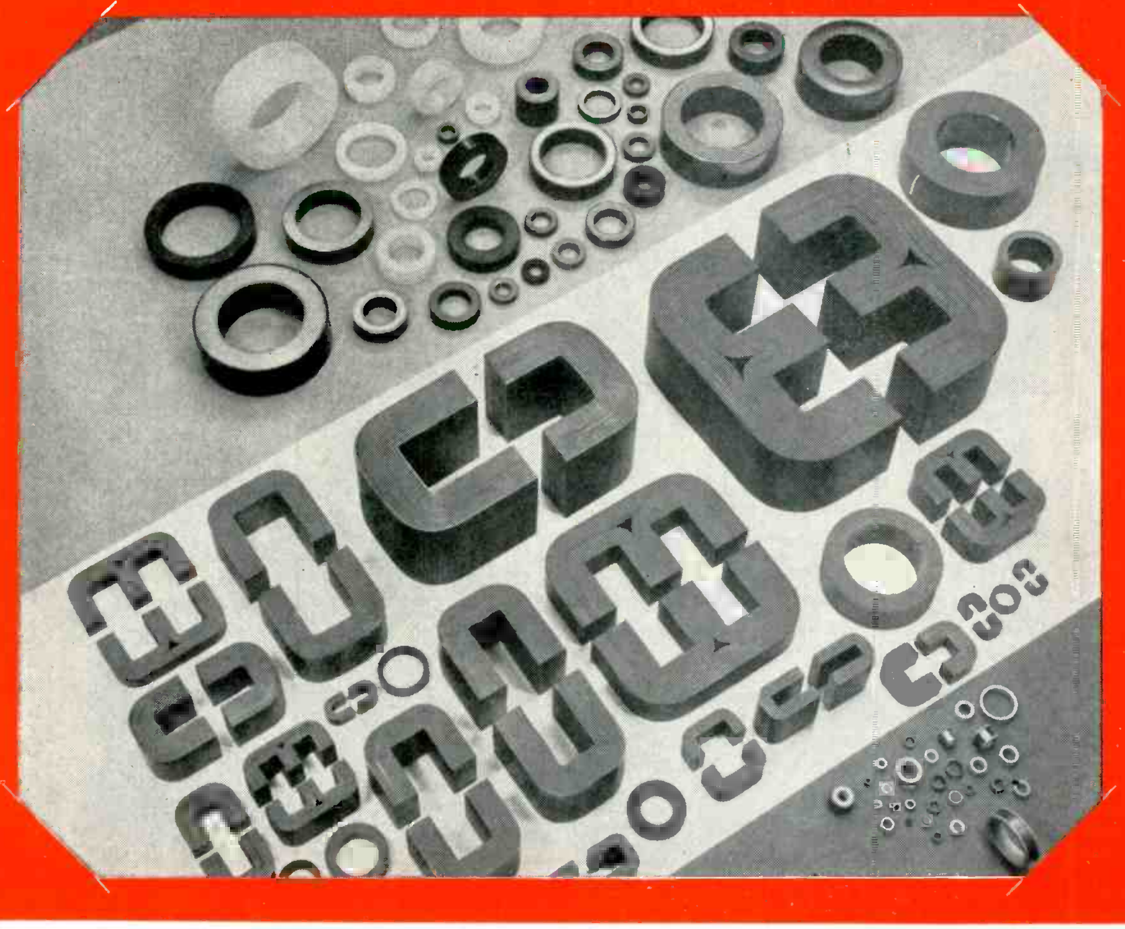
New Catalog—Get this new ferrite catalog free from your Sylvania sales office, or by writing to the address below.

Component Specification: ARNOLD

TOROIDAL CORES
Aluminum and Plastic Cased

SILECTRON CORES
Types C, E and O

BOBBIN CORES
Stainless Steel and Ceramic



The ARNOLD LINE-UP includes ANY TAPE CORES you need

APPLICATIONS

We'll welcome your inquiries on your Tape Wound Core requirements for Pulse and Power Transformers, 3-Phase Transformers, Magnetic Amplifiers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Reactors, Coincident Current Matrix Systems, Static Magnetic Memory Elements, Harmonic Generators, etc.

ENGINEERING DATA

For data on the various types of Arnold Tape Cores, write for these Bulletins:

SC-107A—*Silectron Cores, Types C, E and O*
TC-101A—*Toroidal Cores, of Supermalloy, Deltamax and 4-79 Mo-Permalloy*
TC-108A—*Bobbin Cores*
TC-113A—*Supermendur Tape Cores*

ADDRESS DEPT. T-01

Arnold produces Silectron C, E and O cores, aluminum and plastic cased toroidal cores of high-permeability materials, and bobbin-wound cores to meet whatever your designs may require in tape thickness, material, core size or weight.

As a fully integrated producer, Arnold controls every manufacturing step from the raw material to the finished core . . . and modern testing equipment permits 100% inspection of cores before shipment.

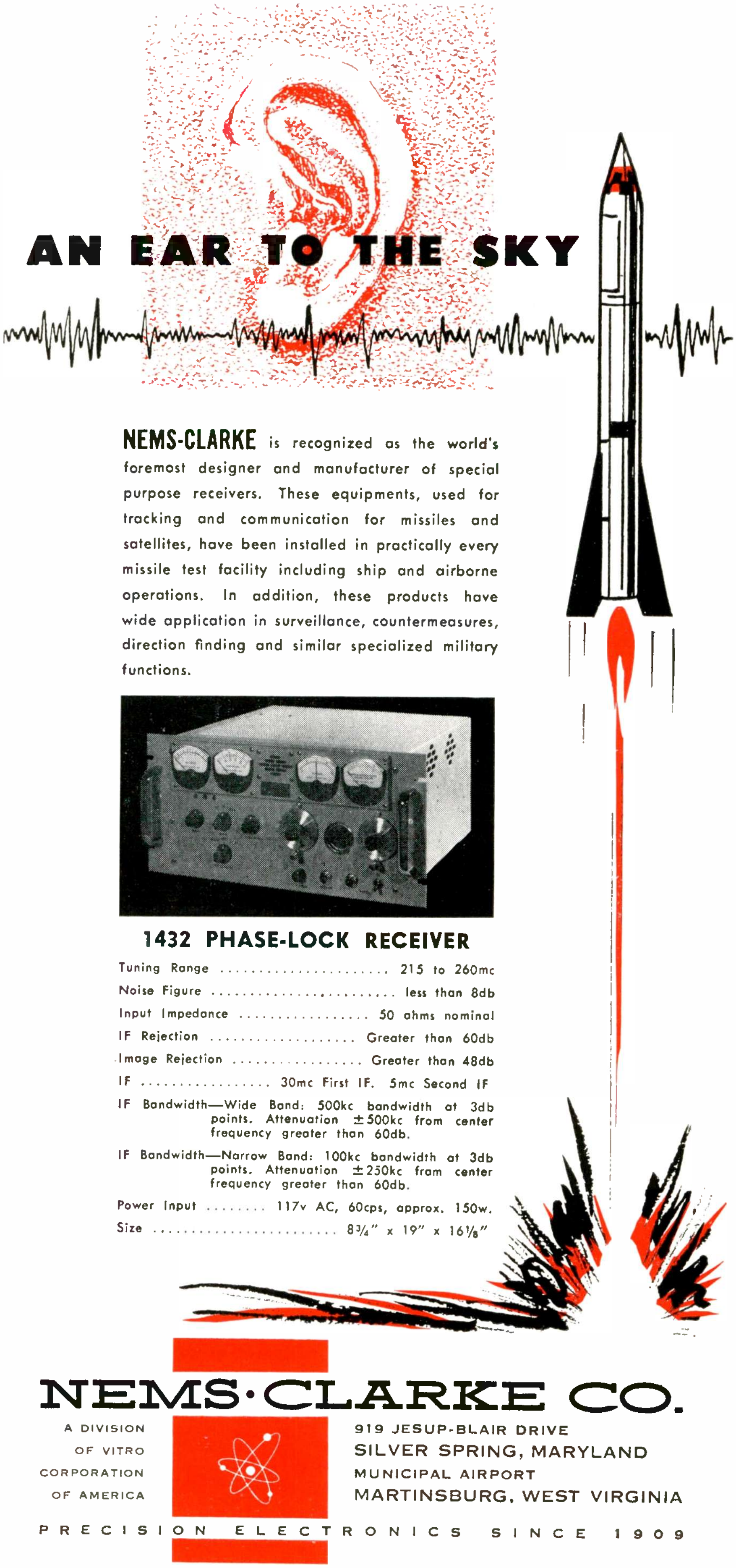
Wide selections of cores are carried in stock as standard items for quick delivery; both for engineering prototypes to reduce the need for special designs, and for production-quantity shipments to meet your immediate requirements.

• *Let us help you solve your tape core problems.* Check Arnold, too, for your needs in Mo-Permalloy or iron powder cores, and for cast or sintered permanent magnets made from Alnico or other materials. Just write or call *The Arnold Engineering Company, Main Offices, Marengo, Illinois.*

7521 C

ARNOLD
SPECIALISTS in MAGNETIC MATERIALS

BRANCH OFFICES and REPRESENTATIVES in PRINCIPAL CITIES
Find them FAST in the YELLOW PAGES



Letters

to the Editor

"Add Us To Your List Of Diode Manufacturers—"

Editor, ELECTRONICS INDUSTRIES:

Again your publication has performed another greatly needed service for all facets of the electronic industry. Your supplement "Semiconductor Diode Specifications," June issue, and added to with your August issue, is undoubtedly the "almost" complete listing of diodes and rectifiers published in this country to date.

I say "almost" due to the fact that the silicon semiconductor diodes types made by Dallons Semiconductors Division of Dallons Laboratories, Inc., were omitted. This was through no fault of anyone concerned but due to an element of time and publishing schedules.

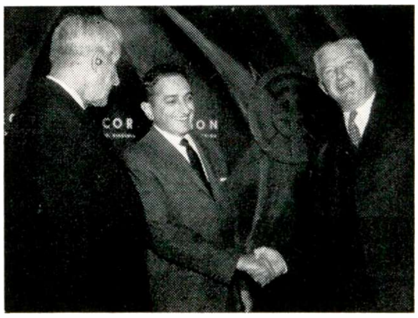
In view of the above I would like to give you a brief idea of our high quality medium power range (up to 35 amperes):

IN248A
IN249A
IN250A
IN1183
IN1184
IN1185
IN1186
IN1187
IN1188
IN1189
IN1190
IN1434
IN1435
IN1436
IN1437
IN1438
IN2154
IN2155
IN2156
IN2157
IN2158
IN2159
IN2160

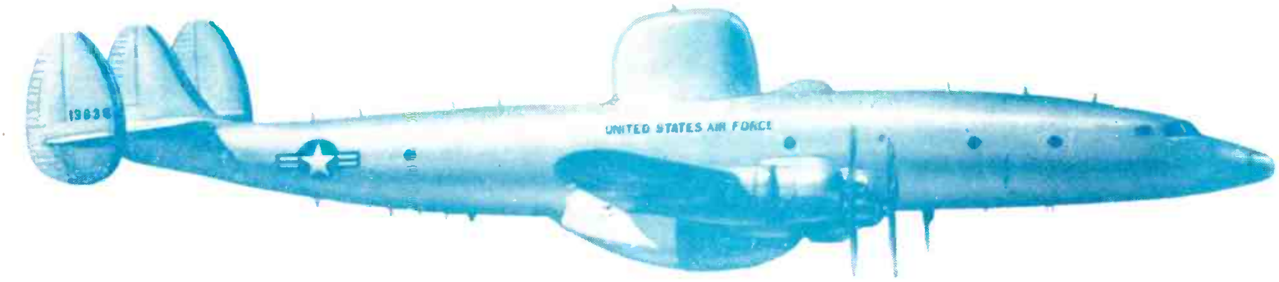
I am convinced that through the publishing of a complete listing of specifications and manufacturers of wire, transistors and diodes, etc., you are performing a service beneficial to all concerned in the growing industry of electronics.

Tom E. Ciochetti
Sales Manager
Dallons Semiconductors
5066 Santa Monica Blvd.
Los Angeles 29, Calif.

ELECTRONIC EXHIBIT



Secretary of Commerce Frederick H. Mueller (right), and Patents Commissioner, Robert C. Watson (left), congratulate Electro Tec Pres., George J. Pandapas on his company's exhibit at the Patent Office's "Electronic-Electrical" display. Sixteen corporations participated in the exhibit.

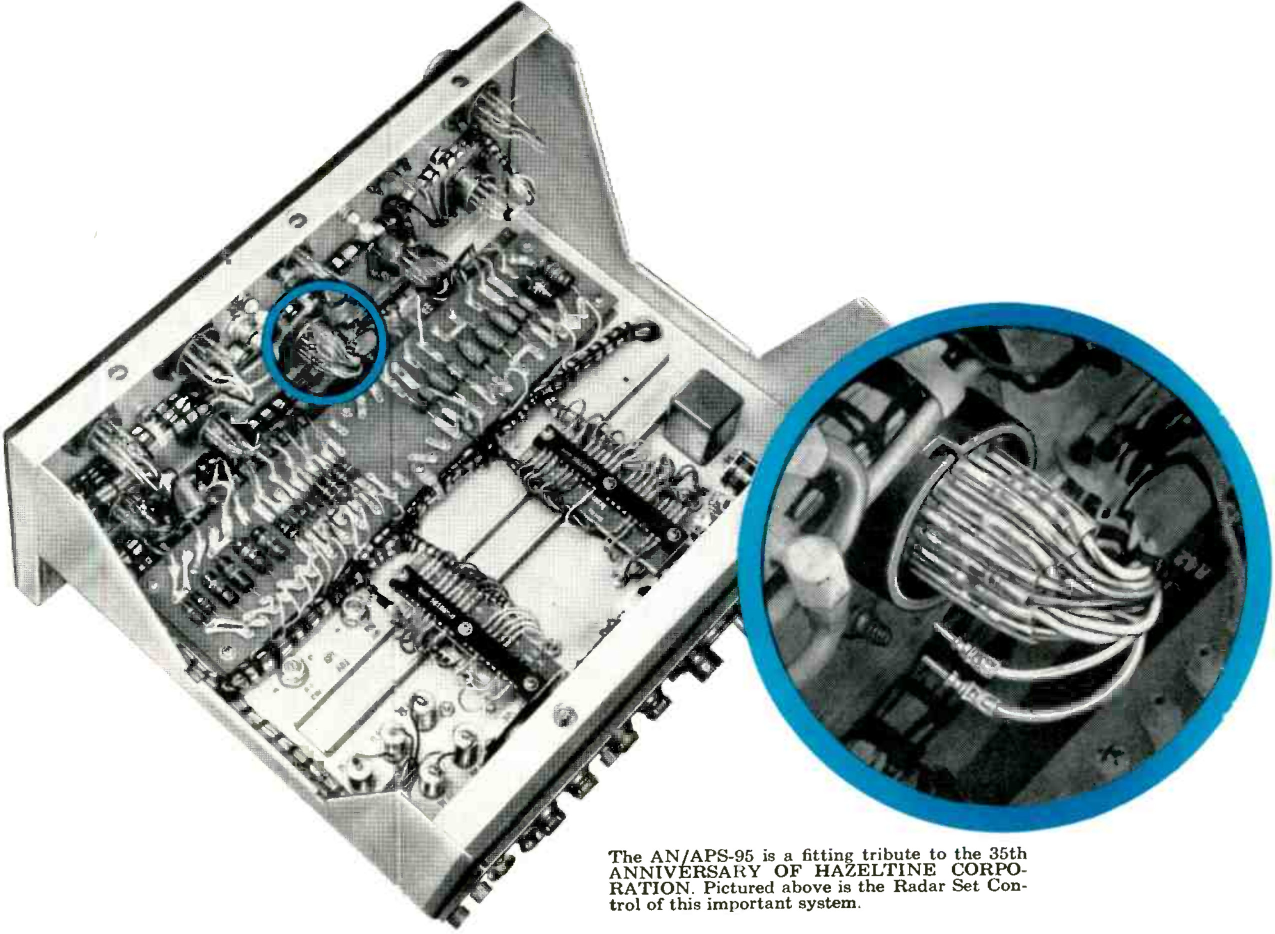


In achieving airborne radar reliability...
HAZELTINE
SPECIFIES A-MP TAPER TECHNIQUE

Designed for this U. S. military Airborne Early Warning Radar plane is one of the most important radar systems in the free world—Hazeltine Corporation's new AN/APS-95. Developed for duty around the clock in all weather, it cannot fail.

And—because it must not fail, Hazeltine engineers specified A-MP Solderless Taper Pins and matching Blocks for all critical circuits. A-MP Taper Technique gives Hazeltine the uniform top reliability and compact size it demands as well as great versatility: formed or pre-insulated solid taper pins in three series; wide size range of stackable one- or two-piece blocks plus precision crimping tools. Everything is solderless, of course.

Industry-proved reliability can be yours too, with this outstanding A-MP Taper Technique. Write today for more information.



The AN/APS-95 is a fitting tribute to the 35th ANNIVERSARY OF HAZELTINE CORPORATION. Pictured above is the Radar Set Control of this important system.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Australia • Canada • England • France • Holland • Italy • Japan

Circle 33 on Inquiry Card

STACKPOLE
Coldite 70®+

fixed composition **RESISTORS**
1/2-, 1- and 2-watt sizes

The resistors that are setting today's higher performance standards! Unmatched for load life and moisture resistance—and, with performance that exceeds MIL-R-11 requirements. And now, for the first time, you can get such resistors in a *complete* line of RC-42 (2-watt); RC-32 (1-watt) and RC-20 (1/2-watt) types from stock from leading distributors!

NOW YOU CAN GET THEM
Immediately!

. . . in any standard value or tolerance

. . . for small runs, for production emergencies, for military prototypes and for hurry-up design and engineering projects.

FROM STOCK . . . from these selected STACKPOLE distributors:

BALTIMORE, MD.
Kann-Ellert Electronics, Inc.
BATTLE CREEK, MICH.
Electronic Supply Corp.
BIRMINGHAM, ALA.
MG Electrical Supply Co.
BOSTON, MASS.
Sager Electrical Supply
BROOKLYN, N. Y.
Electronic Equipment Corp.
CLEVELAND, OHIO
Pioneer Electronic Supply Co.
DALLAS, TEXAS
Wholesale Electronics Supply Co.
DAYTON, OHIO
Srepco, Inc.

DENVER, COLO.
Denver Electronics Supply Co.
GLENDALE, CALIF.
R. V. Weatherford Company
INDIANAPOLIS, INDIANA
Radio Distg. Co.
KANSAS CITY, MO.
Burstein-Applebee Co.
MELBOURNE, FLORIDA
Electronic Supply
MIAMI, FLORIDA
Electronic Supply
NEW YORK, N. Y.
Harvey Radio Co.
PHILADELPHIA, PA.
Almo Radio Co.

SAN DIEGO, CALIF.
Radio Parts Co.
SCRANTON, PA.
Fred P. Pursell
SEATTLE, WASH.
C & G Radio Supply Co.
ST. LOUIS, MO.
Interstate Supply Co.
SYRACUSE, N. Y.
Morris Electronics of Syracuse
TACOMA, WASH.
C & G Radio Supply Co.
WASHINGTON, D. C.
Electronic Wholesalers, Inc.
WATERBURY, CONN.
Bond Radio Supply Co. Inc.

WEST PALM BEACH, FLA.
Goddard Distributors, Inc.
WICHITA, KANSAS
Interstate Electronic Sup. Corp.
WILBRAHAM, MASS.
Industrial Components Corp.
WINSTON-SALEM, N. C.
Dalton-Hege Radio Supply

. . . and G-C/STACKPOLE, TOO!

Attractively packaged by G-C Electronics for service replacement uses, Coldite 70+ Resistors are also available through over 800 G-C distributors.

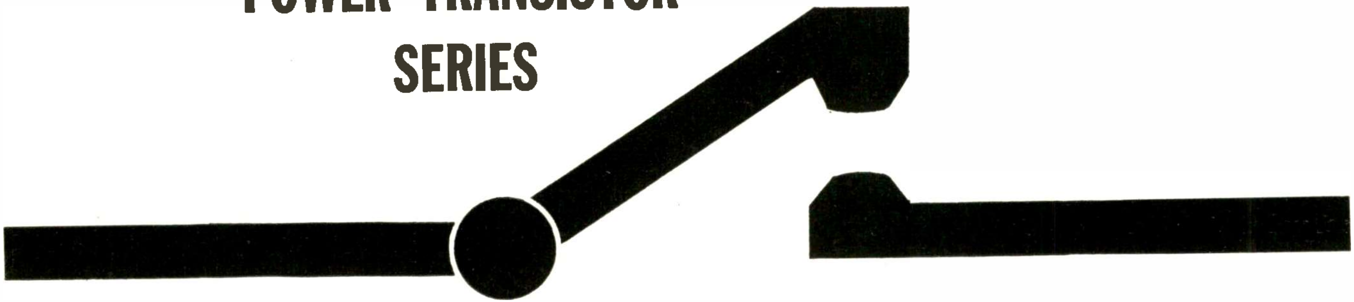
Circle 34 on Inquiry Card

NOW!

Bendix

25-AMP

POWER TRANSISTOR SERIES



Now in production by Bendix are eight 25-ampere peak current power transistors capable of switching up to 1000 watts—and you can get immediate delivery on all eight types.

Newly improved in design, the transistors have a higher gain and flatter beta curve. The series is categorized in gain and voltage breakdown to provide optimum matching and to eliminate burn-out.

Current Gain hFE at Ic = 10 Adc	Maximum Voltage Rating			
	50 Vcb	60 Vcb	90 Vcb	100 Vcb
	30 Vce	40 Vce	70 Vce	80 Vce
20—60	2N1031	2N1031A	2N1031B	2N1031C
50—100	2N1032	2N1032A	2N1032B	2N1032C

Ask for complete details on this newly improved Bendix transistor series . . . and on the entire Bendix line of power transistors and power rectifiers. Write SEMICONDUCTOR PRODUCTS, BENDIX AVIATION CORPORATION, LONG BRANCH, NEW JERSEY, or the nearest sales office.

West Coast Sales Office:
117 E. Providencia Avenue, Burbank, California
Midwest Sales Office:
4104 N. Harlem Avenue, Chicago 34, Illinois
New England Sales Office:
4 Lloyd Road, Tewksbury, Massachusetts
Export Sales Office: Bendix International Division,
205 E. 42nd Street, New York 17, New York
Canadian Affiliate: Computing Devices of Canada, Ltd.,
P. O. Box 508, Ottawa 4, Ontario, Canada

SEMICONDUCTOR PRODUCTS

Red Bank Division

LONG BRANCH, N. J.

Bendix
AVIATION CORPORATION

Circle 35 on Inquiry Card

new, low-cost Keithley micro-microammeter

MODEL 414 *offers high performance over 17 ranges for just $280*

Think of the many ways you could use a truly dependable and economical micro-microammeter:

- testing reverse leakages in diodes and transistors, and grid currents in vacuum tubes. The 414 is ideal for many production tests, requiring only manipulation of a single range switch and very infrequent zero checks.
- monitoring and controlling nuclear reactors. The 414 costs less per channel than more complex systems, offers greater dependability and safety because each channel is independent of the others.
- measuring photocell currents, determining radioactivity in "tagged" biological samples, measuring leakages of insulators, resistors, and capacitors. You can convert the 414 for current integration, use it in a thickness gauge, or as an ionization gauge control.

The 414 is built to the same rigid standards as other, more sensitive Keithley products. It is available with a contact meter for go no-go production tests, alarm and control systems.

SPECIFICATIONS

17 RANGES in 1x and 3x steps, from 10 milliamperes to 0.1 milli-microampere full scale.

ACCURACY within ±3% full scale on all ranges down to 10 milli-microamperes, and within 4% on the more sensitive ranges.

INPUT DROP of less than five millivolts on all ranges, with full-scale signals.

RESPONSE TIME of less than 0.5 second on all ranges for any input capacitance up to 5000 micro-microfarads.

ZERO DRIFT of less than 2% of full scale, in any eight-hour period, on any range.

RECORDER OUTPUT of 5 volts with a 1-ma capability.

INPUT CONNECTOR at front; output connectors at both front and back.

DIMENSIONS 19″ x 5¼″ high x 10″ deep. Net weight, 16 pounds.

PRICE $280.00

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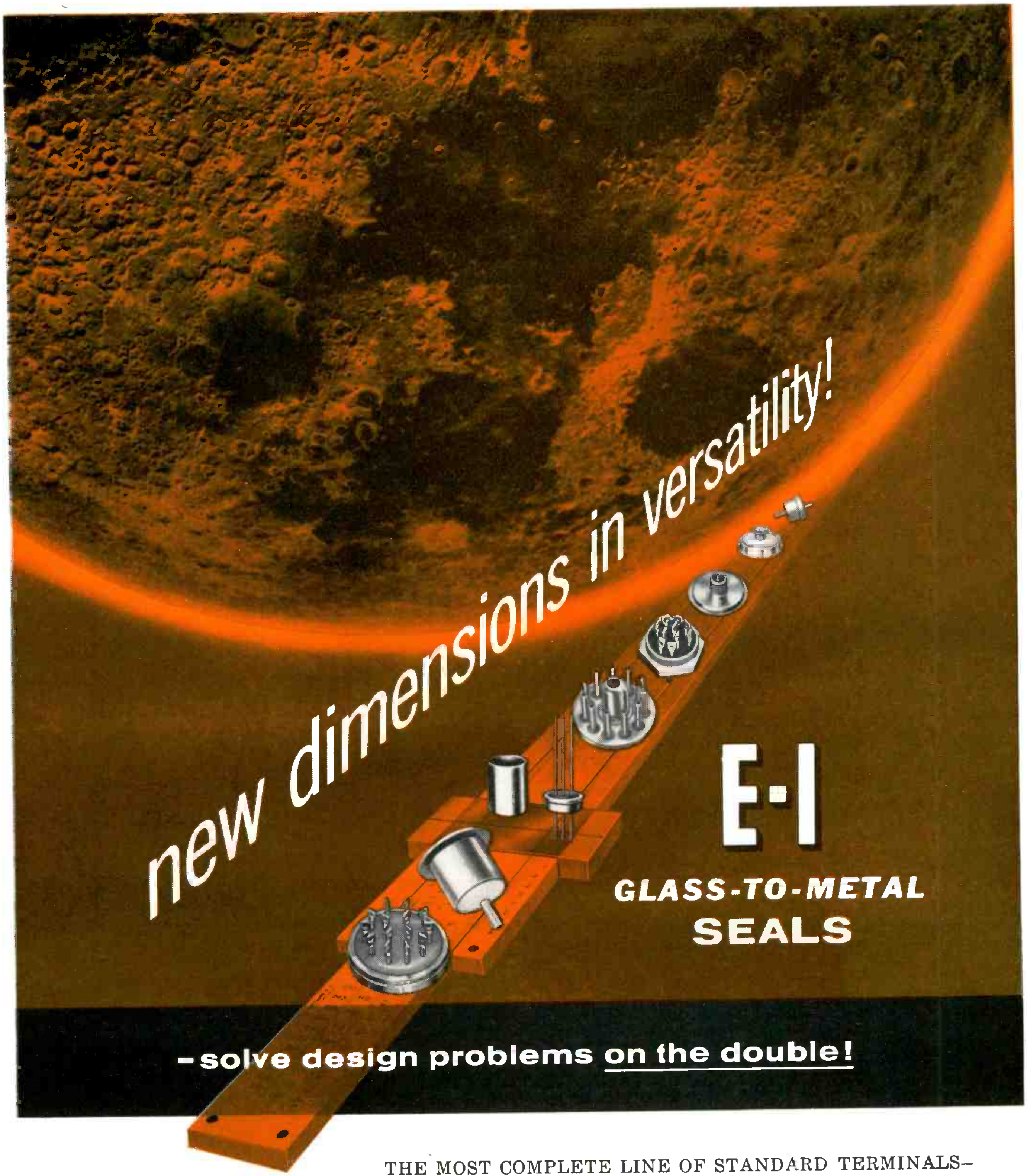

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ELECTRICAL INDUSTRIES
A Division of Philips Electronics & Pharmaceutical Industries Corp.
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Books

Handbook of Automation Computation, Volume #2, Data Processing

By E. M. Grabbe, S. Ramo, and D. E. Wooldridge. Published 1959 by John Wiley & Sons, Inc., 440 4th Ave., New York 16. Price $17.50.

This handbook is directed toward the problem solvers—the engineers, scientists, technicians, managers, and others from all walks of life who are concerned with applying technology to the mushrooming development in automatic equipment and systems. The authors have gathered together in one place the available theory and information on general mathematics, feedback control, computers, data processing, and systems design.

Emphasis has been on practical methods of applying theory, new techniques and components, and the ever broadening roll of the electronic computer. Each chapter starts with definitions and descriptions aimed at providing perspective and moves on to more complicated theory, analysis, and applications.

In general, the handbook assumes some engineering training and will serve as an information source and refresher for practicing engineers.

Exploding Wires

By H. K. Moore, and W. G. Chace. Published 1959 by Plenun Press Inc., 227 W. 17th Street, New York 11. 373 pages. Price $9.50.

This significant monograph on exploding wires is the first to be published in any language. The ever increasing interest in this important scientific phenomenon was initially indicated by the overwhelming response to the Conference on Exploding Wires Phenomenon.

This book not only records this conference, but fills a large gap in the literature on this subject. This work will prove extremely useful to all workers in the field of high speed photography, shockwave, and thermonuclear research. It will also prove useful to students, technologists, and scientists concerned with the fluid physics field.

The conference was held in April 1959 and was conducted by the Geophysics Research Directorate, Air Force Cambridge Research Center with the cooperation of Lowell Technological Institute Research Foundation.

Modern Electronic Components

By G. W. A. Dummer. Published 1959 by Philosophical Library Inc., 15 E. 40th St., New York 16. 472 pages. Price $15.00.

The vastly increased range and complexity of modern electronic equipment has been made possible, to a considerable extent, by the development of components with the appropriate electrical characteristics, size and reliability.

In this book, the author has sought

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Capacity 1¼ gal. **$350**

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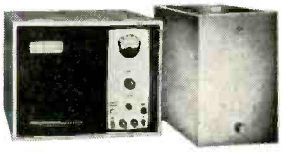
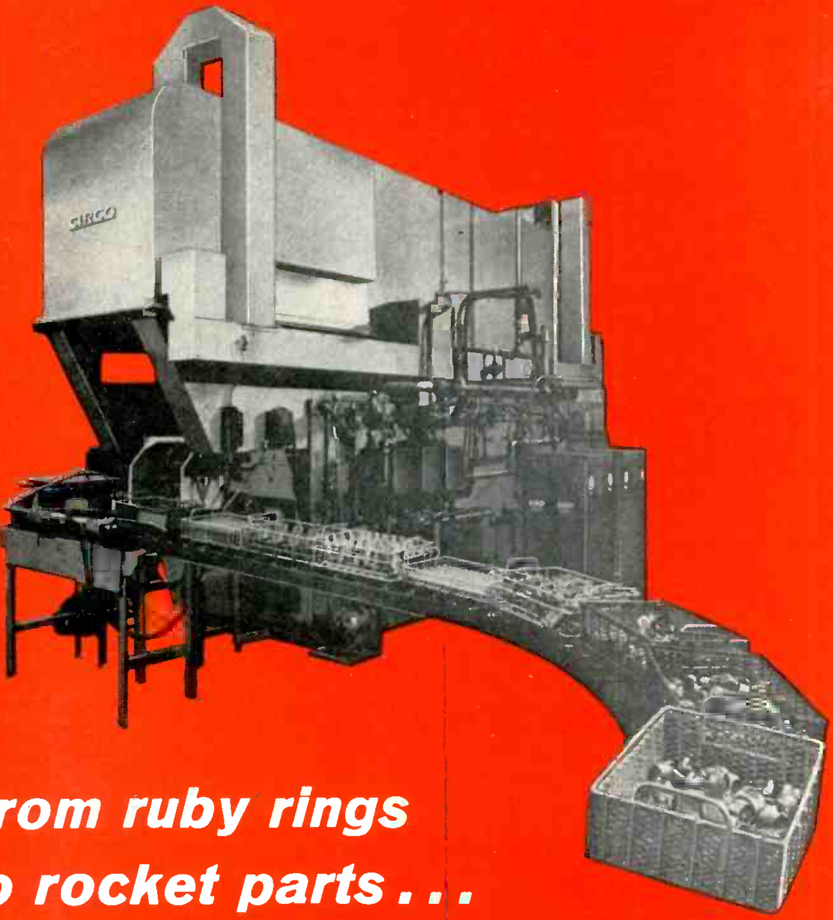


Model BC250
Capacity 5 gal. **$750**

Model BC500
Capacity 12 gal. **$1375**

Model BC1000
Capacity 25 gal. **$2750**



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Books

to present the first comprehensive survey of the characteristics of the more common components, together with information on their behavior under the arduous environmental conditions to which they are now frequently subjected. Chapters on component specifications, transistor type circuit components, reliability, future developments, etc., are also included, and a selected bibliographics to many chapters will help the reader to find the more important sources of specialized information.

Ferrites

By J. Smit and H. P. J. Wijn. Published 1959 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 369 pages. Price $10.00.

This book treats ferrites on an intermediate level. The term ferrite is used to refer to all magnetic oxides containing iron as the major metallic component.

The characteristics of ferrites that are of importance for application purposes are presented and discussed and, whenever possible, explained in terms of intrinsic properties. These properties are in turn treated in relation to the chemical composition of the materials.

The authors deal with many actual problems of the theory of phenomena occurring in ferromagnetic materials during various processes of magnetization. They make greater use of simple physical models than of rigorous mathematical derivations.

The book takes into consideration work conducted in the Philips Research Laboratories in Eindhoven, Netherlands.

Two-Way Radio

By Allan Lytel. Published 1959 by McGraw-Hill Book Co. Inc., 330 W. 42nd St., New York 36, N. Y. 304 pages. Price $9.50.

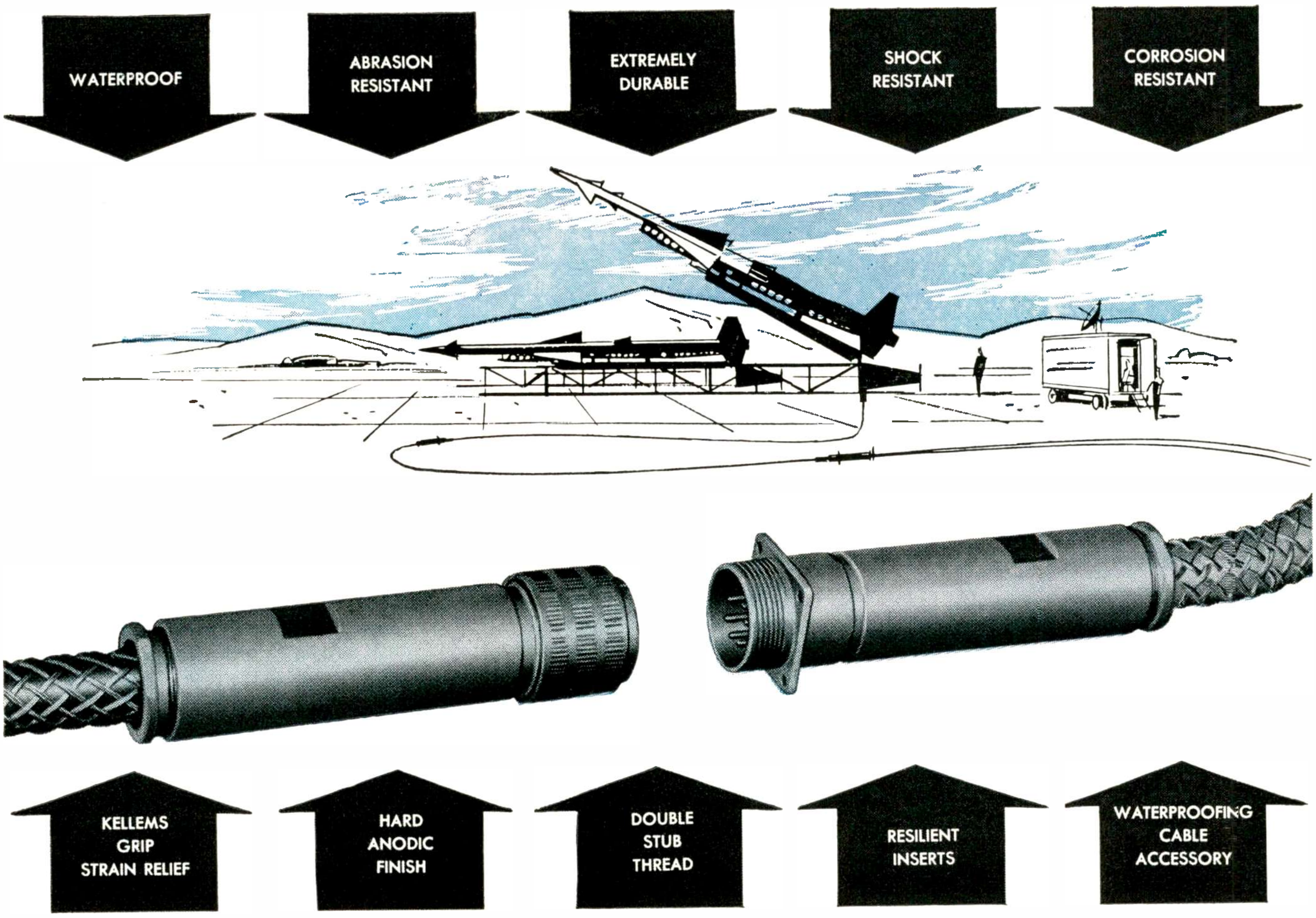
In this single volume one finds an introduction to the theory and practice of voice-modulated radio communications that covers mobile (vehicle) and base-station (fixed) radio transmitters and receivers, plus the related test equipment. The book provides a logical, step-by-step study of the whole field, and covers both AM and FM transmitters and receivers, antennas, selective calling methods, power supplies, installation, and servicing.

Newer types of AM, such as single side band, surpressed carrier sideband, synchronous AM plus the use of transistors, are included together with illustrations that explain technical details.

Nomography, 2nd Ed.

By Alexander S. Levens. Published 1959 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 296 pages. Price $8.50.

This new edition offers three completely new chapters on: circular



Why it pays you to specify

BENDIX QWL ELECTRICAL CONNECTORS FOR USE WITH MULTI-CONDUCTOR CABLE

Used extensively on ground launching equipment for missiles and on ground radar, and other equipment, the Bendix* QWL Electrical Connector meets the highest standards of design and performance.

A heavy-duty waterproof power and control connector, the QWL Series provides outstanding features:

- The strength of machined bar stock aluminum with shock resistance and pressurization of resilient inserts.
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- The resistance to loosening under vibration provided by special tapered cross-section thread design. (Easily hand cleaned when contaminated with mud or sand.)
- The outstanding resistance to corrosion and abrasion of an aluminum surface with the case hardening effect of Alumilite 225 anodic finish.
- The firm anchoring of cable and effective waterproofing provided by the cable-compressing gland used within the cable accessory.
- The watertight connector assembly assured by neoprene sealing gaskets.
- The additional cable locking produced by a cable accessory designed to accommodate a Kellems stainless steel wire strain relief grip.
- Prevention of inadvertent loosening insured by a left-hand accessory thread.
- The high current capacity and low voltage drop of high-grade copper alloy contacts. Contact sizes 16 and 12 are closed entry design.

These are a few of the reasons it will pay you to specify the Bendix QWL electrical connector for the job that requires exceptional performance over long periods of time.

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Scintilla Division
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Bendix
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Books

nomograms; projective transformations; and the relationship between concurency (Cartesian) and alignment nomograms with applications to experimental data. In addition, the author has expanded three chapters to include: methods for designing nomograms for four variables without the need of a turning axis; material on nomograms which consist of two curved scales and a straight line scale, and three curved scales; and a more extensive treatment of the use of determinants.

The mathematical developments for the various type forms throughout the book have been simplified, and many new problems and examples have been introduced. The appendix contains 58 nomograms in such fields as; statistics, tests and measurements, various branches of engineering, physical and biological sciences, food technology, heat transfer, satellite launching, radio activity, etc.

Books Received

The Statistical Theory of Signal Detection

By Carl W. Helstrom. Published 1959 by Pergamon Press, Inc., 122 E. 55th St., New York 22. 363 pages. Price $9.50.

International Tube Encyclopedia

Available from Industrial Promotion Service Corp., 1182 Broadway, New York 1. 700 pages. Price $15.00, plus postage handling.

Space Technology

Published 1959 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 1188 pages. Price $22.50.

How to Increase your Creative Output

Published 1959 by Industrial Relations News, Book Dept., 230 W. 41st St., New York 36. 22 pages, paper bound. Price $1.50.

Tables of the Bivariate Normal Distribution Function and Related Functions

Published 1959 by National Bureau of Standards U. S. Dept. of Commerce. 258 pages. Price $3.25. Order from Supt. of Documents, U. S. Government Printing Office, Washington 25, D. C.

Essential Characteristics

Published 1959 by General Electric Co., Receiving Tube Dept., Owensboro, Ky. 268 pages, paper bound. Price $1.00.

Transistor Work Shop Lecture Series

Published 1959 by Boston Section, IRE, Rome 1006, 73 Tremont St., Boston 8, Mass. Price $5.00.

1960 Microwave Catalog

Published 1959 by DeMornay-Bonardi, 780 S. Arroyo Pkwy., Pasadena, Calif. 320 pages. Available without charge to engineers engaged in microwave work who requests it on a company letterhead.

RCA Power and Gas Tubes

Published 1959 by Electron Tube Div., Radio Corp. of America, Harrison, N. J. 32 pages, paper bound. Price $.30.

* * *

Personals

Robert A. Franklin has been appointed Manager of Engineering of Stromberg-Carlson, San Diego, Calif., a Div. of General Dynamics Corp.

Stephen P. Sanders is now Chief of Environmental Testing Laboratory, Bendix Aviation Corp., Products Div.-Missiles.

North Atlantic Industries Inc., has appointed **Jack Blair** to the post of Chief Mechanical Design Engineer.

Dr. Robert A. Fuchs has joined Electro-Optical Systems, Inc., as a Principal Scientist and Head of the Systems Analysis Group of the Space Defense Systems Div.

William P. Montague has been named Assistant Director of Electronic Requirements for The Martin Co.

American Super - Temperature Wires, Inc., has appointed **James Kenny** as Vice-President in Charge of Engineering. He had previously been Chief Engineer.

J. Kenny

S. Fader

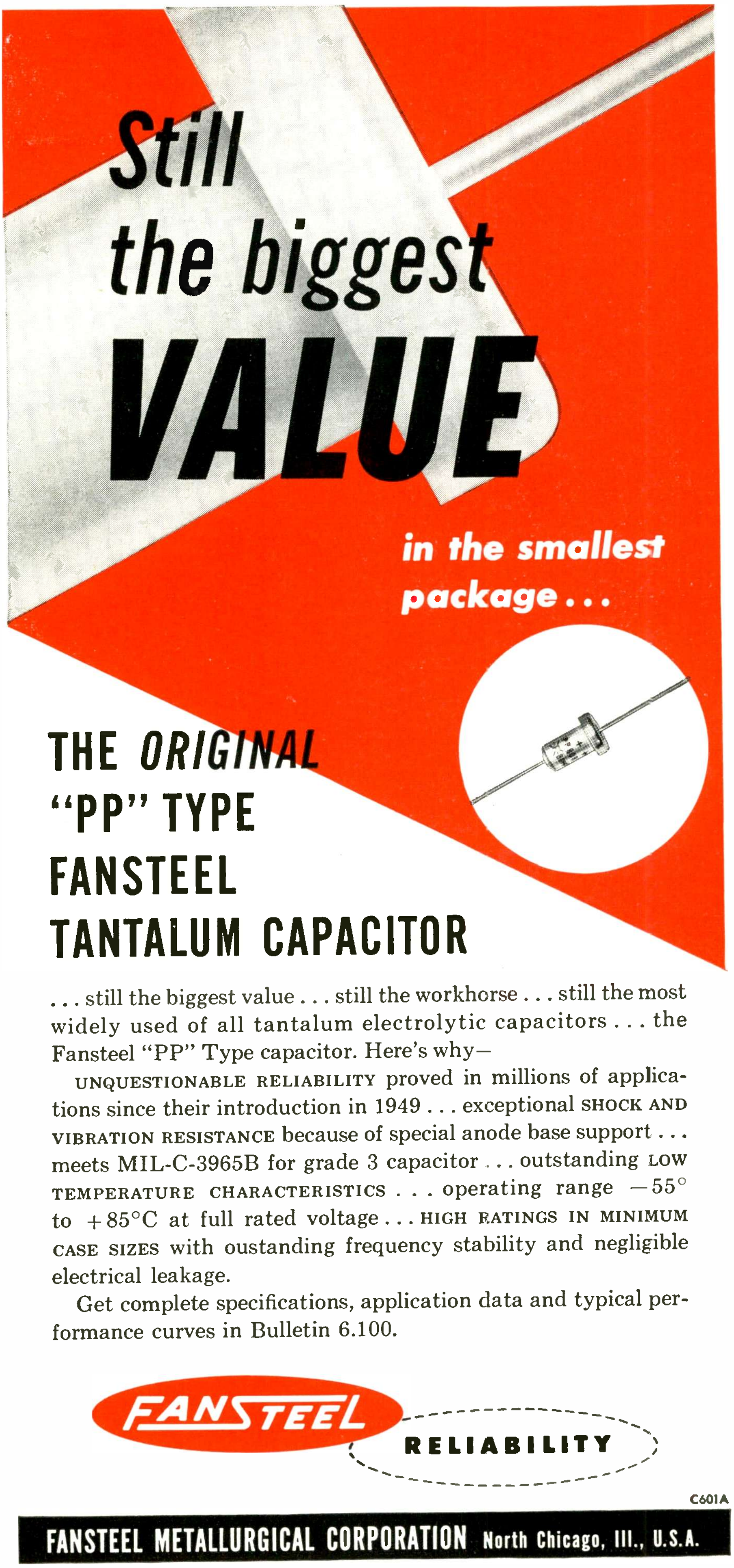
ESC Corp. announced the appointment of **Seymour Fader** to head its entire manufacturing operation. He was formerly Consulting Industrial Engineer for Koor Industries and Crafts Co., Ltd., Tel Aviv, Israel.

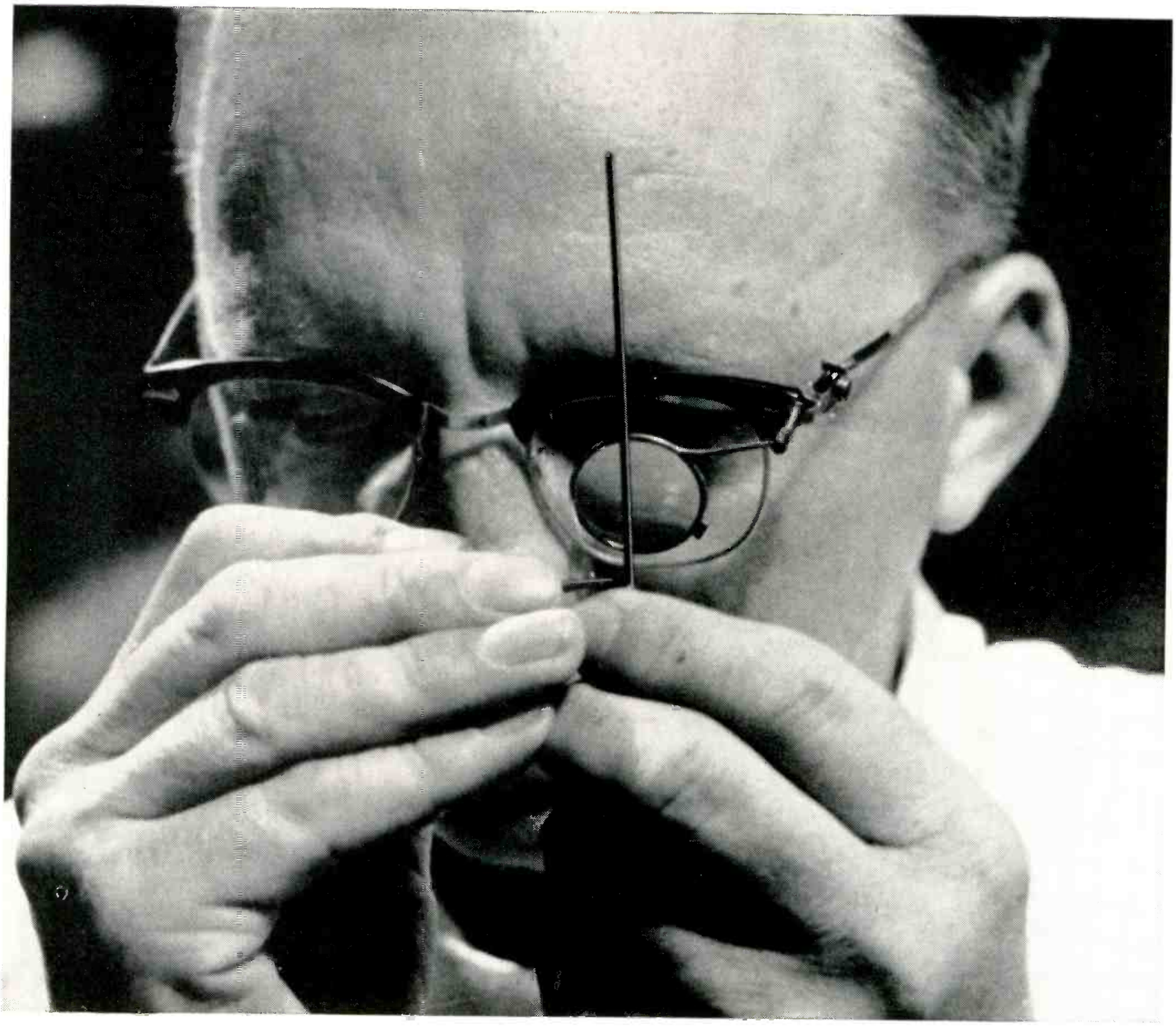
Former U. S. Navy Lt. Commander **Harold R. Walker** has been appointed to the post of Chief Engineer of the Special Products Div., Blonder-Tongue Laboratories, Inc.

Dr. K. N. Satyendra has been appointed Director of Research for the Electronic Systems and Equipment Dept. of Nortronics Div., Northrop Corp.

Stephen J. Jatras is now Director of Engineering of the Lockheed Electronics and Avionics Div. (LEAD).

Panellit, Inc., has appointed **Stanley Knoblock** Chief Engineer of its Eastern division.





Constant surveillance is your assurance of Borg reliability

The technician in the photo above is inspecting a .001" wire which is wound around the mandrel he is holding. This hair-like wire will become the resistance element for a Borg 900 Series Micropot Potentiometer. Because the resistance element is the most important single part of any potentiometer, every 900 Series Micropot element is carefully inspected during and after winding . . . one more reason for the Borg 900 Series Micropot reputation for high reliability. Write for complete military and commercial specifications.

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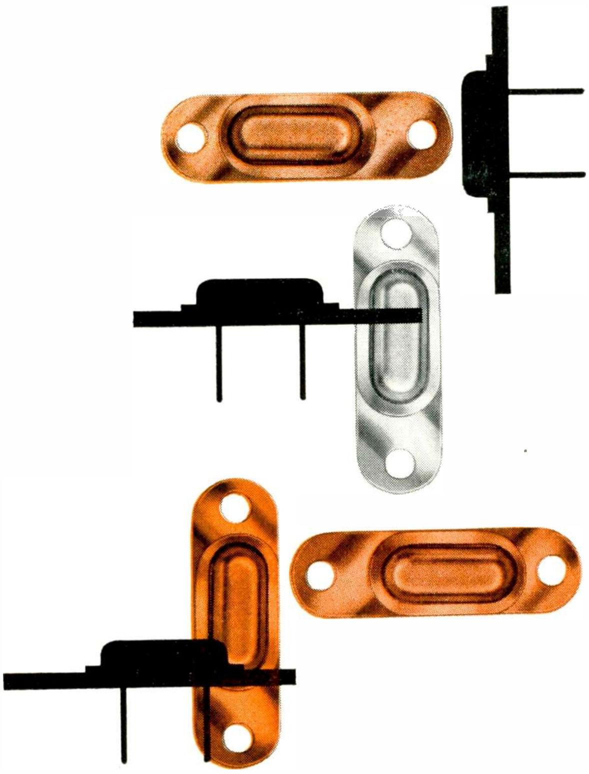
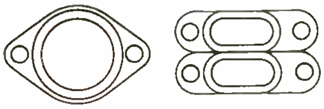


CLEVITE'S NEW
SPACESAVER
TRANSISTOR



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THREE AMPERE SWITCHING TYPES

TEST	CTP 1728	CTP 1735	CTP 1729	CTP 1730	CTP 1731	CTP 1736	CTP 1737	CTP 1733
Min BVcbo @ 2 ma (volts)	40	60	80	100	40	60	80	100
Min BVceo @ 500 ma (volts)	25	40	55	65	25	40	55	65
Min BVces @ 300 ma (volts)	35	50	65	75	35	50	65	75
Max Icbo @ 90°C @ Max Vcb (ma)	10	10	10	10	10	10	10	10
Max Icbo @ 2 V (μa)	50	50	50	50	50	50	50	50
D. C. Current Gain @ 0.5A	30-75	30-75	30-75	30-75	60-150	60-150	60-150	60-150
Max Veb @ 3.0 A (volts)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Max Vce (sat) @ 3.0A, 300 ma (volts)	1.0	1.0	1.0	1.0	0.8	0.8	0.8	0.8
Min fae @ 3.0 A (kc)	20	20	20	20	15	15	15	15
Max Thermal Resistance (°c/w)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Compared with present power transistors of similar ratings, the new Clevite *Spacesaver* gives you important new advantages.

Better Switching — Its low base resistance gives lower input impedance for the same power gain and lower saturation resistance, resulting in lower "switched on" voltage drop. Its lower cut off current means better temperature stability in direct coupled circuits (such as regulated power supplies) and a higher "switched off" impedance.

Better Amplifying — Improved frequency response leads to higher audio fidelity, faster switching and improved performance in regulated power supply applications.

Better Mounting — The *Spacesaver's* simple rectangular configuration and low silhouette make it adaptable to a wide variety of mounting requirements where space is at a premium. In aircraft and missile applications, its low mass (half present type) improves shock and vibration resistance of lightweight assemblies.

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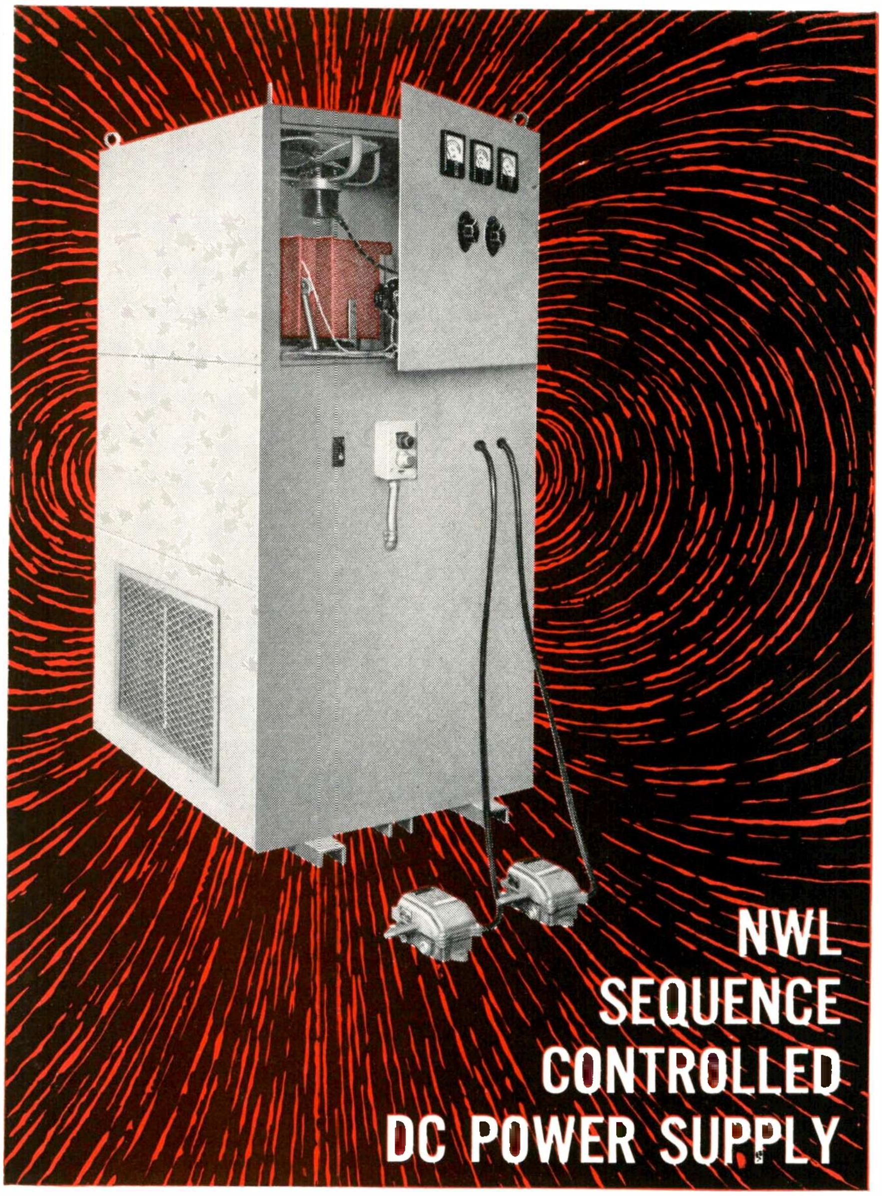


Personals

The appointment of **Cyril L. Fernquist** as Chief Electro-Mechanical Design Engineer has been announced by Transistor Electronics Corp.

Philip C. Wright has been appointed Engineering Program Manager for Motorola's B-70 bomber electronics subcontract.

Edwin M. Hinsdale has been named Chief Engineer, RCA Communications Products Dept.

Milton Magid is joining the FXR Inc., Engineering Staff as Head of Microwave Product Engineering.

Dr. Peter B. Myers has accepted a position as Staff Scientist with the Semiconductor Div. of Motorola Inc.

Dr. Samuel Levine has been appointed to fill the newly created post of Director of Engineering and Research for the Defense Products Div. of Fairchild Camera and Instrument Corp.

The appointment of **Maxwell H. Harts** as Chief Engineer of Alpha Wire Corp. has been announced.

Joseph Carlstein has been named Chief Engineer of the United Aircraft Corp's Norden Div., Ketay Dept. at Commack, L. I.

Charles H. Bredall has joined the Technical Products Div. of Packard Bell Electronics as Senior Project Engineer.

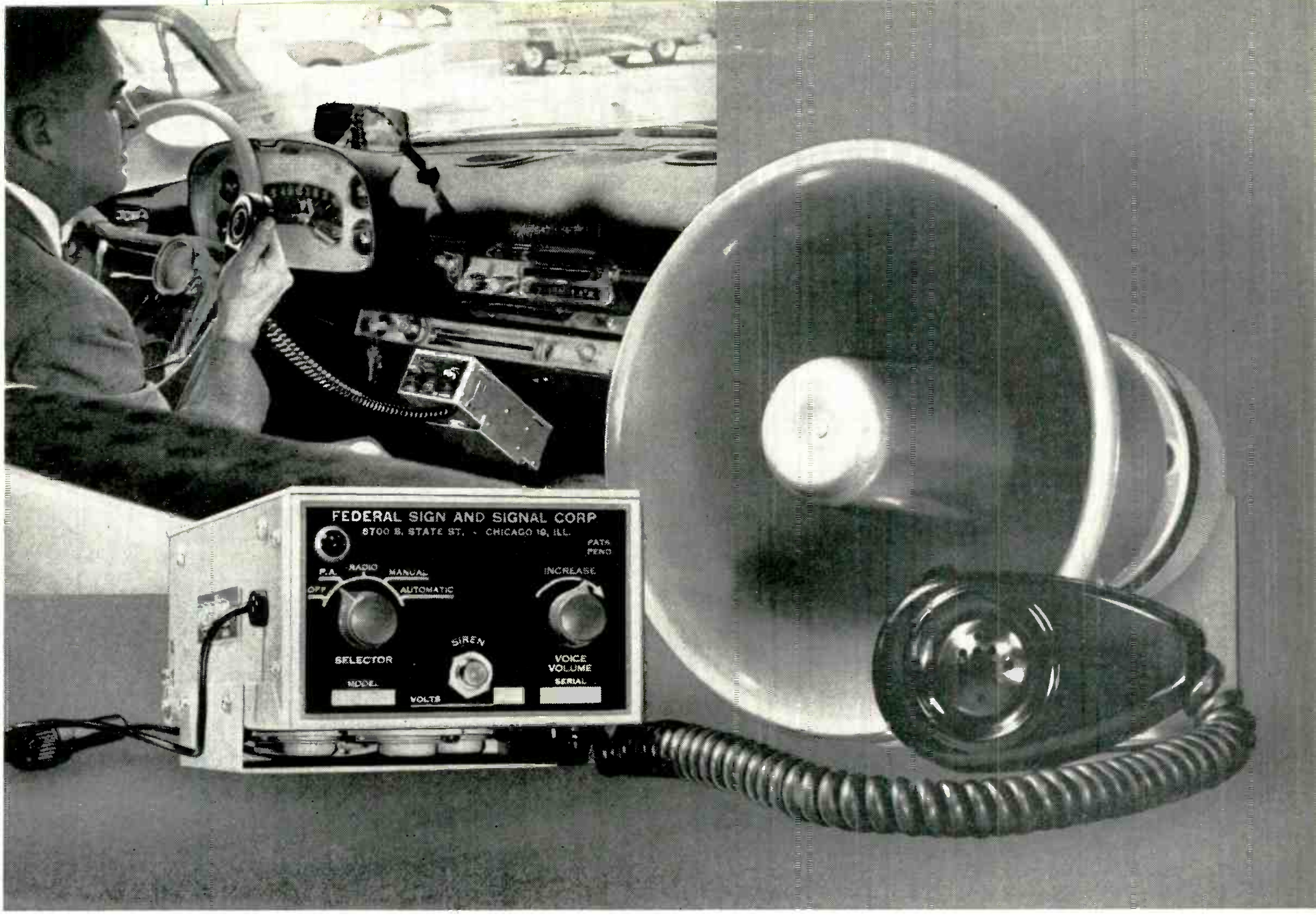
Robert Hamilton has been named Chief Engineer for Kaar Engineering Corp.

Capt. Norman Lee Barr, formerly Director of Aviation and Space Medicine Research for the U. S. Navy, has joined Republic Aviation Corp. as Chief of Space Environment and Life Sciences Research.

Fred Wolff has been named Acting Manager of the Data Systems Engineering Div. of the Servo Corp. of America.

Emanuel Steinberg has been named to the new post of Chief Mechanical Engineer at Consolidated Avionics Corp., a subsidiary of Consolidated Diesel Electric Corp.

Richard G. Bowman is now Technical Assistant to the President, and **Carver T. Bussey** is Special Assistant to the President, Republic Aviation Corp.



FEDERAL SIGN and SIGNAL counts on Tung-Sol transistors to power three-in-one sound device

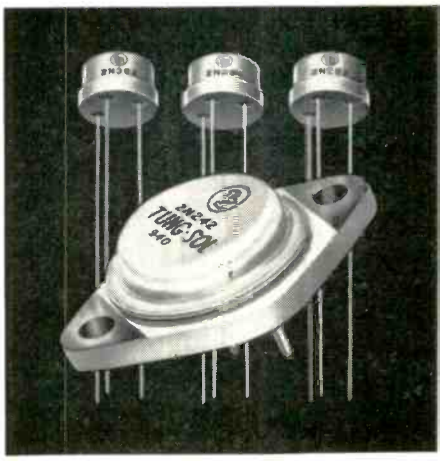
Federal Sign and Signal Corporation has combined a highly directional electronic siren, a mobile public address system and a car radio amplifier into one compact unit. This unique creation, the Interceptor, arms police patrol cars, fire engines, ambulances and civil defense vehicles with a three-pronged weapon to cope with life-and-death emergency.

The Interceptor counts on Tung-Sol power transistors to deliver the necessary three-purpose power with round-the-clock reliability. Federal, in fact, describes the large complement of Tung-Sol 2N242 and 2N382 germanium transistors as "the heart of the unit".

The 2N242 and 2N382 feature tight parameter control, sure-safe hermetic sealing and efficient thermal design . . . qualities which assure peak performance and long life.

Like every other Tung-Sol component, these semiconductors are the products of carefully disciplined factory processes and rough-and-tough life testing aimed at bringing you the best in componentry.

Federal Sign and Signal Corp., the largest manufacturer of sound-producing devices, represents another of the discriminating companies benefiting from Tung-Sol components. Tung-Sol can serve you, too, with premium units for any industrial or military requirements. Get in touch with our applications engineers. They'll be glad to evaluate your circuitry and recommend the components to fit your design. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193.



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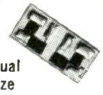

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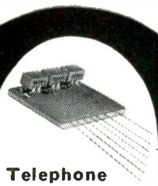
Phono Cartridge Compensating Circuit

Contains 6 fixed resistors. Component Density 1510/in.^{3} (2,610,000/ft.^{3})

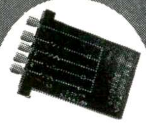


Telephone Line Detector

Contains 6 resistors and 5 capacitors. Component Density 46/in.^{3} (80,000/ft.^{3})

½ actual

100 MILLION



Computer Arc Suppressor

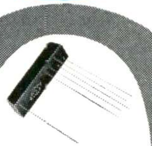
Contains 4 resistors and 4 capacitors. Component Density 8.3/in.^{3} (14,350/ft.^{3})

¼ actual

TV-Height, Linearity and AGC Control Unit

Contains 3 variable and 4 fixed resistors. Component Density 70/in.^{3} (121,000/ft.^{3})

⅓ actual



3-stage Transistor Amplifier

Contains 3 transistors, 5 resistors and 5 capacitors. Component Density 321/in.^{3} (555,000/ft.^{3})

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Proof of Design Flexibility: in hearing aids, guided missiles, appliances, jet aircraft, tv sets, electronic organs, and countless other applications.

CENTRALAB PEC* circuits—combining capacitors, resistors, transistors, and wiring in one compact sub-assembly—have stood the test of time. Since their development during World War II, more than 100,000,000 of them have been used to guarantee circuit performance in a multitude of electronic projects.

During these fifteen years, CENTRALAB has continued to refine and improve its PEC* circuits, giving them even longer life and broader application. The basic concept, however, has remained intact: a packaged circuit adapted to *your* shape and contour requirements, offering you flexibility, versatility, and reliability. PEC* packaged circuit combinations can be designed in an infinite number of sizes and shapes, and special circuits can be produced to meet your requirements and any applicable military specifications.

Consult the CENTRALAB engineering department for further information.

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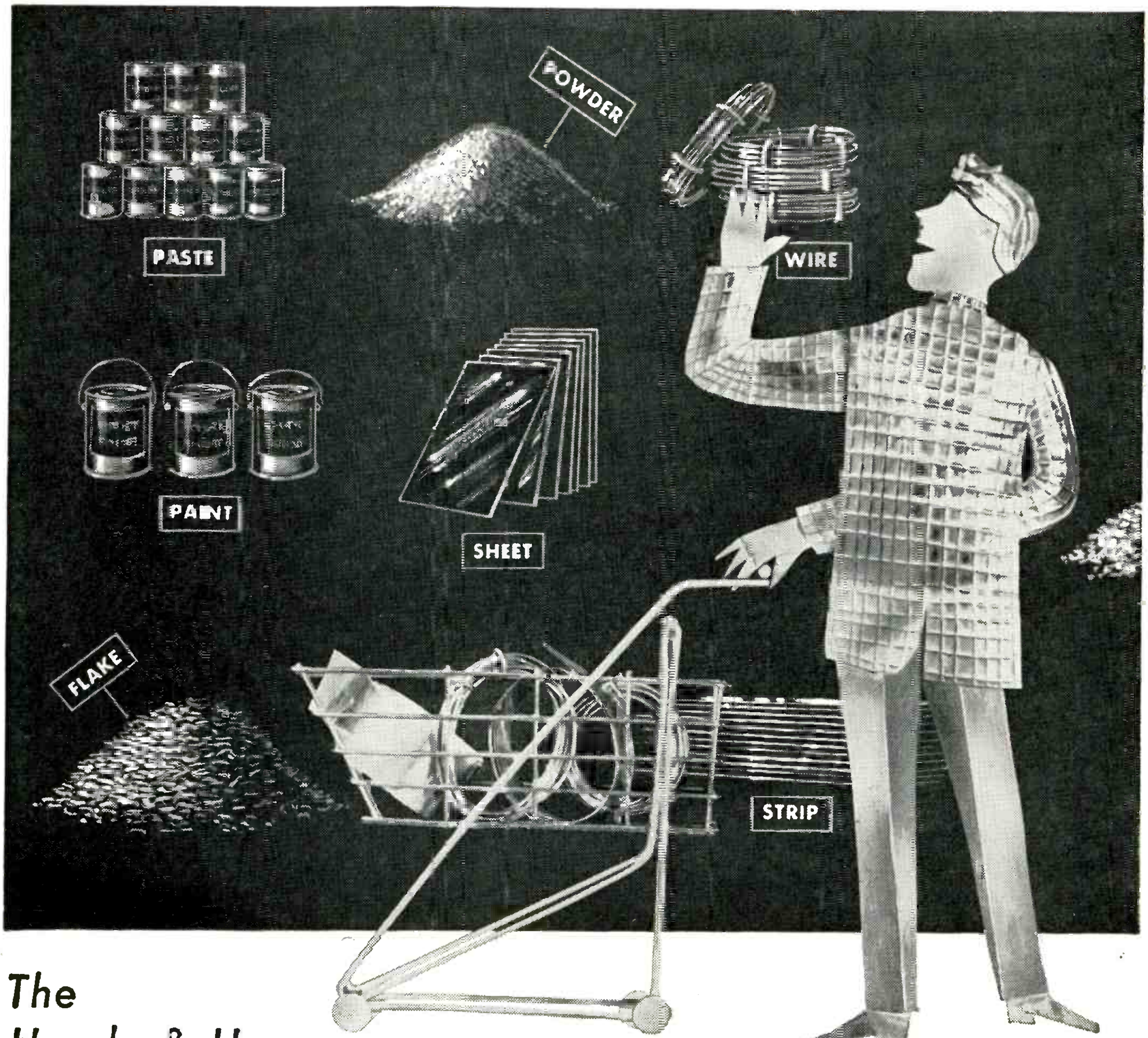

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Silver Conductive Coatings	Bulletin A-4
Silver Powder and Flake	Bulletin A-5

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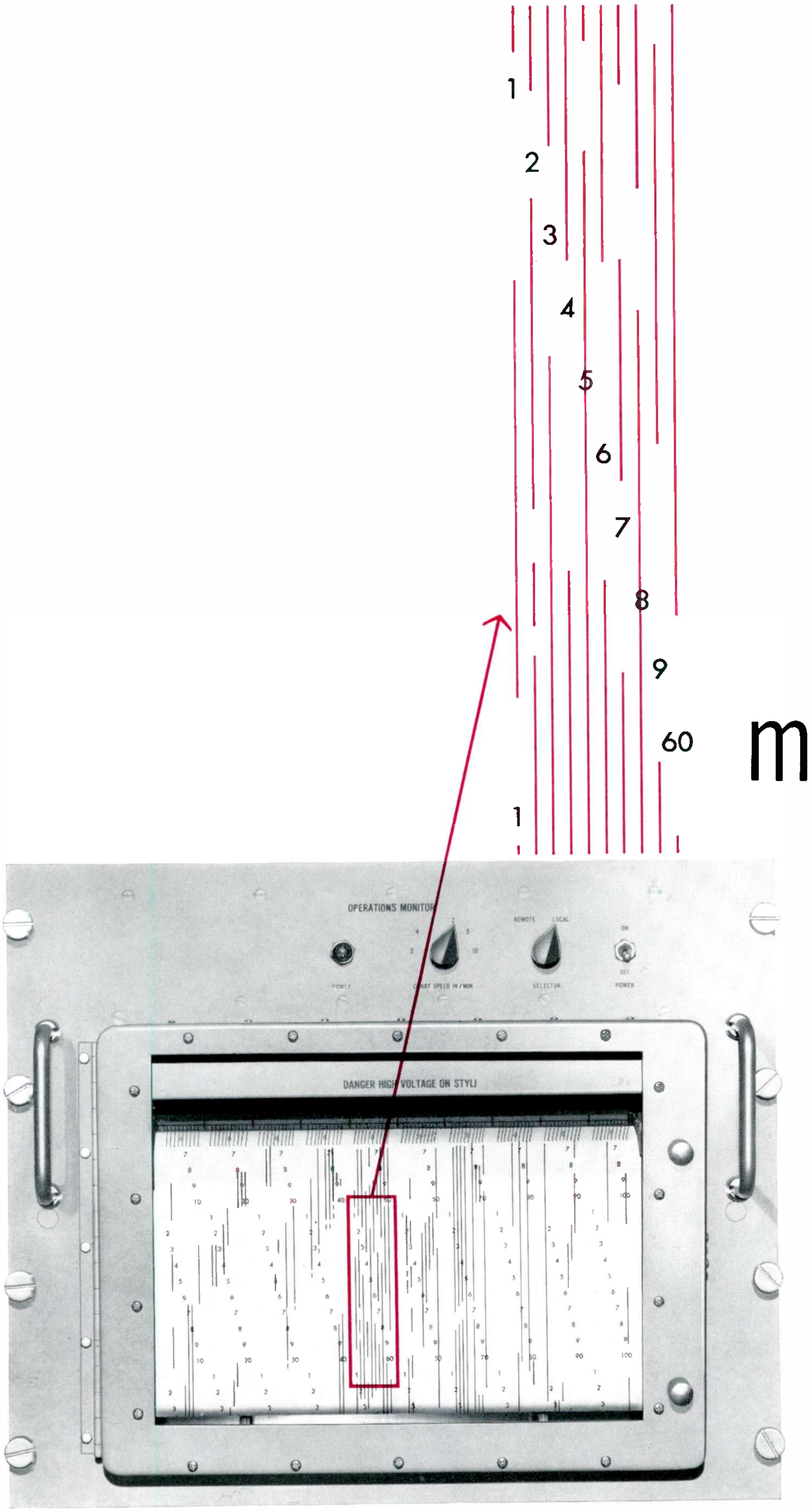

insight at 4 milliseconds

recorded with Brush operations monitors. Multiple high-speed events are reported in writing within 4 milliseconds of occurrence—to establish the basis for split-second, million dollar decisions necessary in today's complex control systems. Up to 120 separate "on-off" event signals are monitored and permanently recorded on a chart only 12″ wide. Fixed-stylus electric writing provides sharp, reproducible traces of uniform clarity. Chart speeds from one to 250 mm/sec permit a precise interpretation of all events, with resolution up to 500 signal changes per second. For military or industrial analysis and control, no direct writing recording system can match the capabilities of Brush Operations Monitors. Write today for complete specifications and application data.

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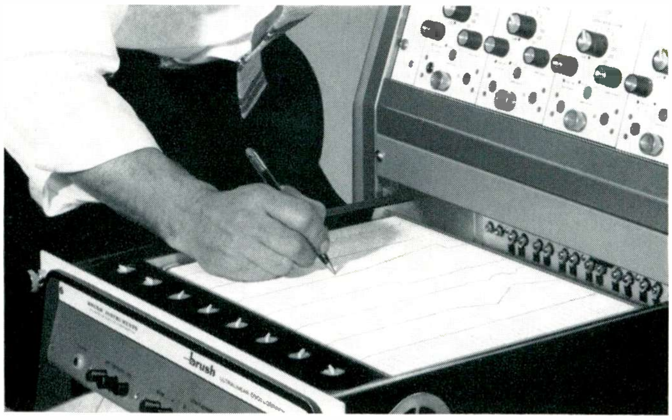

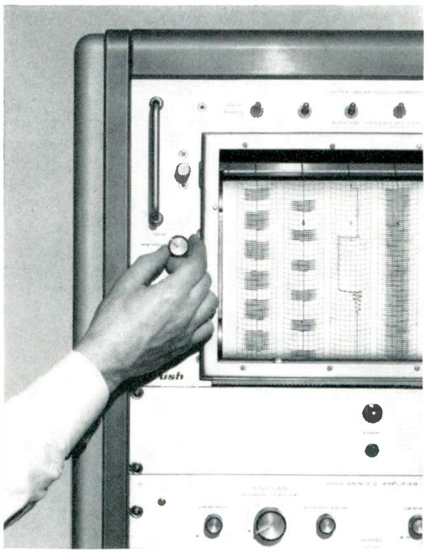

Next month

HUMAN FACTORS IN THE ELECTRONIC INDUSTRIES

Another special staff-prepared editorial feature, similar to the previously published reports on Thermoelectricity, Transistor and Diode Specifications, Microwave Power Devices, Ultrasonics, Electronic Hardware, etc. As electronic equipment becomes more complex, the need for investigating the abilities of the human who will use it increases. Many companies have organized human factor teams for these studies. This is a complete report with background material on the work being done in this field.

COMPUTING SYSTEMS FOR PROCESS CONTROLS

Nine general purpose digital computing systems are commercially available for the control of continuous and batch type industrial processes. For quick reference these computers are compared in a single table.

DESIGNING INPUT TRIGGER CIRCUITS

For a wide variety of jobs these trigger circuits offer correct reliable information at low cost. The circuit is virtually independent of input rise time, can handle large variations of input amplitude and dc level, and rejects noise.

Plus all our other regular departments

Our regular editorial departments are designed to provide readers with an up-to-the-minute summary of world wide important electronic events. Don't miss Radarscope, As We Go To Press, Electronic Shorts, Coming Events, EI Totals, Snapshots of the Electronic Industries. EI International, News Briefs, Tele-Tips, Books, Rep News, International Electronic Sources, Personals, Industry News, etc.

COMING SOON:

RADIO FREQUENCY INTERFERENCE STUDIES

A new series of articles discussing extremely important areas of this most timely subject. Our editors have arranged with more than ten of the most prominent engineers and scientists for this exclusive series. Study areas in this series include: Transmitters, Antennas, Transmission Lines, Receivers, Propagation, Instrumentation, Man Made RFI, Satellite Interference, The Role of Management, etc. This series, running in Electronic Industries throughout 1960, will provide valuable and important reference data. Watch for these articles!

SPECIAL PURPOSE CATHODE RAY TUBES

Another in EI's series of Special Staff Reports. The cathode ray tube has found scores of applications beyond those most commonly thought of . . . oscilloscopes and picture tubes. Here's the story on many new applications and a thorough treatment of the engineering of tubes to meet new technical specifications from the glass and phosphor to the electron gun.

Watch for these coming issues:

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Annual WESCON Issue

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Simultaneous operation of many filters and read-out devices eliminates the scanning or commutation, required in the earlier equipments. The range of bandwidths and numbers of channels that can be accommodated make this a powerful new technique in signal analysis and search.

For Transient Studies . . .

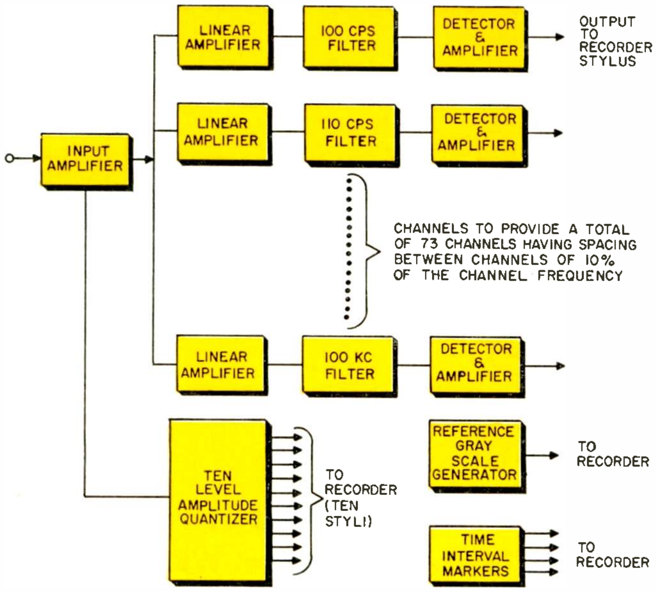
Spectrum Analyzer Supplies

OFTEN it is interesting to describe an action, or phenomena, in terms of the energy content in various portions of a frequency spectrum; or, to locate signals that occur at random time and frequency.

A variety of instruments, "spectrum analyzers," can be used to perform this study. These effectively consist of one or more selective filters which separate the spectral components of the signal.

This article describes a new concept in spectrum analyzer design in which many filters and read-out devices are operated simultaneously. This new technique eliminates the need for scanning or commutation. The result is an analyzer free of the losses or errors inherent in these processes. In addition, an immediate permanent record of spectral density as a function of time and frequency can easily be obtained.

Fig. 1: The Logarithmic Frequency Coverage Spectrum Analyzer.



Early Approaches

Of the earlier approaches, the simplest form of spectrum analyzer uses a filter or receiver, having adequate selectivity characteristics, tuned throughout the frequency range in question. The signal intensity at each frequency of interest is recorded.

The receiver may either be tuned by hand, or swept automatically over the frequency band to be covered. Such a spectrum analyzer is particularly useful where the signal under study is periodic and in its steady state, free from transient effects. However, where transient signals are encountered, such an analyzer may be unsatisfactory. Good frequency resolution requires a low scanning rate; hence, it is possible to miss a transient impulse.

A more complex class surmounts some of the objections to the simplest scanning analyzer. Here, many narrow band tuned filters are used. These filters overlap to cover the frequency spectrum under study. The input signal is delivered simultaneously to all filters. The filter outputs are sampled at a relatively high rate compared with the rise time of the individual filters. This can result in a satisfactory arrangement if the transient condition of the input signal is known and the filters and scanning rates designed to accept it.

If too short an impulse is presented to this instrument, however, it still may be improperly recorded, or even lost, due to the scanning process. Furthermore, the output signal is itself a transient waveform. Therefore detailed analysis of the input signal characteristics can not, in general, be accomplished without resorting to an undue amount of additional equipment.

R. J. Farber

A. Proudfit

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Permanent Record

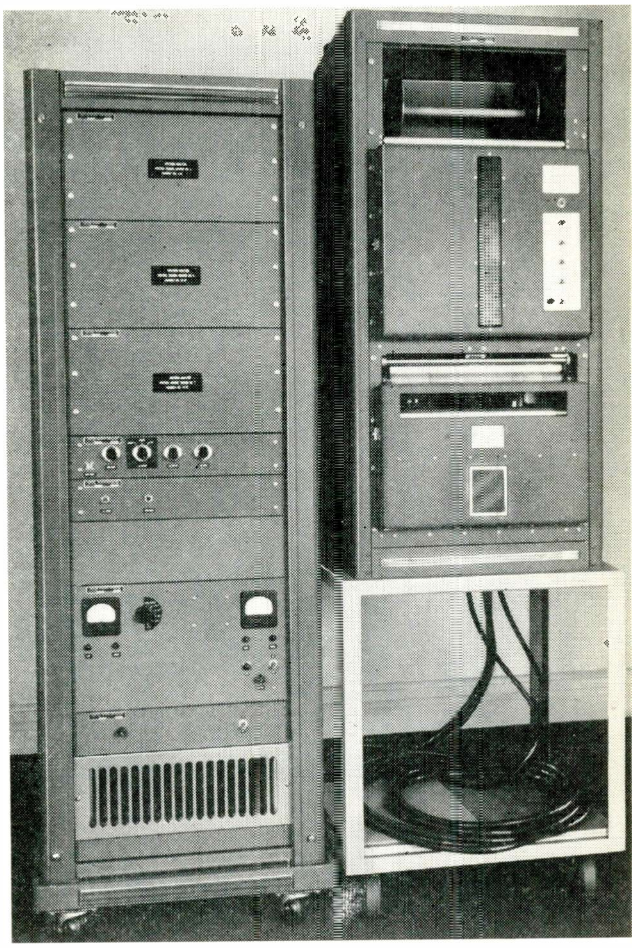


Fig. 3: The complete equipment is housed in this 5½ ft. rack cabinet.

More Flexible Method

The new class of spectrum analyzers operates without frequency scanning. They use a bank of suitable filters whose inputs are connected in parallel, and whose outputs are individually recorded on a continuous rather than on a sample basis. This method is considerably more flexible than the earlier approaches and provides a means to overcome many of the limitations of the earlier equipments. The individual filters or selective networks are each tuned to adjacent portions of the spectrum under study. Each of these networks delivers its output to an individual amplifier and output transducer. If this scheme were carried out with vacuum tube circuits, the heater power alone for a 100 channel analyzer would be enormous and probably result in the instrument being considered impractical. The advent of transistors has made a major change in this situation. Spectrum analyzers having several hundred channels can be constructed without any particular problem of power consumption, equipment heating, or undue size.

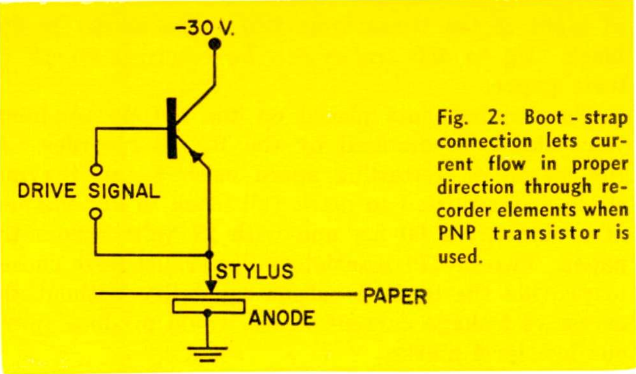


Fig. 2: Boot-strap connection lets current flow in proper direction through recorder elements when PNP transistor is used.

There is substantially no limit to the frequency range which can be covered or the manner in which the spectrum can be divided for analysis. The individual channel bandwidths and the spacing between channels can be varied to satisfy the particular demands being placed on the instrument. A common arrangement involves channels of uniform spacing and constant width to provide arithmetic or linear coverage of the spectrum under study. An alternative is where the individual channel bandwidths and spacing between channels are proportional to frequency, thus producing a logarithmic coverage of the range under study. This latter arrangement is particularly interesting, since it cannot readily be accomplished by either of the two simpler analyzers discussed briefly above.

Logarithmic Coverage

A block diagram of such a logarithmic coverage spectrum analyzer is shown in Fig. 1. The signal in the 100 CPS to 100 KC range is delivered through a 2N414 transistor amplifier to the inputs of 73 spectral channel amplifiers in parallel. These channels were constructed to cover the three decades of frequency with twenty-four channels per frequency decade. To accomplish this, channel n is tuned to a frequency 1.10072 times n-1th channel $n+1$. The requirements placed on this analyzer were such that the selectivity of a single tuned circuit was adequate. Accordingly, each individual channel contains a filter consisting of a single tuned circuit having a 6 db bandwidth of 10% of the center frequency. This is the equivalent of specifying a Q of 17.3 for all channels.

The individual spectral channels consist of a 2N414 input amplifier with the channel filter in its collector

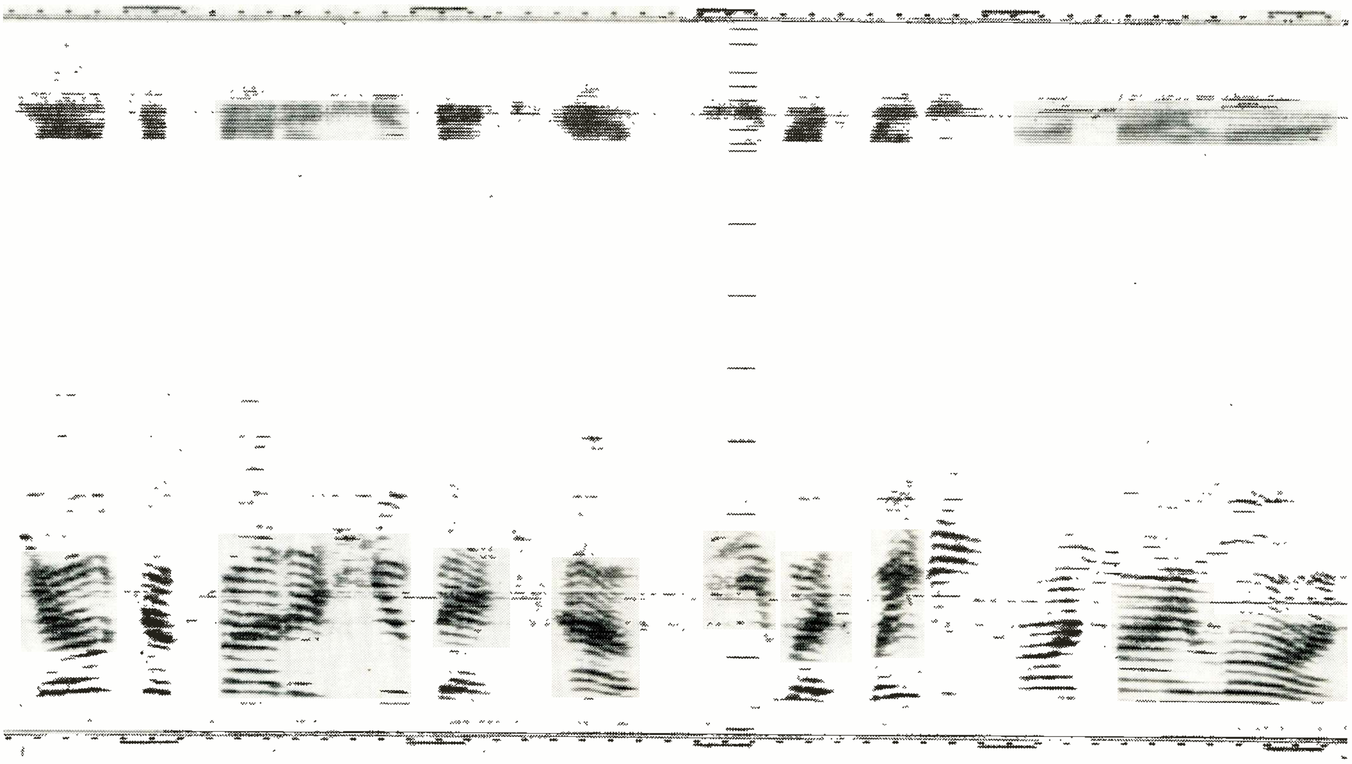


Fig. 4: Spectrum analysis of two phrases commonly used in speech system analysis: "Joe took father's shoe bench out" and "She was waiting on my lawn."

Spectrum Analyzer *(Continued)*

circuit, and a second 2N414 output amplifier. This, in turn, is followed by the signal detector and paralleled 2N270 output DC amplifier. The design of the output stage depends to a large extent upon the nature of the output recorded, and this will be treated later.

The amplification stages prior to the channel filter must be quite linear since a non-linearity at this point can result in harmonic generation and, consequently, spurious outputs. The 2N414 transistor was chosen and was found to provide the desired linearity. More important, since this transistor has an *alpha* cutoff of 7 MC, the gain of such an amplifier can be made substantially independent of frequency over the 100 CPS to 100 KC range.

The resonant filter circuits were constructed based on a single tuned circuit having excessive Q (greater than 17.3) with an external damping resistor added to arrive at the design value. This technique provides a considerable measure of stability for the tuned circuit since the effects of variation of transistor parameters tend to be diminished. Ferrite pot cores were used for the most part, and these were individually resonated with selected capacitors to the desired frequency. The equipment was designed to operate in a laboratory ambient with a temperature range of the order of 15°-35° C. Under these conditions, the tuned circuits were found to be adequately stable.

Output Recorder

In conjunction with a spectrum analyzer of this general class, several forms of output recorder can be considered. Under certain conditions, it may be useful to record on an "off-on" basis whether a signal is present in any particular channel. This can be accomplished by pen-and-ink, electrographic, or other type of "off-on" recorder.

For the present spectrum analyzer, it was desired to record the relative amplitude in each spectral channel. This was accomplished by means of a Hogan Laboratories Model RX-48 multi-channel electrolytic recorder. This device, which marks a sensitized paper in a manner similar to a telephoto recorder, can record a dynamic reflectance range of the order of eight to ten times from white (no mark) to full black. Up to 450 tracks can be recorded on 15 in. wide paper.

The requirements placed on the output amplifiers were therefore dictated by the RX-48 recorder. At the maximum recording speed used, 6 ips, the machine was adjusted to mark full black in any channel at a current of 60 ma and with 27 volts across the paper. Two 2N270 transistors in parallel were chosen to provide the desired output capability without the excessive leakage current which would produce spurious low level marks.

Electrolytic Marking

A characteristic of the electrolytic marking process used is that material from the anode is plated into the paper to produce the mark. The erosion thus produced in the anode is significant, and it is thus desirable to operate with a common, easily replaceable bar as the anode, and the individual styli as cathodes. When a stylus is driven from the plate of a vacuum tube, the direction of current flow is such that the stylus becomes the cathode in the printing process, and the above requirement is satisfied. These conditions are duplicated when an NPN transistor is used. For a PNP transistor, however, the flow of current is reversed, and the circuit must be modified to prevent erosion of the styli. Such a modification is shown in Fig. 2. This circuit connection is a bootstrap arrangement in which the input signal is developed between base and emitter and the output signal between emitter and ground. It should be observed that although the circuit is operated with collector grounded for signal it is not an emitter follower, but a common emitter connection. The bootstrap circuit results in current flowing in the proper direction through the recorder elements so that there is no electrical erosion affecting the styli.

In addition to the primary spectral outputs to the recorder, a number of subsidiary signals are provided to increase the utility of the spectrum analyzer. These include a reference gray scale generator, an amplitude quantizer, and a time interval marker generator.

The density of the mark for any channel is related to the signal energy within the spectral channel. The reference gray scale generator provides signals at eight fixed levels which result in marks at eight steps in reflectance from no mark to full black. These reference levels are produced on both sides of the spectral record to facilitate comparison.

A cam connected to the paper drive mechanism operates a series of switches in sequence. These switches connect current sources, corresponding to the various gray scale levels, to drive circuits similar to those used at the output of the spectral channels. The reference level currents can be adjusted to produce gray scale steps corresponding to equal linear steps in current, equal logarithmic steps in current, or any other arrangement desired.

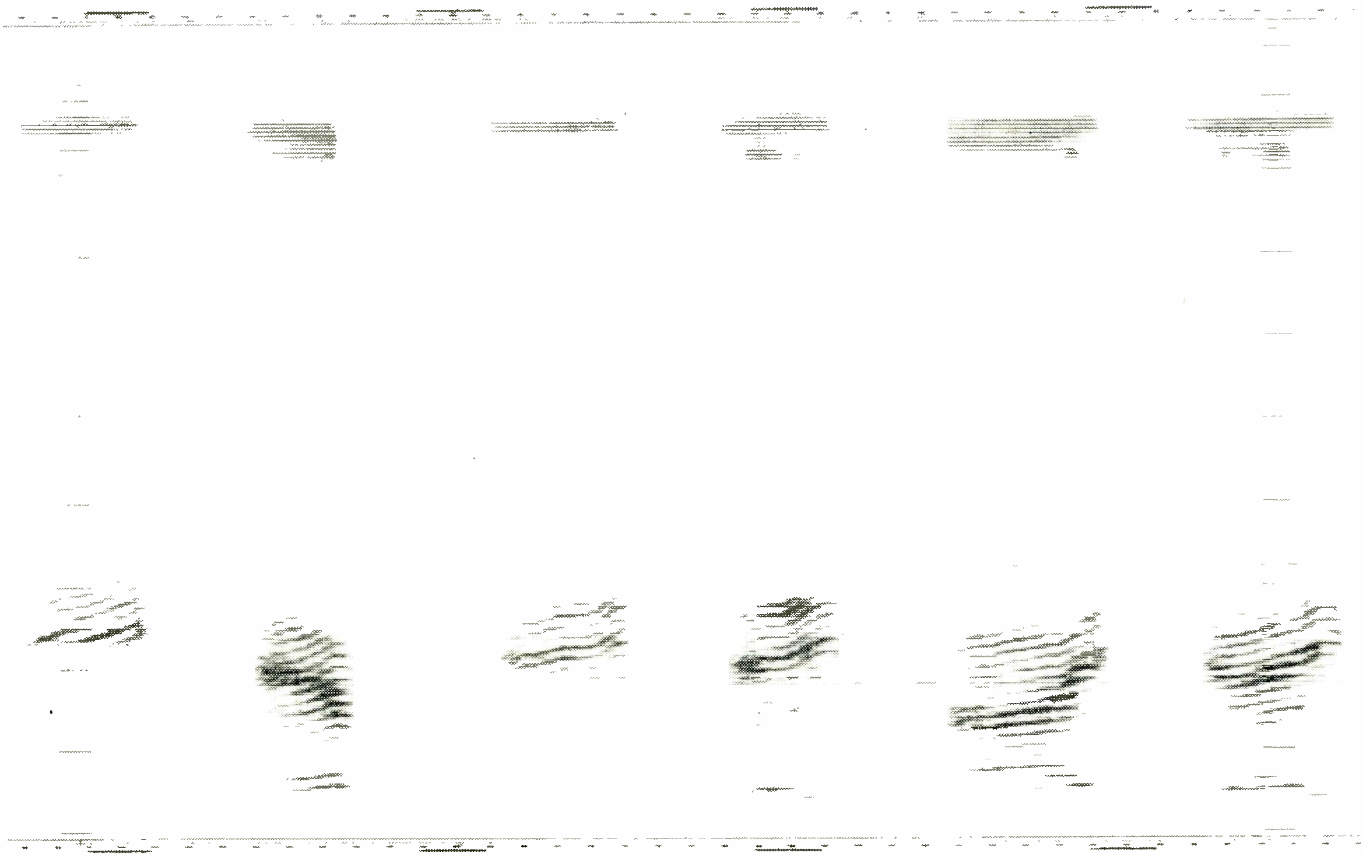
Input Time Function

It is often of considerable value in analyzing a spectral record to have a simultaneous record of the input signal time function. The input signal is delivered to a ten-level amplitude quantizer which in turn is connected through transistor driving circuits to ten adjacent styli on the recorder. This arrangement provides a satisfactory representation of the input signal so that pulse groups or other waveforms can be identified.

The amplitude quantizer employs a transistor amplifier which drives a diode envelope detector. The output of this detector is DC coupled to the parallel connection of ten Schmitt Trigger circuits which act as level sensors. The outputs of the trigger circuits are DC connected through suitable driving amplifiers to the ten styli which produce the envelope display.

The third group of supplementary signals consists of the time interval markers. These provide relative

Fig. 5: Spectrogram of the letters E to J spoken by a male adult.



Spectrum Analyzer *(Continued)*

time information at intervals of 60 sec., 1 sec., 0.1 sec., and 0.01 sec., covering the rates of interest in view of the available recorder speeds (1.2 ipm to 6 ips).

The time interval marks utilize a highly stable tuning fork oscillator to provide the basic time reference. Conventional scaling circuits are employed to divide down the fork frequency to product the time interval marks. The desired scaler outputs are shaped and delivered to appropriate styli of the recorder. In this spectrum analyzer, the 1.0 sec. and 0.01 sec. time markers are produced at both sides of the record so that time data can be reconstructed independent of warping of the recorder paper. The 0.1 sec. marks are connected in parallel with the outputs of the 0.1, 1.0, 10, and 100 KC spectral channels and serve as frequency markers. These markers can be switched off if they obliterate desired data on these channels.

A photograph of the complete equipment is shown in Fig. 3. The 5½ ft. rack cabinet on the left houses all the electronic circuits with the exception of the gray scale calibrator located in the recorder. The upper three panels contain the spectral channels, while the balance of the space is devoted to the various control and subsidiary circuits and power supplies. The RX-48 recorder is contained in the cabinet on the right.

Considerations

While the spectrum analyzer that has just been described employed logarithmic frequency channels, there is substantially no limit to the type of coverage that can be obtained. This analyzer employed filters tuned directly to the frequency channels of interest. Since varying absolute bandwidth, but equal proportional bandwidth (or constant Q), was desired, this approach was indicated. Where equal arithmetic bandwidths are involved, and therefore a significant change in fractional bandwidth over the spectrum it may be more satisfactory to heterodyne the input spectrum to a higher frequency and perform the channel selection with filters that now can have nearly constant fractional as well as absolute bandwidth. In general, the specific techniques to be employed in each specific case is decided upon the peculiar requirements of the situation. The fact of interest is that the general approach is extremely flexible and permits the constraints on the frequency channels to be chosen almost without limit.

An analyzer having equal bandwidth channels also has been constructed. This equipment contains provisions to analyze an input spectrum with both narrow and wide band filters simultantously. The narrow band channels provide frequency resolution, and the wide band channels provide the time resolution data. As implied above, the 0 to 8 KC input range is heterodyned up to the neighborhood of 100 KC, and the analysis performed at that point. In addition, time and frequency marks similar to those described for the first equipment are also included.

Spectrograms

Two spectrograms showing the application of this equipment to speech analysis are shown. Fig. 4 shows the spectrogram of two phases commonly used in speech system analysis. These are "Joe took father's shoe bench out" and "She was waiting on my lawn." The record was made at a chart speed of 5 ips, and 1.0, 0.1, and 0.001 sec. time markers are clearly resolved on either side of the record. The solid lines on the insides of the time marker presentation are shorter period markers not resolved at this chart speed. The frequency markers are seen extending vertically at the middle of the figure. These represent 1 KC and 250 CPS intervals in the narrow band region (lower portion of the figure), and 1 KC intervals in the wide band portion. The spectral lines in the vicinity of 2 KC that appear more or less continually are due to pick up in the microphone of the noise of the recorder gears. These components are seen both in the wide and narrow band records.

A significant demonstration of the capability of the analyzer is given in Fig. 5. This is a record of a man's voice speaking a few letters of the alphabet. The actual record consumes approximately 4 sec. and was made directly in real time. Actually, when a 400 ft. roll of paper is used at a speed of 5 ips, a continuous recording in excess of 16 minutes can be made. This is particularly useful when one is searching for random occurrences or is analyzing an isolated phenomenon lasting for an extended period of time.

A general description of an instrumentation technique has been presented, and specific examples in two spectrum analyzers have been described. The range of bandwidths and number of channels that can be accommodated are such that this analyzer represents an important new technique in the fields of signal analysis, and signal search such as in studies of telemetry, atmospheric noise, whistlers, and other transient phenomena.

A portion of the work described in this paper was supported in part by an Air Force Contract with Hazeltine Research Corp.

* * *

REFERENCE PAGES

The pages in this section are perforated for easy removal and retention as valuable reference material.

SOMETHING NEW HAS BEEN ADDED

An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

When re-designing a tube for changed electrical characteristics it is usually necessary to modify the internal tube dimensions. These three nomographs make it possible to quickly determine the physical characteristics of the new tube from specs of a tube of the same general class.

Nomographs Simplify Electron Tube Design

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Part One of Two Parts

BEFORE any applications of these monographs to tube design problems are presented, the theory upon which the monographs are based should be discussed briefly.

The relation between the physical characteristics of a diode and its plate current is given by the Child-Langmuir space-charge law for biodes which may be written as follows:

$$I_b = K \frac{A_k}{S_{pk}^2} E_b^{3/2} \qquad (1)$$

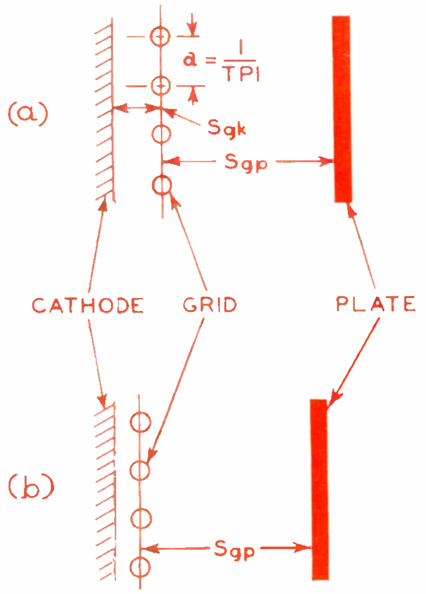


Fig. 1: When the plate and grid No. 1 of the triode with given dimensions (a) are moved closer to the cathode (b), contrary to expectations the g_m/I_b ratio changes.

where

I_b = plate current,
A_k = effective cathode area,
S_{pk} = plate-cathode spacing,
E_b = applied plate potential,
K = a lumped constant containing universal constants and a factor depending on the units of the other symbols in the equation.

This equation shows that the plate current of a diode varies directly as the cathode area, inversely as the square of the plate-cathode spacing, and directly as the three-halves power of the applied plate potential.

Triodes

Triodes may be treated as diodes if the grid plane is considered as an imaginary diode plate. The voltage on this imaginary plate will consist of two components —that contributed by the grid itself and that contributed by the actual triode plate. Inasmuch as the triode plate is somewhat distant from the plane of this imaginary diode plate, the triode plate's effective potential in the plane of the imaginary diode plate is somewhat lower than the actual potential applied to the triode plate. In other words, the triode plate potential must be divided by some factor to obtain its effect in the plane of the imaginary diode plate. This transposing factor is commonly referred to as μ, the triode amplification factor.

Thus, the resultant potential in the plane of our imaginary diode plate, which coincides with the grid plane of the triode, may be written as

Tube Nomographs *(Continued)*

$$(E_b/\mu) + E_c,$$

where:

E_b = applied triode plate potential,

μ = triode amplification factor,

E_c = applied grid-bias potential (negative).

The triode plate-current equation may now be written by substituting $(E_b/\mu) + E_c$ for E_b and grid-cathode spacing S_{gk} for plate-cathode spacing S_{pk} in eq. (1).

$$I_b = K \frac{A_k}{S_{gk}^2} \left(\frac{E_b}{\mu} + E_c \right)^{3/2} \qquad (2)$$

The transconductance of a triode g_m is simply the first derivative of the plate current, Eq. (2), with respect to grid voltage.

$$g_m = \frac{\partial I_b}{\partial E_c} = \frac{3}{2} K \frac{A_k}{S_{gk}^2} \left(\frac{E_b}{\mu} + E_c \right)^{1/2} \qquad (3)$$

Van Der Bijl's expression for the amplification factor, μ, of a triode is as follows:

$$\mu = C N^2 D_g S_{gp} \qquad (4)$$

where

C = a constant

N = turns-per-inch of lateral grid wire

D_g = diameter of grid lateral wire

S_{gp} = grid-plate spacing

From Eq. (4), it can be seen that the amplification factor of a triode varies directly (1) as the square of the number of turns per inch of the grid lateral wire, (2) as the grid lateral wire diameter, and (3) as the grid-plate spacing.

Pentodes

Pentodes, or tetrodes, are considered as an extension of triodes. The pentode grid No. 2 is considered as an imaginary triode plate. For an exact analysis, the effect of the pentode plate potential in the plane of the pentode grid No. 2 should be considered also. However, the µ between the pentode grid No. 2 and the pentode plate is so large that the transposition of the pentode plate potential to the plane of the pentode grid No. 2 results in a very small value. Accordingly, it may be neglected. The plate-current equation for triodes, Eq. (2), may now be rewritten as the cathode-current equation for pentodes, or tetrodes, as follows:

$$I_k = K \frac{A_k}{S_{g1k}^2} \left(\frac{E_{c2}}{\mu_T} + E_{c1} \right)^{3/2} \qquad (5)$$

where

I_k = cathode current

S_{g1k} = grid-No. 1-to-cathode spacing

E_{c2} = applied grid-No. 2 voltage

μ_T = grid-No. 1-to-grid-No. 2 μ, commonly called the triode μ of the pentode

E_{c1} = applied grid-No. 1 bias potential (negative)

Because the plate current of a given pentode, or tetrode, is a fairly constant percentage of cathode current, in the normal operating region, it may be expressed as:

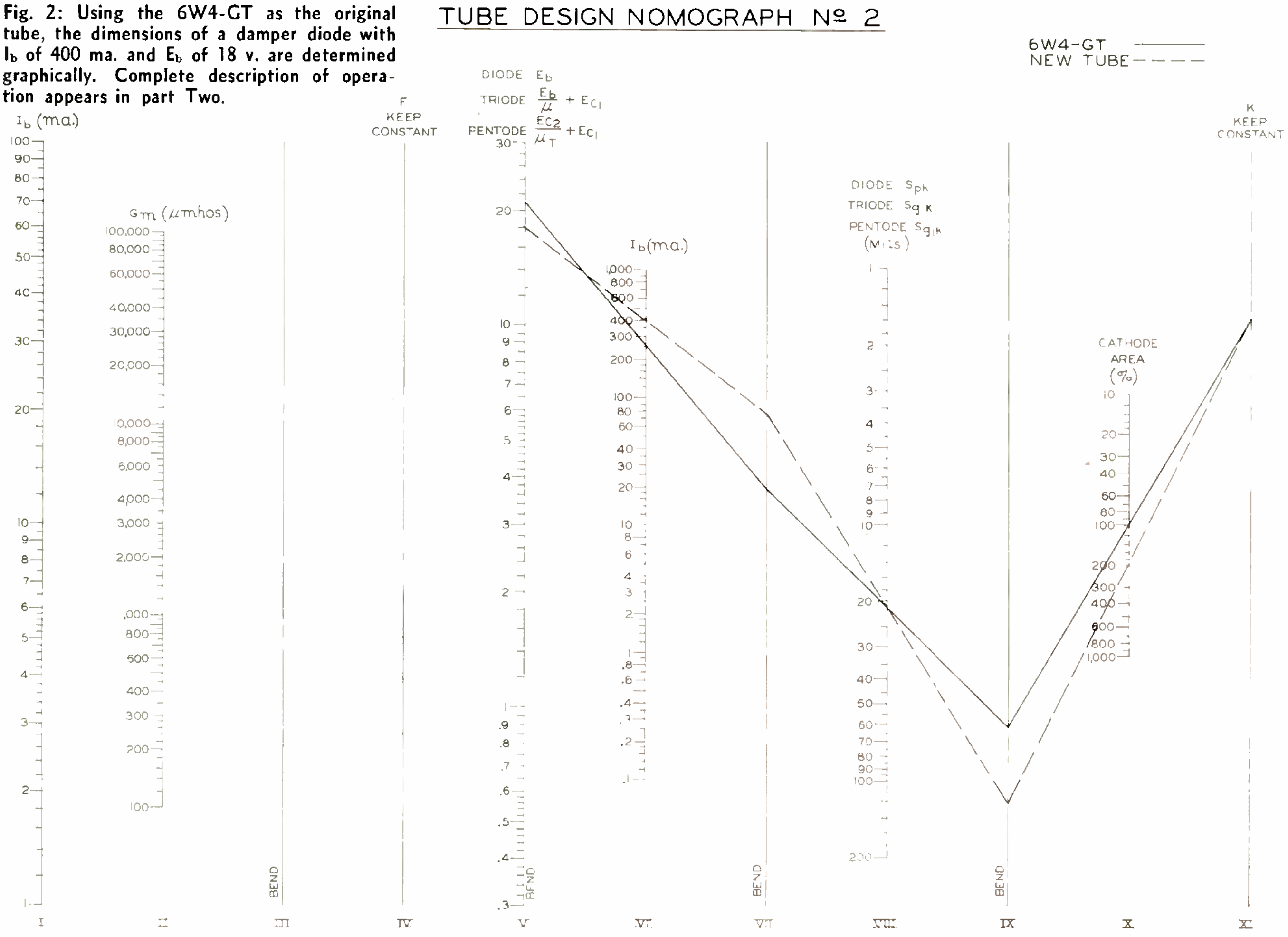


Fig. 2: Using the 6W4-GT as the original tube, the dimensions of a damper diode with I_b of 400 ma. and E_b of 18 v. are determined graphically. Complete description of operation appears in part Two.

$$I_b = K' \frac{A_k}{S_{g1k}^2} \left(\frac{E_{c2}}{\mu_T} + E_{c1} \right)^{3/2} \qquad (6)$$

Then, the transconductance of a pentode, or tetrode, may be expressed as:

$$g_m = \frac{\partial I_b}{\partial E_{c1}} = \frac{3}{2} K' \frac{A_k}{S_{g1k}^2} \left(\frac{E_{c2}}{\mu_T} + E_{c1} \right)^{1/2} \qquad (7)$$

The equation for the triode μ_T, of a pentode may be expressed as follows:

$$\mu_T = C\, N_1^2\, D_{g1}\, S_{g1g2} \qquad (8)$$

where

C = a constant
N = grid-No. 1 TPI
D_{g1} = Diameter of grid-No. 1 lateral wire
S_{g1g2} = grid No. 1-to grid-No. 2 spacing

Other Phenomenon

The above formulas do not take into account a phenomenon of close-spaced tubes which is dependent on the grid No. 1-cathode spacing. This phenomenon can best be described by considering the g_m/I_b ratio of a triode. If Eq. (3) is divided by Eq. (2) the following relationship is obtained:

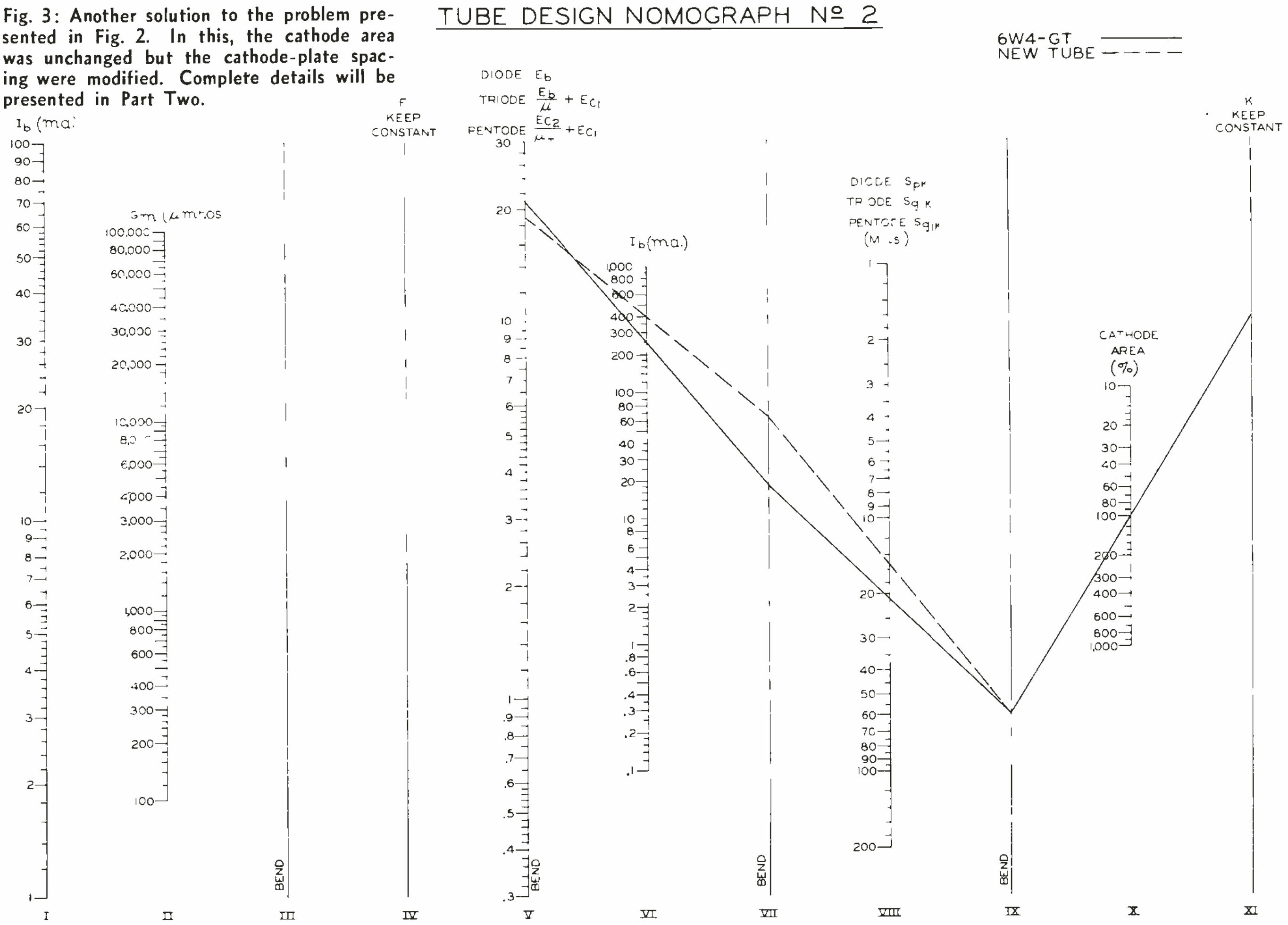
$$\frac{g_m}{I_b} = \frac{3}{2} \frac{1}{\dfrac{E_b}{\mu} + E_c} \qquad (9)$$

This expression indicates that the g_m/I_b ratio of a triode is dependent only on the applied grid and plate potentials and the amplification factor μ. In practice, this relationship is not true. Fig. 1a illustrates a triode with given dimensions. For a given applied plate voltage, E_b, and grid voltage, E_c, the triode of Fig. 1a will have a certain g_m/I_b ratio. Now, if the grid No. 1 and plate are moved closer to the cathode as in Fig. 1b, μ has not been varied, and, according to Eq. (9), the same g_m/I_b ratio as in Fig. 1a should be obtained provided the same value of E_b and E_c are used. Such, however, is not the case. The plate current rises at a faster rate than the transconductance, and the g_m/I_b ratio becomes smaller because S_{gk} has become small with respect to dimension a, and the grid has lost some of its control over the electrons which pass midway between the grid lateral wires. These poorly controlled electrons contribute to plate current but do not contribute appreciately to transconductance.

If the grid No. 1-cathode spacing is greater than 2 or 3 times the pitch dimension a, it may be said that the electrons passing on to the plate are very well controlled. When S_{gk} is decreased below a value which is approximately ½ a, the g_m/I_b ratio degrades rapidly due to poorer control of certain parts of the electron stream.

Because present-day electron tubes have dimensions which are usually in the region of $S_{gk} = ½\, a$, the shortcomings of Eq. (9) must be taken into account if this equation is to be satisfactorily applied. A factor F, which is dependent on the grid No. 1-to-cathode spacing factor a/S_{gk}, is therefore introduced, as follows:

Fig. 3: Another solution to the problem presented in Fig. 2. In this, the cathode area was unchanged but the cathode-plate spacing were modified. Complete details will be presented in Part Two.



Tube Nomographs *(Continued)*

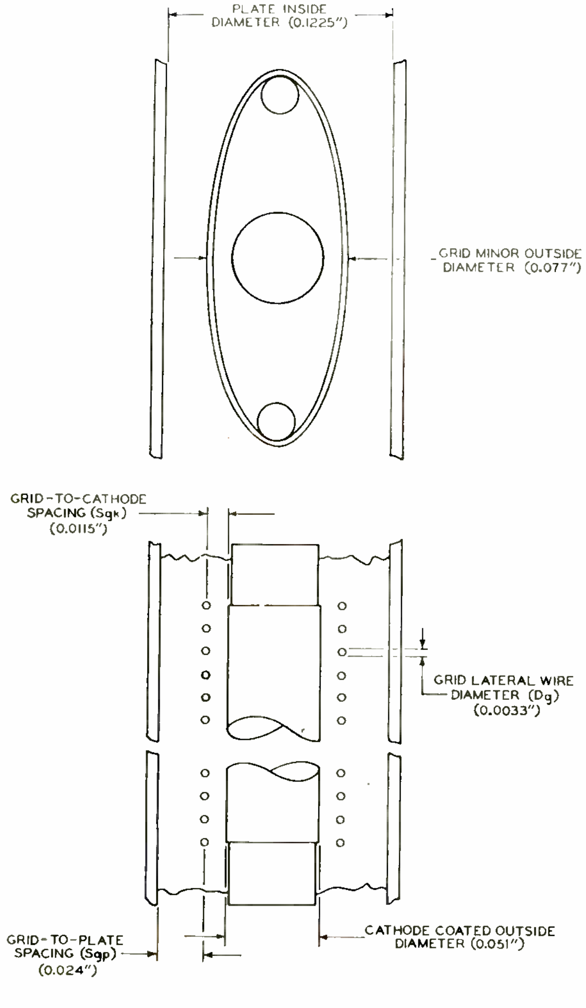
$$\frac{g_m}{I_b} = F\frac{3}{2}\frac{1}{\frac{E_b}{\mu} + E_c} \qquad (10)$$

Applications and Limitations

The nomographs described in this article are used to determine the changes in the dimension of a tube that are required to modify the characteristics μ, g_m and I_b. The starting point in the use of the nomographs is always the notation of data from an existing tube type, referred to as the original, on the appropriate axis of the nomograph. This operation, through the design of the nomographs, determines various tube factors and constants. The next step is the notation of the desired electrical characteristics while the factors determined by the original tube are kept constant. The intersection points on certain axes then will indicate the dimensions of the desired tube. The nomographs cannot be used for changing the plate current-to-screen current ratio of pentodes, modifying the suppression characteristics of pentodes, or for modifying interelectrode capacitances.

The design of the nomographs assumes that the new tube which is being designed is in the same general class as the original tube from which the basic data are obtained. For instance, one should not attempt to calculate the dimensions of a tube in the 6L6 power-pentode class by first inserting the characteristics and dimensions of an r-f amplifier type such as the 6CB6. This requirement is predicated by the fact that the use of the nomographs assumes that the factor F and the constants K and C, remain constant (or vary so little that the variations may be neglected) over the range of the original tube and the desired tube.

Fig. 4: Outline drawing of 6SN7-GTB electrode arrangement will be used in the solution of the sample triode problem presented in Part Two.



Many of the modifications of tube characteristics may be accomplished in more than one way. For instance, diode plate current at a given plate voltage may be increased by either decreasing plate-cathode spacing or by increasing the cathode area. In all cases of multiple solutions, the nomographs will provide either solution and in addition, an infinite number of solutions which represent various combinations of the two. The user of the nomographs must decide on the desired solution by considering other requirements such as inter-electrode capacitances, available heater input power, and the ease with which either change can be made—an important factor when the tube being modified is a production type.

The nomographs and the equations upon which they are based are valid only over a certain limited range. Although extreme solutions may be obtained which appear as mathematically correct, it will be impractical or impossible to construct a useful vacuum tube based on these extreme solutions. For instance, if a tube is being designed to have characteristics similar to those of a r-f amplifier type such as the 6CB6, the diameter of the grid No. 1 lateral wire should be 0.002 inch, the diameter of the grid No. 1 lateral wire of the 6CB6, or some dimension close to this value. A possible mathematical solution, which may also be determined from the nomographs, might indicate a lateral-wire size of 0.008 inch with a compensating number of turns per inch. However, it is obvious that a tube in the 6CB6 category could not be constructed with a grid No. 1 lateral wire that has a diameter of 0.008 inch. In general, if the grid-cathode spacing factor a/S_{gk} and the screening factor D_g/a of the desired tube are kept similar to the corresponding factors of the original tube, the solution obtained will be a valid one.

In triodes and pentodes, the designer does not have complete freedom in the choice of I_b, g_m and triode μ. Eq. (10) shows that for a given set of applied voltages, two of the three characteristics above may be chosen but the third characteristic is then dependent. When solving triode and pentode problems, the user of the nomographs should not attempt to modify I_b, g_m, and triode μ, simultaneously. Instead, two of these characteristics, say I_b and g_m, should be modified and the problem solved with the nomographs to see where the third characteristic falls. If the third characteristic is a value which is other than that desired, the problem becomes one of an advanced nature and requires a significant modification of the grid-cathode spacing factor a/S_{gk} which, in turn, will modify the F factor.

(Continued Next Month)

What's New . . .

The Ferroelectric Converter

THE ferroelectric converter, developed by ITT Corp., produces high-voltage ac or dc electrical power. The theory of this converter is based on the known phenomenon that the permittivity or dielectric constant of certain ferroelectric materials varies with temperature. The temperature at which the maximum dielectric constant occurs is known as the Curie point. The permittivity curve of one of these dielectrics, barium titanate, is shown in Fig. 1.

The operating principle and the basic circuit can be described with the aid of Fig. 2. The main element is a large capacitor with a dielectric consisting of a suitable ceramic ferroelectric material e.g., barium titanate. This capacitor is maintained in a charged state by a battery or other source through a holding diode with a high back voltage. If the capacitor is at the Curie temperature T_c, its capacitance is at a maximum due to the high permittivity K_c.

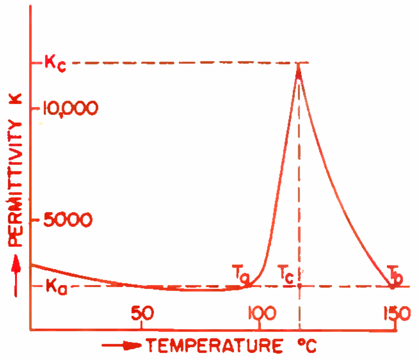


Fig. 1 Permittivity of a dielectric, barium titanate, around Curie temperature.

If the capacitor is cooled to a temperature T_a or heated up to T_b, its permittivity drops to K_a or K_b, respectively, Fig. 1. There is a corresponding drop in capacitance. Since the change cannot decrease because of the diode, there must be a rise of capacitor voltage. Hence, the capacitor voltage has been stepped up by the cooling or heating of the capacitor. This increased voltage also means an increase of electrical energy. The energy increase is due to the conversion of thermodynamic or heat energy into electrical energy.

A permittivity curve, Fig. 1, does not quantitatively describe the energy gain. The permittivity is dependent on the electrical field strength which changes during a temperature cycle. The permittivity curve given in Fig. 1 is applicable only with a low applied voltage or field strength. Practical energy converters operate at higher levels of field strength, in which case the permittivity has no appreciable drop, if any, below the Curie temperature. The converter, consequently, is operated between the Curie temperature and a higher temperature.

To further illustrate the operating mechanism of the ferroelectric energy converter, a 2-plate capacitor with air dielectric can be used and charged as in Fig. 2. Moving both capacitor plates apart will also increase the voltage according to the decrease in capacitance. The only difference is the mechanism of the capacitance change. The energy has been supplied, in this case, in the form of mechanical work expended by pulling the capacitor plates apart against the electrostatic attracting force.

Both this model as well as the ferroelectric energy converter can be looked at as parametric amplifiers for d-c signals. The battery of Fig. 2 has simply to be treated as a d-c input signal which is to be amplified. Voltage and power gain are as derived above. The frequency of capacity variation is equivalent to the "pump" or power frequency.

Battery Power Eliminated

Ferroelectric energy converters

(*Continued on page* 176)

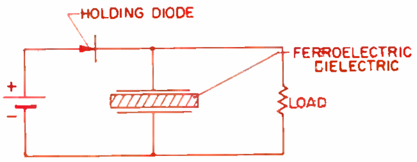


Fig. 2: Basic circuit of the ferroelectric energy converter aids understanding.

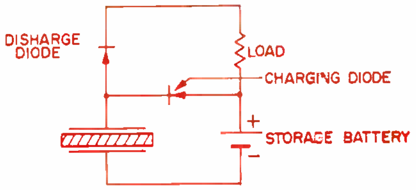


Fig 3: Ferroelectric energy converter circuit requiring no primary battery power

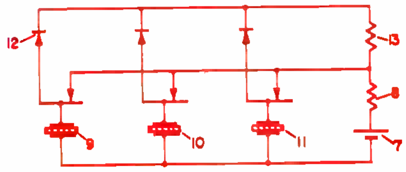


Fig. 4: Another method of eliminating power is the multiple capacitor converter.

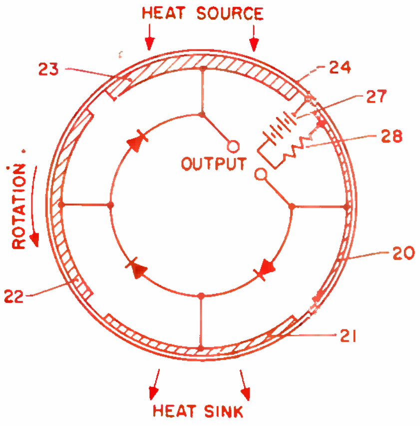
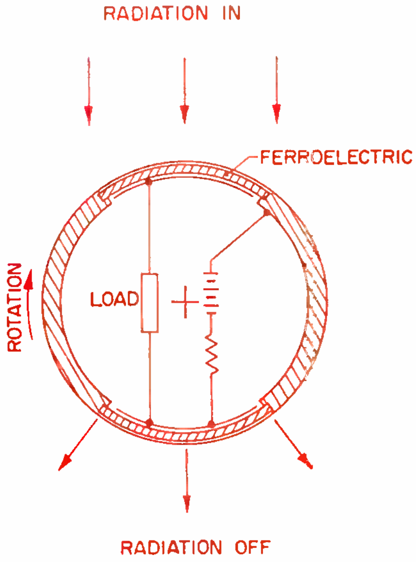


Fig. 5: This high-voltage converter lends lends itself to satellites or space vehicles

Fig. 6: Spinning space vehicles could use this a-c generator. Note radiation effect.



Interference Prediction

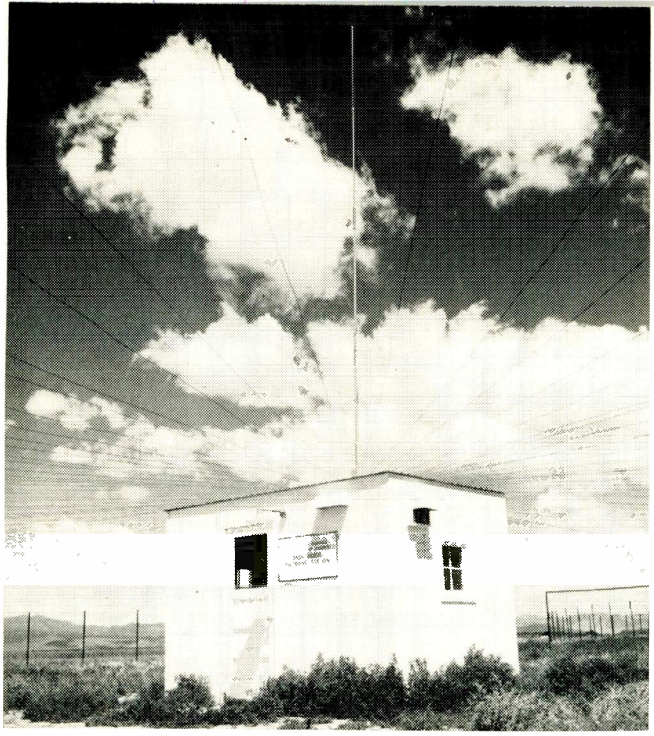


Fig. 1: Noise recording station typical of those set up by NBS during the International Geophysical Year. Data obtained from a world-wide network of these stations formed the basis for a graphical method which can be used to predict the characteristics of radio noise.

As noise, particularly atmospheric noise, is the limiting factor in radio reception, it is very important to be able to predict its characteristics under various conditions throughout the radio frequency range. Such a prediction, including an estimation of the possible interference to a given communications system, can be derived from an amplitude-probability distribution. In this, voltage levels are plotted against the percentage of time these levels are exceeded.

However, although the amplitude-probability distribution is a particularly useful tool, its direct determination necessitates detailed measurements at all frequencies and at many locations. The complex equipment and the large number of personnel required to carry out these observations make continuous routine measurements virtually impossible.

The National Bureau of Standards Boulder Laboratories has found a solution to this problem in an empirical graphical method. With this method, it is only necessary to measure three statistical moments—the average noise power, the average envelope voltage, and the average logarithm of the envelope voltage. From these quantities, four parameters can be derived to describe completely the amplitude - probability distribution as plotted on special graph paper designed so that a Rayleigh distribution of thermal noise plots as a straight line. The curve is the usual plot of voltage in decibels against the percentage of time the level is exceeded. This approach was developed by W. Q. Crichlow, C. J. Roubique, A. D. Spaulding, and W. M. Beery of the Bureau's Central Radio Propagation Laboratory.

As the initial step in developing this graphic method, it was found that the shape of the curve of over 100 recorded distributions, when plotted on the special paper, could be approximated by two non-parallel straight lines connected by the arc of the circle tangential to the two lines. The lower portion of this curve, representing low voltages and high probabilities, is composed of many random overlapping events, each containing only a small portion of the total energy. This portion of the curve approached the Rayleigh straight line distribution. The section representing very high voltages with low probabilities is, in general, composed of non-overlapping large pulses occurring infrequently. This section also was found to be well represented by a straight line.

Four parameters are needed to define this distribution: (1) a point through which the Rayleigh line passes; (2) a point and (3) a slope for the high-voltage, low-probability line; and (4) a parameter of some kind to determine the radius of the circular arc. Since four parameters are needed and only three statistical moments are measured, a dependency between two of the parameters was established. From experimentally measured distributions at eight frequencies and various bandwidths, a linear relationship was found between the radius of the circle and the slope of the high-voltage, low-probability line.

The experimentally measured distributions were then numerically integrated to obtain the three measurable moments, so that the relationship between the three moments and the four parameters could be determined. It is this relationship which allows measured moments to be used to plot the amplitude-probability distribution.

As a check on the accuracy of this method, the numerically integrated moments were compared to moments which had been recorded at the same time as the distributions. Approximately 60 sets of distribution measurements were analyzed to determine the error, which was largely introduced by the recorder. The standard deviation in the rms voltage values was about 1.1 db, with an average error of —0.4 db. Ninety per cent of the values were within 2 db of the mean.

This method of obtaining an amplitude - probability distribution from the three measured moments results in a distribution which is valid only for the bandwidths in which the moments were measured.

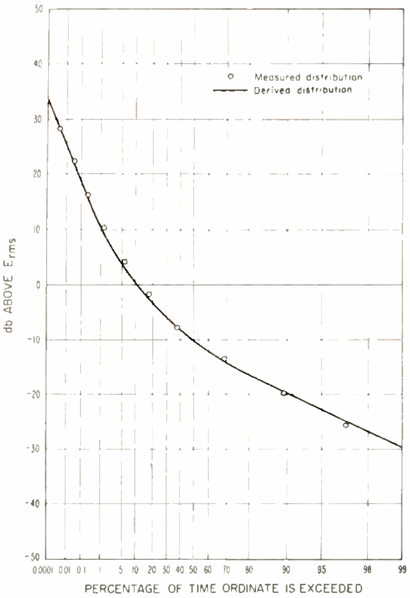


Fig. 2: Graph illustrating the effectiveness of a graphical method for obtaining the amplitude-probability distribution of atmospheric noise.

For h-f applications, the transistor can be considered as a linear active two-port network, which can be specified at a particular frequency by a set of four different parameters. One of the most commonly used is the "y" parameter. Described here are means for measuring and applying the "y" parameter along with ideas for designing a single stage amplifier.

For H-F Circuit Design . . . . .

Applying Transistor "y" Parameters

By V. G. K. REDDI
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As the use of transistors in r-f amplification is ever increasing, it is essential for a designer to understand the small-signal properties of the transistors at those frequencies. For this purpose, the functional model of a transistor can be considered as a linear active two-port network, which can be specified at a particular frequency by a set of four independent parameters. These parameters completely characterize the device for power gain considerations. In transistor work the most commonly used parameters are the "y" (short circuit admittances) and the "h" (hybrid) parameters. Each of these sets involves two immittances measured at the input and output terminal pairs (the opposite terminal pair being either open or short-circuited) and two transfer parameters.

Here the y parameter representation of linear two-port devices and the measurement of transistor y parameters at high frequencies are discussed. Different ways of designing single stage transistor amplifiers using small-signal two-port parameters are indicated. The usefulness of y parameters in the investigation of the potential instability and the calculation of maximum available power gain of a transistor is demonstrated. A numerical example is worked out using y parameters in amplifier circuit design.

REFERENCE PAGES
The pages in this section are perforated for easy removal and retention as valuable reference material.
SOMETHING NEW HAS BEEN ADDED
An extra-wide margin is now provided to permit them to be punched with a standard three-hole-punch without obliterating any of the text. They can be filed in standard three-hole notebooks or folders.

Fig. 1: A two-port network is illustrated

A two-port network with the usual terminal markings and sign conventions is shown in Fig. 1. The device (Fig. 1) can be characterized by the relations existing between the currents and voltages I_1, I_2 and E_1, E_2, respectively. If these relations can be expressed by a set of linear differential equations, the device is called linear. For any fixed operating point and small-signal operation, the transistor can be considered as a linear device. Any two of the four quantities I_1, I_2, E_1, E_2 may be given in terms of the remaining two. The set of four functions of frequency which relate the terminal currents I_1 and I_2 to terminal voltages E_1 and E_2 of a two-port linear device is known as the y parameters. The linear equations which identify the y parameters are:

$$I_1 = y_{11} E_1 + y_{12} E_2 \qquad (1)$$

$$I_2 = y_{21} E_1 + y_{22} E_2 \qquad (2)$$

where

$y_{11} = \frac{I_1}{E_1}$ when $E_2 = 0$—input admittance at port 1 when port 2 is shorted.

"y" Parameters *(Continued)*

$y_{22} = \dfrac{I_2}{E_2}$ when $E_1 = 0$—input admittance at port 2 when port 1 is shorted.

$y_{12} = \dfrac{I_1}{E_2}$ when $E_1 = 0$—transfer admittance from port 2 to port 1 when port 1 is shorted.

$y_{21} = \dfrac{I_2}{E_1}$ when $E_2 = 0$—transfer admittance from port 1 to port 2 when port 2 is shorted.

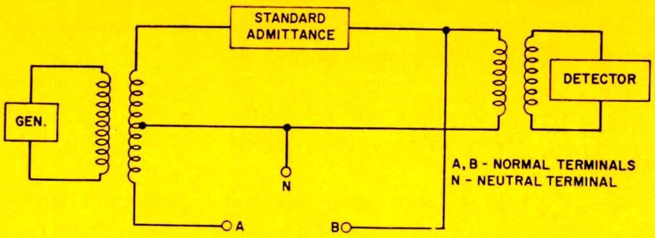
Measuring y Parameters

The short-circuit measurements indicated in the various definitions of these y parameters can be readily made, using simple bridge techniques. A 3-terminal device like a transistor triode can be connected in 3 different ways—namely common base, common emitter and common collector. Associated with these 3 orientations, there are 6 driving points and 3 transfer admittances that can be measured, but measurement of certain combinations of 4 admittances out of the above 9 will be sufficient to characterize the transistor in any orientation. The choice of the 4 parameters to be measured depends on the ease of measurement, accuracy desired, usefulness of direct reading, type of measuring equipment available, etc. The Wayne Kerr B801 VHF Admittance Bridge (range 1MC-100MC) is one of the instruments for y parameter measurements being used for this work.[1] The parameters being measured are y_{11e}, y_{22e}, y_{12e} and y_{11b}. (The subscripts "b" and "e" refer to grounded base and grounded emitter configurations respectively.)

Simplified diagram of Wayne Kerr B801 bridge and the circuits to measure the above-mentioned 4 y parameters are shown. It should be noted that the neutral terminal N is left open when driving point admittances are measured. The values of capacitances in the circuits shown are chosen such that they offer a good short circuit at the frequency of measurement.

There are some other commercially available instruments useful for measuring small-signal parameters of transistors at high frequencies. For example, an article in the Boonton Radio Corporation publication, "The Note Book" (Fall 1958, No. 19) describes a method of measuring small-signal parameters of transistors using an RX meter.

Fig. 2: Simplified diagram of Wayne Kerr B801 bridge



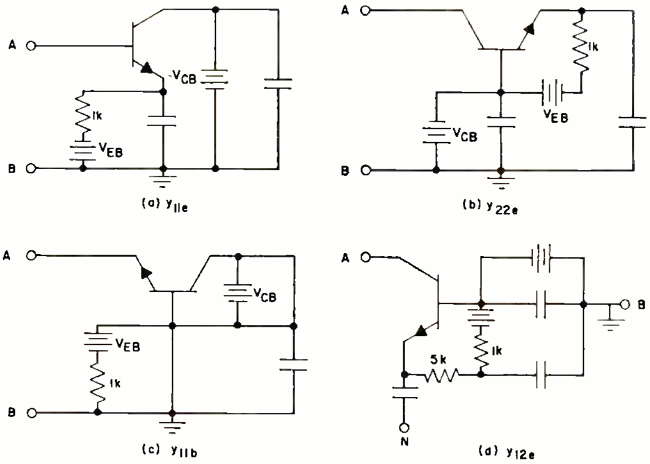


Fig. 3: Circuits for measuring y_{11e}, y_{22e}, y_{11b} and y_{12e}

R-F Amplifier Design

To use a transistor as a linear amplifier, it is essential to investigate whether the device is potentially stable or not at the frequencies and operating conditions of interest. A device like a transistor is called "potentially unstable" if the device can be made to oscillate with passive terminations and with no external feedback. This property of self-sustained oscillation of a transistor is due to several mechanisms that contribute to internal feedback in the device. At high frequencies the significant feedback path is due to the collector-to-base capacitance. In a bilateral two-port active network like the transistor there is always a frequency range where the device is potentially unstable. Hence, it is of primary importance to investigate the potential instability of a transistor in the frequency range of interest when it has to be used as an amplifying device.

The criterion for potential instability in a two-port active network terminated with a source and load, as shown in Fig. 4, can be expressed in terms of the small-signal y parameters[2] as follows:

$$(g_{11} + g_s)\,(g_{22} + g_L) \leqq \left|\frac{y_{12}\;y_{21}}{2}\right| \left[1 + \cos \underline{/y_{12}\;y_{21}}\right] \quad (3)$$

where

g_{11} = Real part of y_{11}

g_{22} = Real part of y_{22}

g_s = Source conductance

g_L = Load conductance

Since transistors always have a resistive input impedance, one has to consider, at all stages, the power gain of the device. Terminating impedances come in only to establish a relationship between voltage and current at the terminals. To predict the amplifier performance at a particular frequency, with specified load and source terminations, the maximum power gain that can be obtained is of primary importance to a designer.

One starts the design of a narrow band transistor amplifier with the small-signal two-port parameters measured at the center frequency. In general, narrow band transistor amplifiers can be categorized as neutralized and unneutralized. Neutralization is essentially a method of making a non-unilateral active two-port network unilateral. This is accomplished by connecting it with a passive two-port network, which has the negative of the reverse transmission of the active two-port. The resulting combination two-port is now unilateral. There are a number of ways of doing this.[3] For example, neutralization is achieved by bridging the input and output port with a passive two-terminal network, whose admittance is the same as the reverse transadmittance of active two-port.

When a transistor is neutralized, there is no regeneration in the system. Also, the input and output impedances of transistors are independent of load and source impedances, and, hence, input and output networks can be designed independently. A knowledge of small-signal y parameters enables one to design readily the neutralizing network and the input and output networks.

The transducer gain, defined as the ratio of actual load power to the power available from the source when the transistor is neutralized, can be calculated by the relation:

$$G_T \text{ neutralized} = \frac{4 \, |y_{21} - y_{12}|^2 \, g_s \, g_L}{[\, (y_s + y_{11} + y_{12}) \, (y_L + y_{22} + y_{12}) \,]^2} \qquad (4)$$

If the source and load admittances provide conjugate matches after neutralization at the input and output ports, the transducer gain will be a maximum and is given by the expression:

$$G_T \text{ max. neutralized} = \frac{|y_{21} - y_{12}|^2}{4 \, (g_{11} + g_{12}) \, (g_{22} + g_{12})}$$

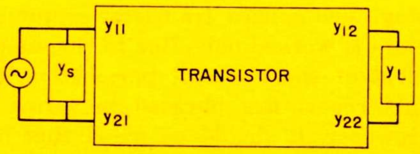


Fig. 4: Two-port active network terminated with a source and load

There are other methods of transistor amplifier design developed without the use of neutralization. Linvill and Schimp[4] have analyzed the problem of conjugate matching at the two ports of the transistor simultaneously, starting from small-signal parameters, and have derived expressions for maximum available power gain (which is also maximum transducer gain) and for optimum source and load admittances for the case when transistor is potentially stable. To facilitate the design of amplifiers, a set of charts has been developed from which can be read power gain and input impedance as a function of load termination. They have shown that the expression:

$$\frac{P_{out}}{P_{in}} = \frac{|y_{21}|^2}{4 \, g_{11} \, g_{22} - 2 \, \text{Re} \, (y_{12} \, y_{21})}$$

(where Re $(y_{12} \, y_{21})$ is the real part of the product of y_{12} and y_{21}) is within 3 db of the maximum available power gain, provided the transistor is potentially stable. (Refer to Reference 2 for design procedure of amplifiers employing potentially unstable elements.)

Until now we were concerned with the design of a 1 stage amplifier on a single frequency basis. However, in practice, one is interested in multistage amplifiers to give desired gain, which operate over a range of frequencies broad enough that parameters may change significantly over the range. In such cases, the effect of transistor-parameter variation with frequency on gain, stability and driving point impedances of amplifiers becomes important. However, a study of single frequency performance of transistor is a convenient starting point in the design of amplifiers. Literature is available that deals with the design of multistage broad band amplifiers (References 2, 5, 6 and 7). In these references, problems such as aligning and broadband matching of multistage amplifiers and design procedure to yield constant gain over a range of frequencies are dealt with.

The characterization of a transistor at discrete frequencies by measurement of small-signal two-port parameters forms the basis for all above investigation. Discrete frequency characterization of a transistor is also useful to synthesize a physical model of transistor or transistor equivalent circuit good over a range of frequencies.[8]

An Example

As an example of the use of y parameters in circuit design, let us consider the design of a single stage neutralized common emitter amplifier operating at 30MC, using Fairchild 2N697.

The values of measured y parameters of 2N697 at the operating bias values of $v_c = 20$ volts and $I_e = 20$ma and $f = 30$MC are:

$$y_{11e} = (22.5 + j\,14.7) \, 10^{-3} \text{ mhos}$$
$$y_{22e} = (1.7 + j\,5.7) \, 10^{-3} \text{ mhos}$$
$$y_{12e} = (-0.8 - j\,0.38) \, 10^{-3} \text{ mhos} = 3.88 \times 10^{-3} \, \underline{/ - 101.6^\circ}$$
$$y_{11b} = (60 - j\,75) \, 10^{-3} \text{ mhos}$$

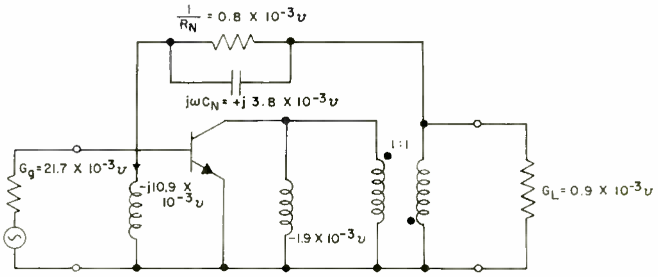
The forward transfer admittance in the common emitter configuration is readily calculated using the relation:

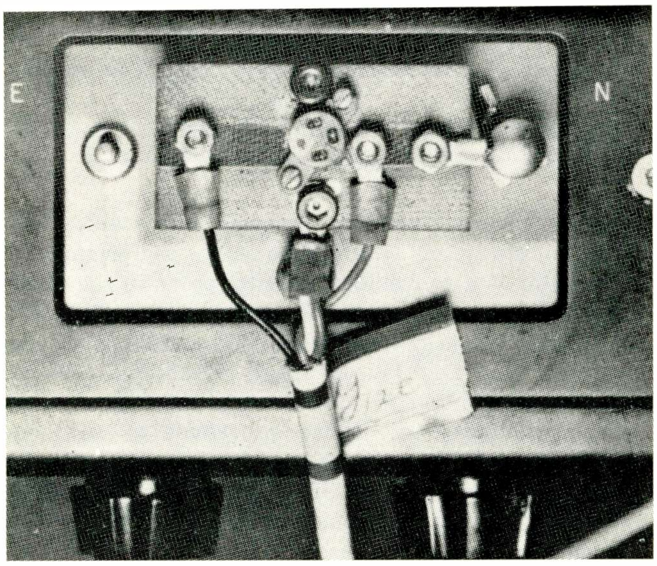
$$y_{21e} = (y_{11b} - y_{11e} - y_{22e} - y_{12e}) = (36.6 - j\,91.6) \, 10^{-3} \text{ mhos}$$
$$= 98.8 \times 10^{-3} \, \underline{/ - 68.2^\circ}$$

$$y_{12e} \times y_{21e} = 383 \times 10^{-6} \, \underline{/ - 169.8^\circ}$$

The potential stability of the transistor is readily checked when operated with a load and source conductance equal to zero (if the transistor is stable under this extreme condition, the transistor will be stable under any other source and load terminations) by the inequality:

Fig. 5: A 30 MC neutralized amplifier circuit with conjugate matching at the input and output. The biasing is omitted





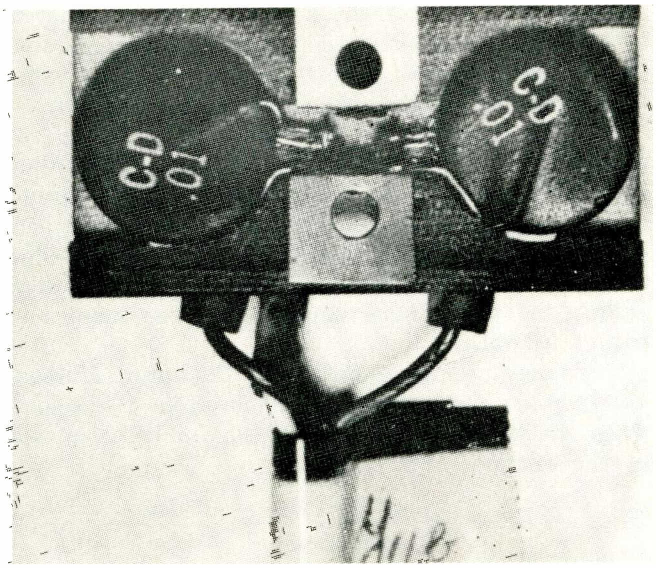


Fig. 6a (left): Top view of the jig mounted on Wayne Kerr B801 bridge for measuring y_{12e}. Fig. 6b (right): Bottom view of the jig for measuring y_{11b}.

"y" Parameters *(Concluded)*

$$g_{11e}\, g_{22e} \geqq \left|\frac{y_{12e}\, y_{21e}}{2}\right| \left[1 + \cos \underline{/\; y_{12e}\, y_{21e}}\right]$$

$$22.5 \times 1.7 \geqq \frac{383}{2}\left[1 + \cos\left(-\ 169.8°\right)\right]$$

$$38.25 = 3.06$$

Hence, the transistor is potentially stable at this operating condition.

The maximum neutralized power gain is calculated using the relation:

$$\text{Gt max. neutralized} = \frac{\left[y_{21e} - y_{12e}\right]^2}{4\,(I_{11e} + I_{12e})\,(I_{22e} + I_{12e})}$$

$$= \frac{(37.4)^2 + (87.8)^2}{4 \times 0.9 \times 21.7} = 116.5 = 20.66 \text{ db}$$

After neutralization, the input admittance $= y_{11e} + y_{21e} = (21.7 + j\ 10.9)\ 10^{-3}$ mhos.

After neutralization, the output admittance $= y_{22e} + y_{12e} = (0.9 + j\ 1.9)\ 10^{-3}$ mhos.

The 30MC neutralized amplifier circuit with conjugate matching at the input and output is shown (the biasing is omitted) in Fig. 5.

Summary

Transistor y parameters have been defined and the techniques of measuring them are discussed. The use of small-signal parameters in the design of transistor amplifiers is indicated. A design example of a single stage neutralized transistor amplifier using y parameters is worked out. Due to the simplicity of measurement of short circuit parameters, the discussions in this report are phrased in terms of y parameters. However, it should be noted that one can discuss in the same way using either open circuit (z) or hybrid (g or h) parameters.

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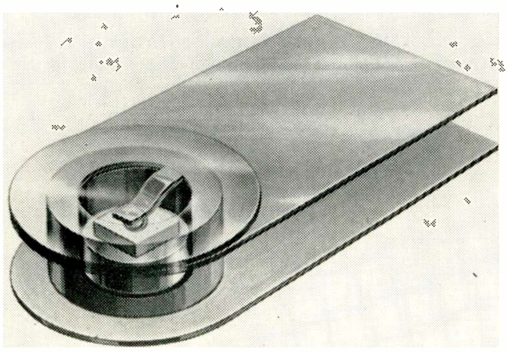
Tunnel Diode



No larger than the head of a match, tunnel diode in RCA developed low-inductance case with integral ribbon measures less than ¼ in. in overall length and has a height of about 1/16 in. Cylindrical ceramic case and ribbon lead-and-tab construction provide an inductance of only 0.4 millimicrohenry. The tiny component is now being offered on a sampling basis by the RCA Semiconductor and Materials Division for engineering evaluation.

Operating 100 times faster than a transistor, tunnel diodes make possible up to 1 billion decisions a second in ultra-high-speed computers.

In Part One the Physical basis for temperature variation was discussed. This part shows how one may combine certain temperature dependent characteristics to produce a unit with relatively temperature insensitive properties.

Thermal Characteristics of Silicon Diodes

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Part Two of Two Parts

THE forward characteristic of a silicon diode has a negative temperature coefficient, i.e., the forward voltage for a given forward current decreases with increasing temperature, for sufficiently low forward currents. As the forward current is increased, the temperature coefficient decreases in magnitude to zero, then changes sign and increases. This behavior is due to the positive temperature coefficient of resistivity of silicon over the range of temperature usually encountered in practical applications.

The forward current at which the temperature coefficient vanishes is a function of the resistivity of the base silicon and the geometrical configuration of the diode. At this current, the forward characteristic curves corresponding to different temperatures cross one another. The forward voltage drop corresponding to this cross over current is relatively insensitive to temperature. The forward voltage drop at the cross over current is plotted as a function of the nominal "zener" voltage for the Hoffman IN200 series of diodes in Fig. 10.

Fig. 11 shows the cross over current as a function of "zener" voltage for the same series of diodes.

The voltage drop corresponding to the cross over current is of the order of one volt, Fig. 10. Therefore, to achieve high reference voltages, two or more diodes must be put in series. The voltages obtained from such series combinations of forward biased diodes overlaps the range of zener voltages obtainable for silicon aluminum alloy diodes.

Since the forward impedance of the diodes would be additive, one might expect the series string to be a poorer regulator than a single reverse biased diode of the same voltage. However, the reverse characteristic of the diodes (Hoffman IN465 through IN470) becomes softer as one goes down in zener voltage.

Below about six volts, the forward characteristic is sharper than the reverse breakdown characteristic so that for very low voltages better regulation can be achieved by using series strings of forward biased units.

Fig. 13 compares the breakdown characteristic for a IN466 diode with that for a series string of five forward biased units. From these results it is apparent that better low voltage regulator diodes can be made from series strings of forward biased units than from a single reverse biased unit.

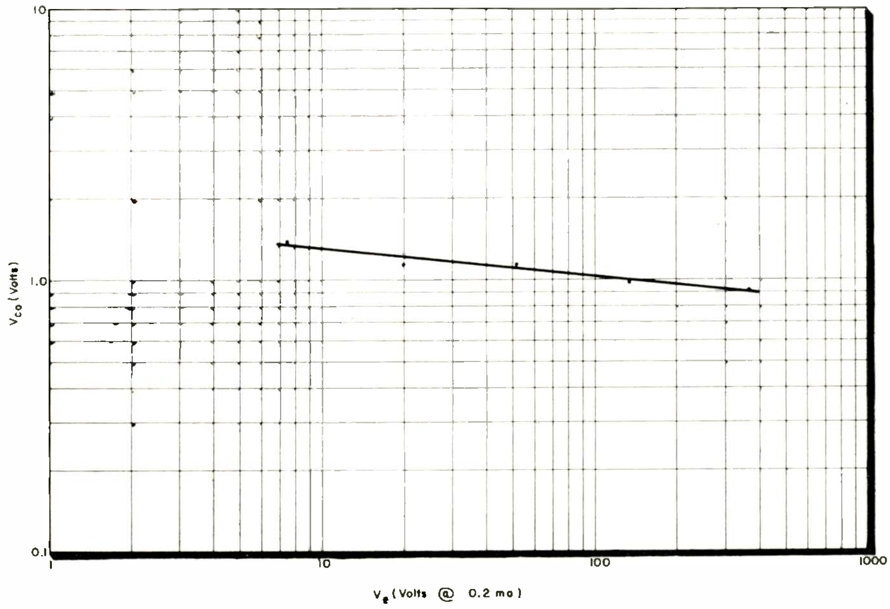

Fig. 10: Forward voltage drop corresponding to the cross-over current as a function of the nominal zener breakdown voltage.

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reverse breakdown characteristics forms the basis for a very reliable measure of thermal resistance and thermal time constants. Reverse saturation current

nium. In silicon, therefore, the reverse current cannot be considered a reliable measure of junction temperature.

Silicon Diodes *(Continued)*

If the reverse and forward breakdown voltages were linear functions of the temperature over the above temperature range, it would only be necessary

Silicon Diodes *(Continued)*

Thermal Resistance

One may determine the thermal resistance from measurements of the forward or reverse breakdown voltage as a function of temperature. Since our results are equivalent for either breakdown region, we will describe the measurement only for forward conduction.

The forward voltage drop at a low current level is measured in baths held at two different temperatures. The measuring current is applied in the form of a low current pulse of short duration and low repetition rate to avoid self heating in the diode. The change in forward voltage drop at this current is then due to the change in junction temperature produced by the two temperature baths. It is desirable to use as low a measuring current as possible to minimize self heating and because the sensitivity of the measurement, i. e., the change in forward voltage drop for a given change in temperature, increases with decreasing forward current. The measuring current is shown schematically in Fig. 17a for a zero based square wave form of pulse.

The unit is now left in the low temperature bath and heated by an adjustable high current pulse. The forward voltage drop is periodically sampled during the low current pulse and the high current pulse is adjusted in magnitude until the forward voltage at the low current equals the value it had in the high temperature bath. The wave form of the current pulse now appears as shown in Fig. 17b. It consists of a non-zero base square wave whose lower limit corresponds to the low current pulse and whose upper limit is the high current pulse.

The purpose of the high current pulse is to produce self heating in the diode. Its magnitude is adjusted until the junction is at the same temperature it was at in the high temperature bath, as determined by the forward voltage drop at the low current level. The thermal resistance is then equal to difference in temperature between the baths divided by the power consumed in self heating the diode. For a square wave pulse, dc meters will read one-half the peak current and one-half the voltage corresponding to this peak current. The average power consumed is, therefore, twice the ammeter and voltmeter readings. The thermal resistance is given by

$$R_T = \frac{\Delta T}{2IV}$$

where, ΔT is the change in temperature between the baths, and I and V are the current and voltage readings.

If one employs a square wave heating pulse as indicated above, the repetition rate must be high enough to prevent the junction from cooling off appreciably while switching from the high current to the

Fig. 15: Breakdown voltage as a function of temperature with reverse current as a parameter.

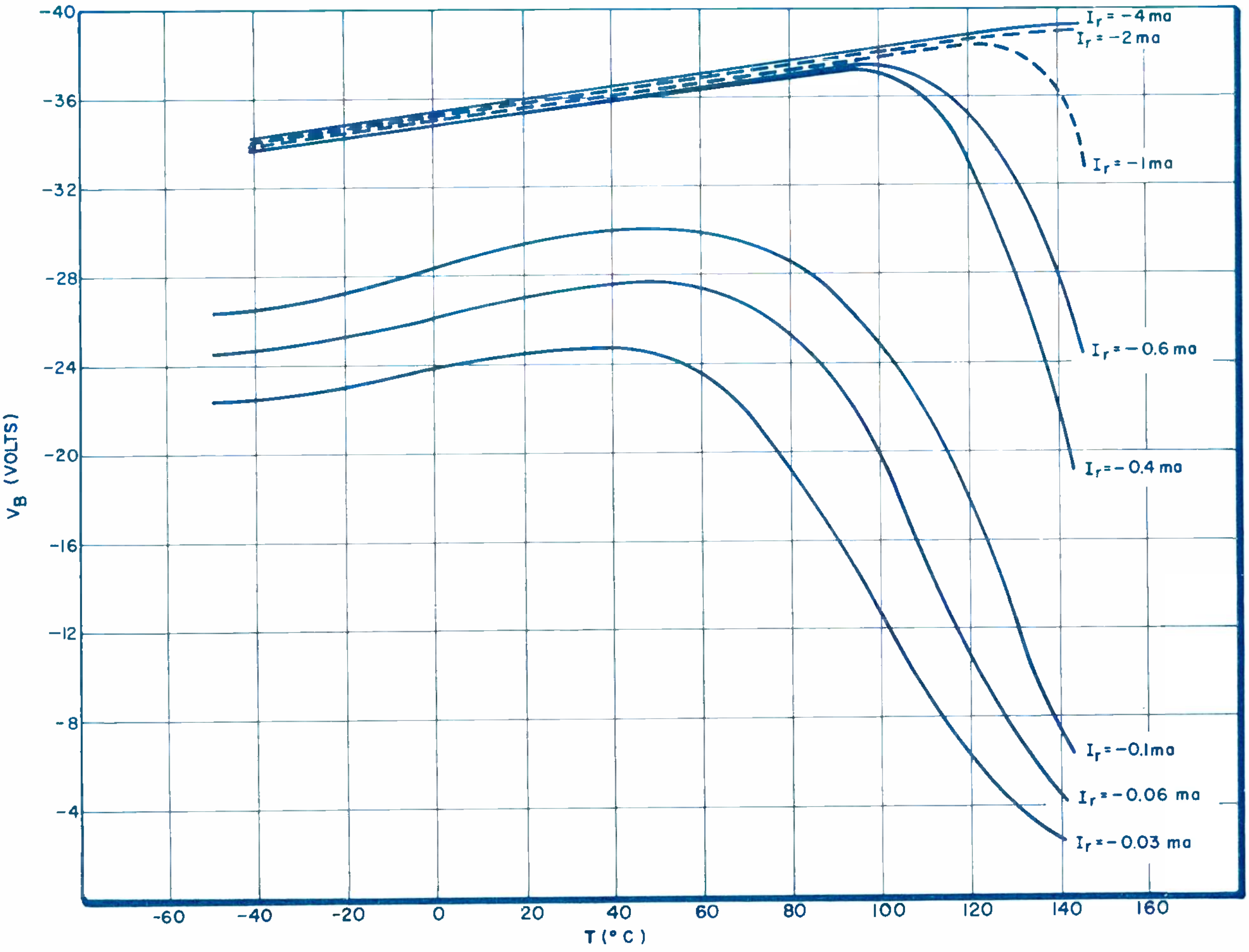
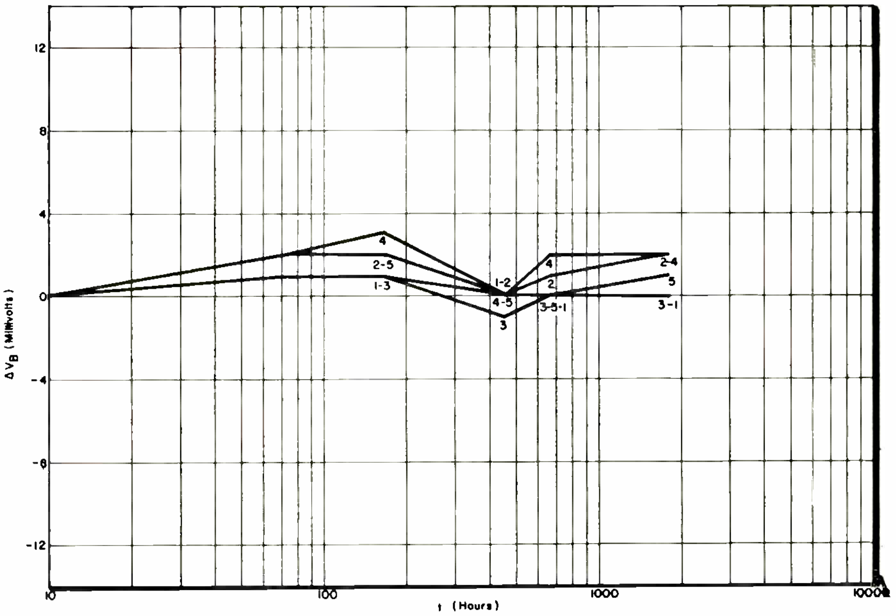


Fig. 16 (right): Change in nominal output voltage versus time for some 1N430 diodes under various operating conditions.



measuring pulse. If the junction does have a chance to cool off, the forward voltage drop will be too high at the measuring current and the power pulse will have to be increased. Since the temperature difference remains the same, the thermal resistance will be erroneously low. Because of these difficulties, we no longer employ a square wave heating pulse but rather one in which the duration of the heating pulse greatly exceeds the duration of the measuring pulse.[20]

Thermal Time Constants

The rapidity with which the diode cools off after the high current pulse depends on its thermal time constant. The shorter the thermal time constant, the higher the repetition rate must be, for square wave pulses, to obtain a reliable value for thermal resistance. When one applies a forward current pulse to a diode, it initially follows its room temperature characteristic curve. Then self heating causes the unit to shift to a higher temperature characteristic. If the current is suddenly reduced, the diode follows the high temperature characteristic down to the new current level; then moves out to a lower temperature characteristic curve as the unit cools off.

Self heating, therefore, causes the diode to trace out a sort of current-voltage hysteresis loop whose shape and area depend on the thermal time constant. Fig. 18 shows the forward voltage drop as a function of time across a diode when a forward current pulse is applied. The voltage drop initially rises to a high value as the unit follows a low temperature characteristic and then decays to its final steady-state value when thermal equilibrium is reached. The decay is approximately exponential and the thermal time constant is the time required for the voltage excess over the saturation voltage to decay to *1/e* of its initial value.

The decay is not quite a simple exponential and may be more accurately represented by a series of exponential decay factors. We have found that the curve can usually be adequately represented by a series of three time constants. These thermal time constants have been tentatively associated with the time required to achieve equilibrium between junction and case, case and heat sink, and heat sink and ambient. The time constants increase in the order given and details on their measurement and interpretation will be presented in a forthcoming article[20]

The data presented herein and the devices described are the result of the labors of many people of the Hoffman Semiconductor Division. In particular I should like to thank M. Byczkowski and L. Rose for many helpful discussions on certain aspects of the thermal characteristics.

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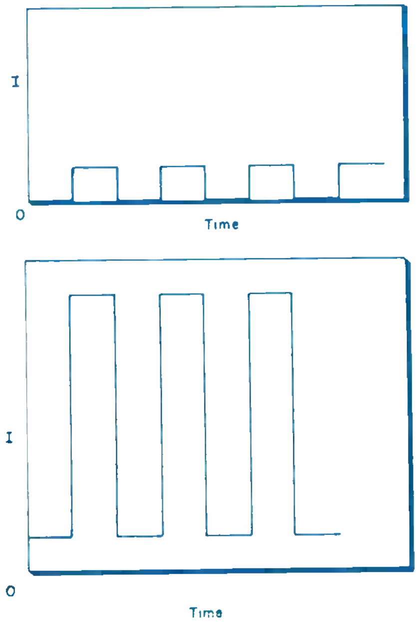


Fig. 17 (left): Pattern of square wave pulses used in measuring resistance. (top) zero biased low current pulses for initial measurement of forward voltage drop; (bottom) pulse pattern for diode self heating.

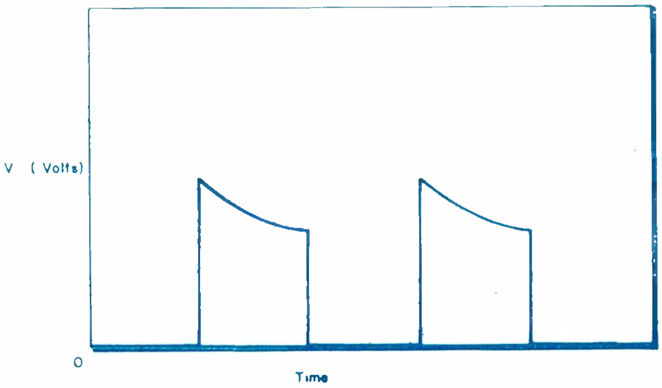


Fig. 18 (right) Forward voltage drop as a function of time for an applied forward current pulse.

By **Dr. E. J. SCHUBERT**
*Burroughs Research Center**
Paoli, Pa.

Compact matrices of low cost and high reliability are one of the most powerful building elements in data handling systems. To accomplish this, printed circuit techniques are contemplated for manufacturing these compact diode or resistor networks. Progress and state of the art are given here.

For Data Handling Systems . . .

Printed Diode and Resistor

Part Two of Two Parts

3 RESISTOR MATRICES

Linear networks perform a variety of arithmetic operations in analog computers. Referring more specifically to a current node with p branches, the current in a preferred single branch as the output must be the negative sum of all other p - 1 branch currents according to Kirchhoff's law.

The linear network in Fig. 7 comprises a set of p inputs. n of the p inputs are at potential U_1 representing the binary ONE level, p-n inputs are connected to a potential U_0, representing the binary ZERO signal. U_2 might be a fixed bias potential applied through the impedance Z_2. In the output line is a load, Z_3.

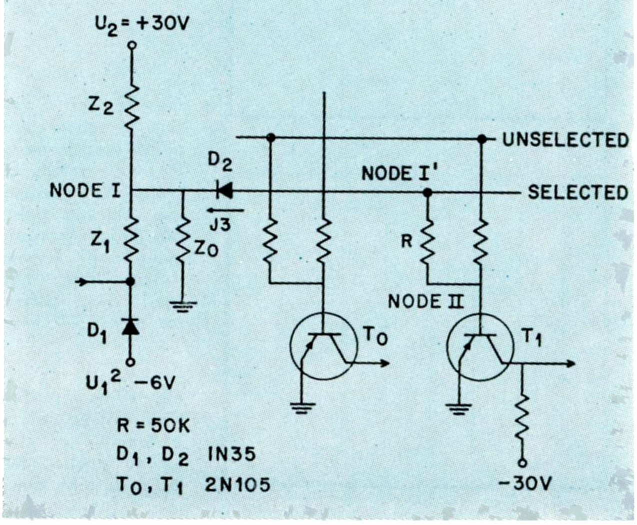
Because all resistors in such a network should be preferably of uniform value, R, the individual impedance will be defined accordingly. The outcome of the circuit analysis which follows reflects solely the number of inputs and the output buffering in the relation of the fan-in factor, p, and fan-out factor, m.

$$Z_0 = R/(p - n)$$
$$Z_1 = R/n$$
$$Z_3 = R/m$$

The output busses impose the load, Z_3, on the individual decoder nodes, I, by forming another node, II, virtually at the reference node if the impedance of the node-forming circuit element is negligible with respect to R. This statement is correct for the base emitter diode of a transistor amplifier at node II.

In Fig. 8, the actual circuits are shown in a small section comprising parts of the decoder and encoder. To define U_1 independent of signal fluctuation a clamping diode, D_1, to the potential, U_1, is provided at each input. If $n = p$, the branch through $Z_0 = \propto$ is non-existent and the output current, I_3, being negative, will flow from the encoder part of node I (denoted by I′) through diode D_2 into the decoder part of node I. Any current in the opposite direction for $n < p$ is inhibited. At node II, the current passes from the reference ground through the emitter base junction and R into node I′. The forward resistance of the emitter base junction is several orders below R, in this case 50 K. Accordingly, the voltage across the emitter base junction of T_1 does not suffice to operate the transistor amplifier, T_0, in an unselected output.

Fig. 8: Schematic drawing of a section of a resistor matrix



perature limits will be less than that between either limit and room temperature. Generally, it is sufficient to match the voltage changes of the forward and reverse biased diodes over two temperature intervals; the lower operating to room and room to the upper operating temperature.

The fact that output voltage falls relatively rapidly with increasing temperature is in part accounted for by the effects discussed above; and, in part by the strong dependence of the reverse current on temperature. Quite apart from any effects due to the series resistance, the positive temperature coefficients of avalanche diodes are modified by the fact that the reverse voltage decreases for small reverse currents with increasing temperatures. The net result of the two competing effects is that there is a cross over point in the reverse breakdown characteristics corresponding to different temperatures.

The cross over current increases with increasing temperature in such a way that for any given current there is a temperature range over which the reverse voltage increases with temperature; and, a higher temperature range over which it falls with increasing temperature. For high currents which are well beyond the "zener" knee, the cross over occurs at a temperature which is well beyond the operating temperature of the diode. This behavior is illustrated in Fig. 15 by a IN1784 one watt voltage regulator diode. The particular unit is a reverse current reject, otherwise the cross over would not occur at reasonably high currents within the temperature range shown.

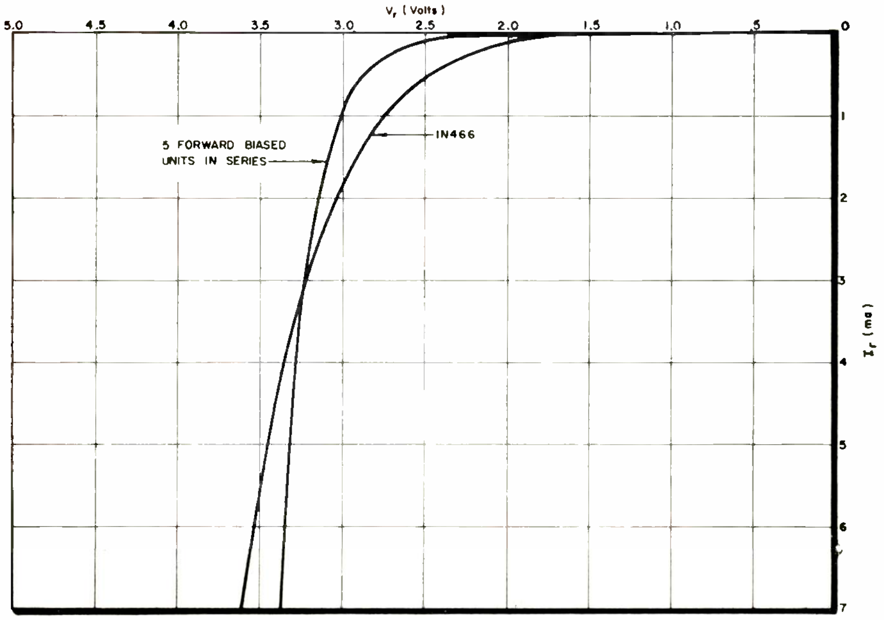
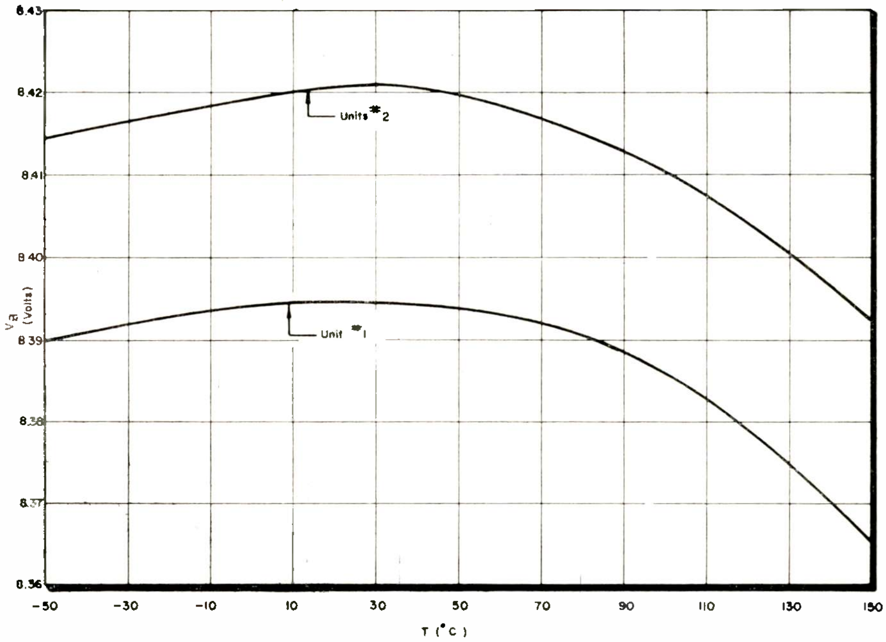


Fig. 13 (above): Comparison of the breakdown characteristic of a low voltage reverse biased diode with that for a series string of five forward biased units.

Fig. 14 (below): Output voltage versus temperature for some typical 1N430 diodes.



Reference Unit Stability

The stability of the characteristics of these units with time has been exhaustively treated elsewhere.[17, 18] However, since their use in certain critical control applications depends on this stability, typical output voltage vs. time curves are shown in Fig. 16. The results are normalized in such a way that the positive and negative changes in output voltage from the initial 25°C value are plotted as a function of time under various operating conditions.

The temperature variation of the forward and reverse breakdown characteristics forms the basis for a very reliable measure of thermal resistance and thermal time constants. Reverse saturation current is also a strong function of temperature.[19] It is also the parameter most frequently used to measure thermal resistance. Unfortunately, for silicon at room temperature and higher, the temperature dependence of the reverse current is complicated by space charge generated currents.

In addition the effects of surface leakage and structural imperfections on reverse current are amplified in silicon as compared to germanium. The cause is the reverse currents in silicon which are typically several orders of magnitude lower than for germanium. In silicon, therefore, the reverse current cannot be considered a reliable measure of junction temperature.

Silicon Diodes *(Continued)*

Thermal Resistance

One may determine the thermal resistance from measurements of the forward or reverse breakdown voltage as a function of temperature. Since our results are equivalent for either breakdown region, we will describe the measurement only for forward conduction.

The forward voltage drop at a low current level is measured in baths held at two different temperatures. The measuring current is applied in the form of a low current pulse of short duration and low repetition rate to avoid self heating in the diode. The change in forward voltage drop at this current is then due to the change in junction temperature produced by the two temperature baths. It is desirable to use as low a measuring current as possible to minimize self heating and because the sensitivity of the measurement, i. e., the change in forward voltage drop for a given change in temperature, increases with decreasing forward current. The measuring current is shown schematically in Fig. 17a for a zero based square wave form of pulse.

The unit is now left in the low temperature bath and heated by an adjustable high current pulse. The forward voltage drop is periodically sampled during the low current pulse and the high current pulse is adjusted in magnitude until the forward voltage at the low current equals the value it had in the high temperature bath. The wave form of the current pulse now appears as shown in Fig. 17b. It consists of a non-zero base square wave whose lower limit corresponds to the low current pulse and whose upper limit is the high current pulse.

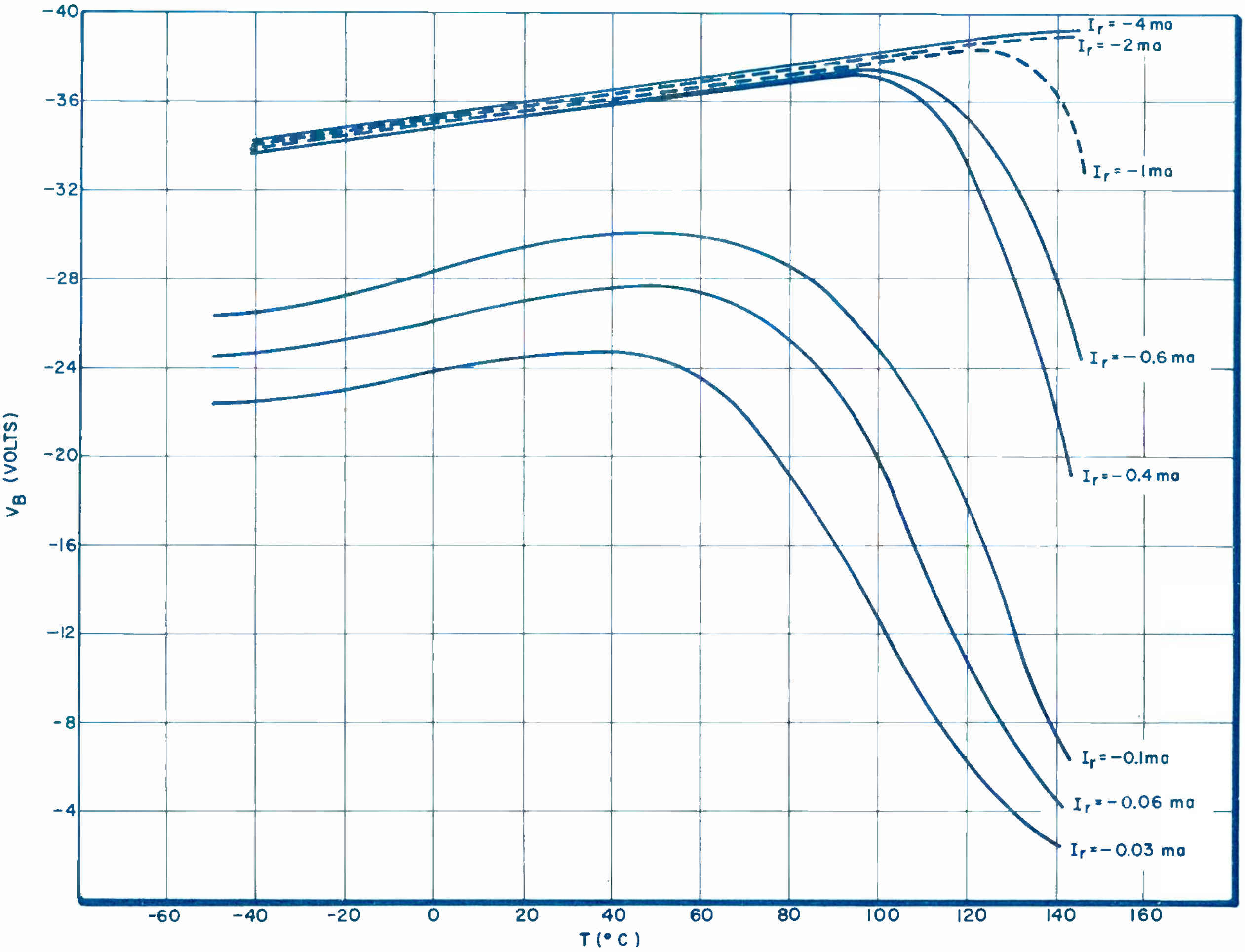
The purpose of the high current pulse is to produce self heating in the diode. Its magnitude is adjusted until the junction is at the same temperature it was at in the high temperature bath, as determined by the forward voltage drop at the low current level. The thermal resistance is then equal to difference in temperature between the baths divided by the power consumed in self heating the diode. For a square wave pulse, dc meters will read one-half the peak current and one-half the voltage corresponding to this peak current. The average power consumed is, therefore, twice the ammeter and voltmeter readings. The thermal resistance is given by

$$R_T = \frac{\Delta T}{2IV}$$

where, ΔT is the change in temperature between the baths, and I and V are the current and voltage readings.

If one employs a square wave heating pulse as indicated above, the repetition rate must be high enough to prevent the junction from cooling off appreciably while switching from the high current to the

Fig. 15: Breakdown voltage as a function of temperature with reverse current as a parameter.



The threshold potential of these junctions contributes to the same effect.

In Fig. 9 a complete circuit capable of the translation from teletype code to "excess three" code is depicted. The nodes correspond to those in Fig. 8.

Manufacturing Techniques

To take full advantage of this concept of resistor matrices requires the use of printed circuit techniques for wiring and formation of the resistors to such an extent as to insert the diodes, D_2, into these printed circuits *only*. As shown below, the switching function is independent of the resistor value, R, which indicates high reliability despite drift due to aging or environmental conditions.

The concepts are similar to those for diode matrices.

Matrices

One method is to etch patterns of parallel lines from a metal foil clad base and to cover the base with an insulating layer having a perpendicular pattern of conductors. Through perforations in this layer, resistive strips or spots will form the junctions at the desired intersections. This approach, although least expensive, has some inherent limitations because of the generally lower softening point of the insulating layer. Another more eleborate method uses a base with parallel strips on both sides forming a grid. One set of strips has plated-through holes in such a way that the through connections are exactly in the free area between the perpendicular strips on the other side. Wherever a resistive junction is required, a resistor is bonded to the collector strips. The input signals were obtained from a square wave generator U_1 with low impedance and a signal of 6 volts. Appropriate coding into the decoder section was provided through a set of switches S_1 to S_4. The unselected decoder outputs at node I show a slight ripple which does not appear at the transistor output because of threshold potentials in the base circuits. With increasing repetition rate, the storage of the transistor becomes predominant and determines eventually the limit frequency at 33 KC as indicated in Fig. 10 c.d.

Circuit Analysis and Design Criteria of Resistor Matrices

In Fig. 7b the equivalent circuit of a resistor matrix is shown. Arbitrarily the direction of currents towards the node I is assumed to be positive and the set of equation may be written accordingly:

$$\begin{array}{llllll} U_0 = & + I_0 Z_0 & & & - I_3 Z_3 \\ U_1 = & & + I_1 Z_1 & & - I_3 Z_3 \\ U_2 = & & & + I_2 Z_2 & - I_3 Z_3 \\ 0 = & + I_0 & + I_1 & + I_2 & + I_3 \end{array}$$

As stated previously, all individual resistors should be of uniform value R. This condition may be imposed on those represented by Z_0, Z_1 and Z_3 with the exception of Z_2. Depending on the circuit analysis, this resistor will be eventually of value R if U_2 may be chosen freely.

$$Z_0 = R/(p - n) \qquad Z_1 = R/n \qquad Z_3 = R/m$$

The determinant D of the above set may be expressed correspondingly:

$$D = \begin{vmatrix} R/(p-n) & 0 & 0 & -R/m \\ 0 & R/n & 0 & -R/m \\ 0 & 0 & Z_2 & -R/m \\ 1 & 1 & 1 & 1 \end{vmatrix}$$

$$D = R^2 [Z_2 (m + p) + R]/mn (p - n) = d/n (p - n)$$

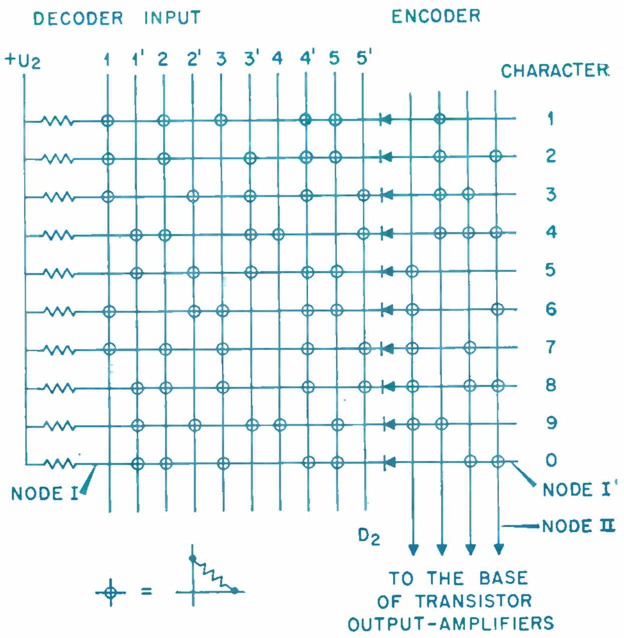


Fig. 9: The resistor matrix is capable of code translation from teletype to an excess-three code

In the last form the factor d comprises the portion of the determinant D which is independent of the number n of varying inputs in the state ONE. Solving the set of equations for I_3 yields:

$$I_3 = \begin{vmatrix} R/(p-n) & 0 & 0 & U_0 \\ 0 & R/n & 0 & U_1 \\ 0 & 0 & Z_2 & U_2 \\ 1 & 1 & 1 & 0 \end{vmatrix} D^{-1}$$

For the most frequent ZERO level $U_0 = 0$ the expression for I_3 becomes eventually:

$$I_3 = - (U_1 Z_2 n + U_2 R) R/d$$

To perform binary logic the direction of I_3 must be positive for $n = p$ and must reverse for $n \leqq p - 1$. Instead of unequal equations it may be said that the

Printed Matrices *(Concluded)*

switching from n = p to n = p-1 must cause a change of 2i increments.

$$U_1 Z_2 p + U_2 R = + i$$
$$U_1 Z_2 (p - 1) + U_2 R = - i$$

Eliminating i yields the design criterion:

$$U_1 Z_2 (2p - 1) + 2 U_2 R = 0$$

Selecting $R = Z_2$ as a specific choice gives the relation between signal level and bias:

$$U_2 = (0.5 - p) U_1$$

Substituting into the previous expression for I_3 proves that the switching function as change of direction of I_3 depends on n only.

$$I_3 = (p - n - 0.5) U_1 m / R (m + p + 1)$$
$$\text{For } n = p\text{: } I_3 = - 0.5 U_1 m / R (m + p + 1)$$

To draw current out of the reference node or out of the base of a pnp transistor at node II requires a positive current as defined earlier. The signal voltage U_1 must be negative in this case using a positive bias U_2. For any value of $n \leq p - 1$ the direction of I_3 will reverse. The diodes D_2 are provided to block the path for reverse currents, in order to inhibit uncontrolled current distributions in the encoder due to the varying number of n for the individual input combinations.

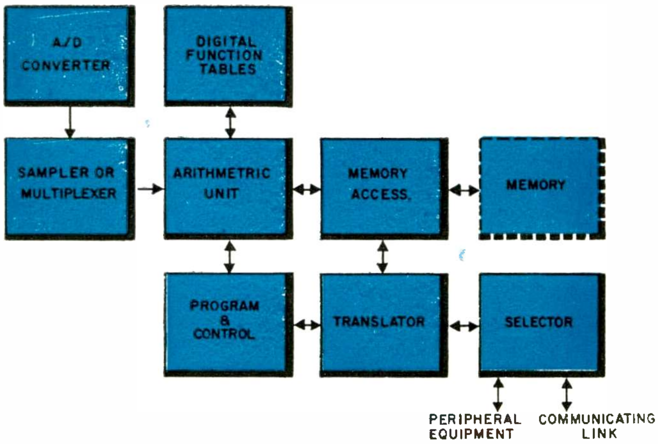


Fig. 11: A typical digital system is illustrated

The total differential quotient of I_3 with respect to the analytical variables U_1 and R serves as an indication of parameter drift.

$$dI_3/I_3 = + dU_1/U_1 - dR/R$$

It will be noted that the current I_3 drives m transistor-base-inputs and must suffice for saturation at the upper tolerance limit for R. An increase in drive current of 100% does not affect proper operation as generally known. Allowing a resistor tolerance of ± 20% for values of R assures a considerable safety margin for other parameter changes.

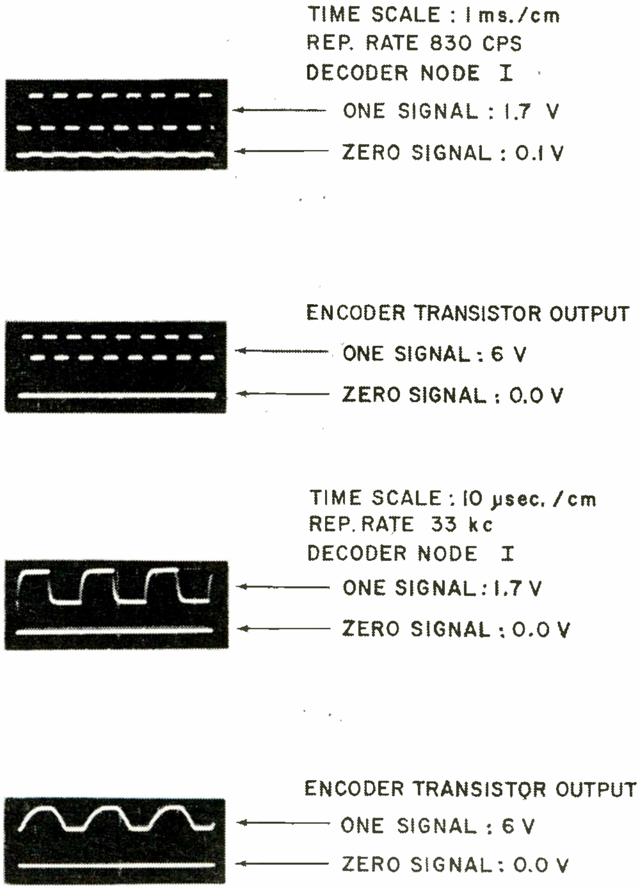


Fig. 10: Waveshapes show the performance of resistor matrix

Conclusions

Compact matrices of low cost and high reliability are one of the most powerful building elements in data handling systems. In Fig. 11 a typical digital system is illustrated and in nearly all units marked, large matrices might be of significance in new and more efficient system concepts.

With present component assemblies, some of the applications were prohibitive, e.g. the use of digital function tables. Smaller control computers with serial arithmetic are feasible using either stored functions of one or two variables or logarithmic operations for much faster operation. In such computers, floating radix points with 12 significant bits may be utilized requiring 64 word storage with automatic interpolation.

Integrated data processing demands compact and flexible translating equipment for direct communication among units with different notations and coding.

Another area of applications of growing significance are high speed peripheral units based on electronic principles for character formation and character recognition.

Prototypes of printed diode matrices have been evaluated and found satisfactory at frequencies up to 250 KC, limited by the present size of the diode junction with a shunt capacitance of 6500 $\mu\mu f/cm^2$. It may be anticipated that the manufacturing cost of the printed diode matrix will be low enough to justify the use of two level logic in all applications requiring medium pulse rates. In this case attenuations less than 3.5 db and S/N ratios better than 15 db (voltage time integral) may be expected.

Multinode resistor networks may be utilized as switching matrices representing large logical or digital function tables. Non-linear components are restricted to one diode per decoder line and one transistor per encoder output.

Tests of a prototype matrix with a 5-bit address and 35 encoder outputs were satisfactory for 6 volt input swing, up to 33 KC, producing 20 volt output. The speed limit was due to frequency cut-off of the audio transistors 2N105 several orders beyond the specified repetition rate of less than 1 KC.

Acknowledgments

Development and evaluation of the diode matrix was supported by Westinghouse Electronics Division in Baltimore as assignee of the related proprietary rights. In particular John Herb, Pittsburgh, was most instrumental in producing suitable prototypes. The evaluation was conducted by Brian Belman, Baltimore.

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of this article can be obtained by writing on company letterhead to

The Editor

ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

The resistor matrices were developed at the Research Center of the Burroughs Corporation in Paoli, Pa.

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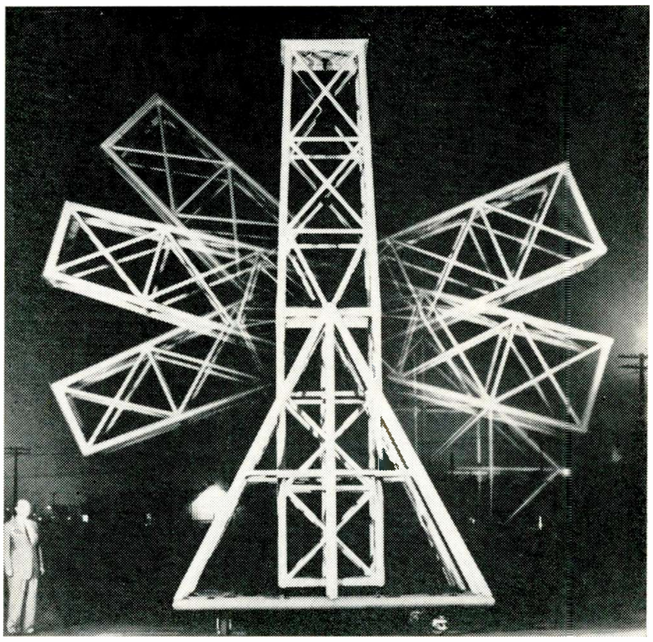
* Since preparing this article, Dr. Schubert has relocated. He is now Technical Director with Monitor Systems, Inc., a subsidiary of Epsco, Inc., located in Ft. Washington Industrial Park. Ft. Washington, Pa.

"Teeter-Totter" Tower



New antenna pattern tower, shown in motion (multiple exposure), literally swings models or antennas under test from 25 ft. top position down to ground working height.

A NEW fiberglass antenna pattern tower which swings heavy models from a 25-ft. height down to ground level for servicing is being manufactured by Blaine Electronetics, Van Nuys, Calif. Dubbed "Project TEETER-TOTTER," reflects the unusual 22-ft. truss beam which actually operates like a giant seesaw or balanced beam capable of swinging weights on the order of a ton, this tower was designed to fit a growing need expressed by many antenna design and test engineers in this country and abroad.

The requirements of Lockheed Aircraft Corp. Radar and Antenna Research Group guided the original design and development of the equipment.

Designated Blaine Model 14/T6, this extra heavy duty fiberglass tower, essentially "transparent" to radio, is designed to support or position not only mock-ups, models and missiles up to 500 lbs. in weight, but also two-axis azimuth/elevation positioners which themselves may weight some quarter of a ton.

A rugged steel base platform, 12-ft. sq., on 4 heavy duty swiveling casters forms the frame from which rise two stable pyramids made of fiberglass tubing. At the top of the pyramids are bearings for the shaft-axle which is 5 in. in diameter. The beam itself is 4 ft. sq. in section. Its members are special high glass content reinforced plastic tubes, exceedingly strong and rigid and resembling a welded tubular steel structure in appearance. The use of fiberglass reinforced plastic tubes as primary and secondary structure assures virtually no pattern interference.

Already in action at Lockheed's Burbank Antenna Range, this new tower will be a primary equipment at that company's extensive new high accuracy antenna laboratory/range at the Newhall/Saugus research facility site.

Minnesota	62	65	+3
Missouri	46	49	+3
Montana	None	None	—
Nebraska	10	11	+1

Wyoming

4,844

—*These figures are from the "ELECTRONIC INDUSTRIES' Census of Manufacturers."*

1959-1960 Statistics of the

ELECTRONIC STATISTICS

(Continued)

DISTRIBUTION OF ELECTRONIC ENGINEERS IN U. S.

State	% of U.S.
New York	23.91
California	16.64
Massachusetts	12.15
New Jersey	9.02
Pennsylvania	7.01
Illinois	4.91
Maryland	4.31
Ohio	3.30
Indiana	3.20
Texas	2.79
Connecticut	2.35
Minnesota	2.13
Wisconsin	1.56
Florida	1.41
	94.75

ELECTRONIC COMPANIES BY NUMBERS OF EMPLOYEES

No. of Employees	No. of Companies
1-19	1,021
20-49	886
50-99	774
100-249	822
250-499	493
500-999	269
1,000-2499	272
2500-4999	41
Over 5000	34

Source—ELECTRONIC INDUSTRIES' Census of Manufacturers

Aircraft Industry Sales

(In Million Dollars)

Year	Total	Aircraft and Parts	Engine and Parts	Propellers and Parts	Other Products and Services
1957	11,766	6,772	2,527	183	2,284
1958	11,470	6,319	2,179	163	2,809
1959*	8,227	4,040	1,245	73	2,871

Source—Aerospace Industries Assoc.

THE ELECTRIC INDUSTRY'S RECORD FOR 1959 AND PREDICTIONS FOR 1960

	1958	1959	1960
Generation, all components	645 billion kwhr	707 billion kwhr	761 billion kwhr
Total generation including railways and industrial	—	790 billion kwhr	—
Generating capability	144.7 million kw	165 million kw	176.7 million kw
Total benerating capability including railways and industrial	—	183 million kw	—
Kw use per capita	—	4,481 kw	—
Increase in utility system capability	—	11.8 million kw	9.3 million kw
Increase in government agency capability	—	3.5 million kw	2.6 million kw
Peak demand	—	129.3 million kw	—
Reserve	—	35.5 million kw	—
Construction expenditures by utility companies	—	$3.5 million	$3.4 million
Total investment	—	$46 billion	—
Record week	—	14.5 billion kwhr	—
Sales to large industrial customers	275 billion kwhr	303 billion kwhr	—
Sales to residential customers	159 billion kwhr	172 billion kwhr	—
Sales, commercial	101 billion kwhr	112 billion kwhr	—
Sales, other	34 billion kwhr	38 billion kwhr	—
Average annual use	3,366 kwhr	3,550 kwhr	—
Revenues, gross	$8,454 million	$9,150 million	—
Income, net	$1,532 million	$1,670 million	—
Taxes, total	$1,963 million	$2,120 million	—
Wages and salaries	$1,494 million	$1,570 million	—
Fuel costs	$1,335 million	$1,420 million	—
Nuclear production	—	490,000 kwhr	—
Hydro-electric production	—	15.2 billion kwhr	—

Government Electronic Contract Awards

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies during Fiscal Year 1959.

Accelerometers	61,675
Adapter, headset	46,386
Adapter, tube socket	85,383
Amplifiers	10,160,751
Amplifiers, a-f	531,313
Amplifiers, r-f	71,843
Amplifiers, servo	1,433,373
Analyzers	518,950
Analyzers, amplitude distribution	31,050
Analyzers, spectrum	1,536,395
Antennas & accessories	9,153,335
Antenna kits, search	229,445
Assemblies, electronic	81,635
Batteries, dry	15,399,909
Batteries, storage	3,769,322
Batteries, thermal	40,695
Battery chargers	1,525,734
Beacon equipment, radar	1,042,406
Beacon equipment, radio	1,448,009
Bridge, impedance	108,300
Cable assemblies	2,086,791
Cable, armored	28,238
Cable, electronic	948,968
Cable, telephone	1,207,083
Calibrators	116,292
Calibrators, frequency	125,247
Capacitors	594,159
Cavity assemblies	25,772
Cells, photoelectric	26,845
Cells, solar	500,000
Choppers	73,104
Circuit breakers	155,133
Coder-decoders	10,560,037
Communications systems	114,194
Components, electronic	1,586,787
Computers accessories	39,424,868
Computers, analog	503,485
Computers, digital	97,022
Connectors	1,585,402
Connectors, cable	1,901,951
Connectors, panel	210,900
Controls	243,368
Controls, radio	1,557,483
Converters	456,299
Converters, digital to analog	33,600
Converter, kinetape	553,558
Converters, signal	96,182
Converters, SSB	83,819
Converter, telephone signal	59,553
Converters, wave form	110,784
Countermeasurers equipment	346,572
Couplers	65,618
Crystal units	555,350
Data loggers	83,869
Decoders, audio	474,775
Delay lines	299,501
Detectors, infrared	41,850
Diodes, semiconductor	164,073
Diodes, variable capacitance microwave	99,150
Direction finder sets	852,233
Discriminators	30,785
Domes, sonar	797,880
Dummy loads	109,985
Duplexers	49,072
Earphones	28,969
Equipment, coordinate data	1,048,800
Equipment, communications	246,310
Equipment, electronic	767,296
Equipment, monitoring	53,920
Equipment, telemetry	189,017
Facsimile equipment	248,632
Filters	102,002
Filter, band pass	85,170
Filters, hi-fi	30,000
Filters, r-f	140,710
Fire control equipment	3,240,000
Fuses & accessories	1,008,723
Generators, digital timing	48,450
Generators, pulse	232,968
Generators, scan pattern	44,909
Generators, signal	3,731,891

Radio-TV-Electronic Industries

Federal Expenditures for Research and Development[a]

(Millions of Dollars)

Year Ending June 30	Total	Major National Security	Other
1940	$ 74	$ 26	$ 48
1941	198	144	54
1942	280	211	69
1943	602	472	130
1944	1,377	1,178	199
1945	1,591	1,372	219
1946	918	784	134
1947	898	768	130
1948	853	698	155
1949	1,080	889	191
1950	1,080	871	209
1951	1,298	1,063	235
1952	1,815	1,565	250
1953	2,100	1,830	270
1954	2,085	1,806	279
1955	2,085	1,804	281
1956[b]	2,538	2,202	336
1957[b]	3,027	2,596	431
1958[b] [c]	3,498	2,988	510
1959[b] [c] E	4,841	4,108	732
1960[b] [c] E	5,484	4,572	912

E. Estimate.

[a] Includes increase of "Research and Development Plant" ($304 million in 1957).

[b] Includes pay and allowances of military personnel.

[c] Figures for "Total" and "National Security" include figures previously classified as "procurement." An additional $2 billion in support of "research and development" continues to be financed from "procurement" funds.

Source—Exec. office of the President, Bureau of the Budget Estimates Div., "Budget of the U.S. Government."

EMPLOYMENT IN COMMUNICATION EQUIPMENT AND RELATED PRODUCTS

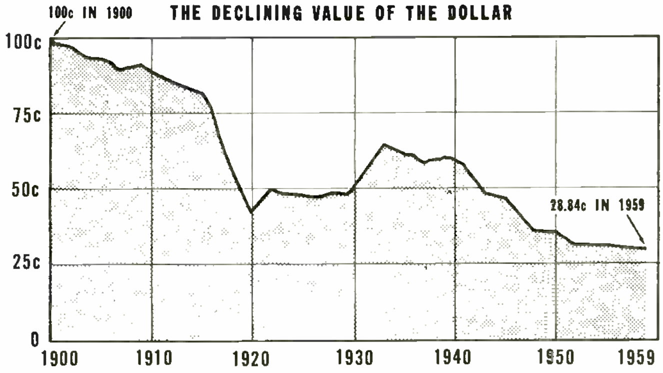
(Thousands of employees)

Year	Monthly Average	Year	Monthly Average	Year	Monthly Average
1950	350.7	1953	556.0	1956	557.8
1951	405.8	1954	490.1	1957	579.8
1952	474.2	1955	515.7	1958	551.4

Month	1956	1957	1958	1959
January	542.7	566.5	552.0	583.0
February	541.4	565.7	541.0	586.8
March	537.3	565.4	535.3	589.5
April	539.1	563.2	528.3	590.2
May	543.1	569.1	526.7	600.0
June	549.2	580.0	532.3	
July	548.5	582.5	536.6	
August	563.8	598.5	554.6	
September	569.9	608.1	569.4	
October	585.3	602.4	576.0	
November	592.0	587.7	582.6	
December	579.7	568.6	582.5	

—Source: Bureau of Labor Statistics

Note: Though this series does not measure levels of electronics employment exactly, it is a reliable indicator of short-term variations in electronics manufacturing activity.



THE DECLINING VALUE OF THE DOLLAR

Source: National Bureau of Economic Research and Bureau of Labor Statistics

ELECTRONIC FIRMS—BY STATES

Headquarters offices by number and state for the 4,844 electronic manufacturers, showing changes during past year.

State	*1958*	*1959*	*Change*
Alabama	2	2	—
Alaska	None	None	—
Arizona	12	15	+3
Arkansas	1	1	—
California	679	731	+52
Colorado	17	17	—
Connecticut	226	230	+4
Delaware	13	15	+2
Washington, D. C.	15	16	+1
Florida	35	41	+6
Georgia	4	5	+1
Idaho	None	None	—
Illinois	501	545	+44
Indiana	95	102	+7
Iowa	25	26	+1
Kansas	8	8	—
Kentucky	8	10	+2
Louisiana	5	5	—
Maine	3	3	—
Maryland	46	52	+6
Massachusetts	329	341	+12
Michigan	87	97	+10
Minnesota	62	65	+3
Missouri	46	49	+3
Montana	None	None	—
Nebraska	10	11	+1
Nevada	None	1	+1
New Hampshire	26	29	+3
New Jersey	484	518	+34
New Mexico	10	10	—
New York	961	1,018	+47
North Carolina	17	17	—
North Dakota	None	None	—
Ohio	240	259	+19
Oklahoma	13	14	+1
Oregon	15	15	—
Pennsylvania	319	331	+12
Rhode Island	38	40	+2
South Carolina	6	6	—
South Dakota	None	None	—
Tennessee	10	11	+1
Texas	41	42	+1
Utah	6	6	—
Vermont	11	12	+1
Virginia	22	26	+2
Washington	10	11	+1
W. Virginia	4	5	+1
Wisconsin	75	81	+6
Wyoming	4	4	—
		4,844	

—These figures are from the "ELECTRONIC INDUSTRIES' Census of Manufacturers."

ELECTRONIC STATISTICS

(Continued)

DISTRIBUTION OF ELECTRONIC ENGINEERS IN U. S.

State	% of U.S.
New York	23.91
California	16.64
Massachusetts	12.15
New Jersey	9.02
Pennsylvania	7.01
Illinois	4.91
Maryland	4.31
Ohio	3.30
Indiana	3.20
Texas	2.79
Connecticut	2.35
Minnesota	2.13
Wisconsin	1.56
Florida	1.41
	94.75

ELECTRONIC COMPANIES BY NUMBERS OF EMPLOYEES

No. of Employees	No. of Companies
1-19	1,021
20-49	886
50-99	774
100-249	822
250-499	493
500-999	269
1,000-2499	272
2500-4999	41
Over 5000	34

Source—*ELECTRONIC INDUSTRIES' Census of Manufacturers*

Aircraft Industry Sales

(In Million Dollars)

Year	Total	Aircraft and Parts	Engine and Parts	Propellers and Parts	Other Products and Services
1957	11,766	6,772	2,527	183	2,284
1958	11,470	6,319	2,179	163	2,809
1959*	8,227	4,040	1,245	73	2,871

Source—Aerospace Industries Assoc.

THE ELECTRIC INDUSTRY'S RECORD FOR 1959 AND PREDICTIONS FOR 1960

	1958	1959	1960
Generation, all components	645 billion kwhr	707 billion kwhr	761 billion kwhr
Total generation including railways and industrial	—	790 billion kwhr	—
Generating capability	144.7 million kw	165 million kw	176.7 million kw
Total benerating capability including railways and industrial	—	183 million kw	—
Kw use per capita	—	4,481 kw	—
Increase in utility system capability	—	11.8 million kw	9.3 million kw
Increase in government agency capability	—	3.5 million kw	2.6 million kw
Peak demand	—	129.3 million kw	—
Reserve	—	35.5 million kw	—
Construction expenditures by utility companies	—	$3.5 million	$3.4 million
Total investment	—	$46 billion	—
Record week	—	14.5 billion kwhr	—
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Income, net	$1,532 million	$1,670 million	—
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Wages and salaries	$1,494 million	$1,570 million	—
Fuel costs	$1,335 million	$1,420 million	—
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Amplifiers, r-f	71,843
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Analyzers	518,950
Analyzers, amplitude distribution	31,050
Analyzers, spectrum	1,536,395
Antennas & accessories	9,153,335
Antenna kits, search	229,445
Assemblies, electronic	81,635
Batteries, dry	15,399,909
Batteries, storage	3,769,322
Batteries, thermal	40,695
Battery chargers	1,525,734
Beacon equipment, radar	1,042,406
Beacon equipment, radio	1,448,009
Bridge, impedance	108,300
Cable assemblies	2,086,791
Cable, armored	28,238
Cable, electronic	948,968
Cable, telephone	1,207,083
Calibrators	116,292
Calibrators, frequency	125,247
Capacitors	594,159
Cavity assemblies	25,772
Cells, photoelectric	26,845
Cells, solar	500,000
Choppers	73,104
Circuit breakers	155,133
Coder-decoders	10,560,037
Communications systems	114,194
Components, electronic	1,586,787
Computers accessories	39,424,868
Computers, analog	503,485
Computers, digital	97,022
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Connectors, cable	1,901,951
Connectors, panel	210,900
Controls	243,368
Controls, radio	1,557,483
Converters	456,299
Converters, digital to analog	33,600
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Converters, signal	96,182
Converters, SSB	83,819
Converter, telephone signal	59,553
Converters, wave form	110,784
Countermeasurers equipment	346,572
Couplers	65,618
Crystal units	555,350
Data loggers	83,869
Decoders, audio	474,[illegible]75
Delay lines	299,501
Detectors, infrared	41,850
Diodes, semiconductor	164,073
Diodes, variable capacitance microwave	99,150
Direction finder sets	852,233
Discriminators	30,785
Domes, sonar	797,880
Dummy loads	109,985
Duplexers	49,072
Earphones	28,969
Equipment, coordinate data	1,048,800
Equipment, communications	246,310
Equipment, electronic	767,296
Equipment, monitoring	53,920
Equipment, telemetry	189,017
Facsimile equipment	248,632
Filters	102,002
Filter, band pass	85,170
Filters, hi-fi	30,000
Filters, r-f	140,710
Fire control equipment	3,240,000
Fuses & accessories	1,008,723
Generators, digital timing	48,450
Generators, pulse	232,968
Generators, scan pattern	44,909
Generators, signal	3,731,891

Gyros & gyroscopes	1,586,636
Handsets	215,902
Headsets	1,471,022
Horn, waveguide	26,026
Indicators	5,237,284
Indicators, coupler, antenna	215,782
Indicators, frequency channel	869,484
Indicators, radar	425,250
Insulators	113,290
Integrators, video signal	146,098
Intercoms	297,678
Inverters	343,384
Kits, modification	6,542,859
Leads, test	61,959
Limiters, fuze	260,081
Loudspeakers	149,608
Measuring systems, electronic	977,941
Meters	1,307,680
Meters, alpha	49,188
Meters, amp	131,661
Meters, frequency	1,846,701
Meters, r-f	73,198
Meters, volt	996,971
Meters, VTVM	50,068
Meters, watt	36,728
Microphones	1,033,319
Modulators	172,348
Monitors, coordinate data	1,491,670
Monitors, r-f	329,445
Monitors, telegraph	1,462,551
Monitors, telemetric data	493,952
Multimeters	699,115
Multiplexers	750,922
Navigational equipment	4,434,517
Networks, pulse	252,418
Oscillators	791,389
Oscilliscopes	1,957,894
Oscillographs	617,987
Paper, recording, electrosensitive	239,838

Potentiometers	560,738
Power supplies	2,600,157
Radar equipment	117,397,661
Radiac equipment	2,329,528
Radio direction finders	2,630,622
Radio equipment	3,543,392
Radio equipment, SSB	176,250
Radio receivers	13,984,982
Radio sets	16,117,534
Radio receivers/transmitters	46,067,286
Radio transmitters	15,045,484
Radiosonde	1,518,909
Radomes	6,457,750
Readers, tape	77,996
Reactors	99,434
Receivers, loran	548,650
Receivers/transmitters, telemetric data	855,223
Recorders/reproducers, accessories & components	10,533,508
Rectifiers	385,699
Reflectors, parabolic	31,365
Relays, armature	1,433,762
Relays & assemblies	1,972,079
Relays, solenoid	311,132
Resistors	3,074,396
Scanners	69,000
Semiconductor devices	406,746
Slotted lines	91,238
Solenoids	197,254
Sonar equipment	3,992,702
Spectrophotometer, infrared	143,072
SSB equipment	11,470,366
Stroboscopes	44,200
Standards, frequency	357,553
Switches	1,708,137
Switchboard equipment	1,748,197
Switches, ferrite	40,521
Switches, rotary	289,765

Switches, pressure	544,143
Switches, thermal	154,809
Switches, toggle	296,444
Synchros	5,046,940
Systems, telemetry	751,751
Tape, magnetic	3,692,523
Terminal lugs	121,977
Terminals, telephone	1,841,648
Thermocouples	538,536
Thermostats	292,538
Telemetry equipment	1,513,733
Teleprinters	406,097
Teletypewriters	10,957,580
Test sets, radar	1,366,377
Test sets, radio	1,303,969
Test bridges	262,800
Transceivers	127,703
Transducers	360,109
Transformers	832,021
Transistors	725,067
Transmitters	2,688,648
Transmitters, coordinate data	350,000
Transmitters, radar	1,160,337
Transmitters, rate gyro	81,778
Transmitters/receivers, tape	12,267
Transmitters, SSB	25,878
Transmitters, synchro	198,117
Transponders	1,889,746
Tubes, cathode ray	165,230
Tubes, electron	48,661,825
Tubes, klystron	2,110,071
Tubes, magnetron	9,035,687
Tube testers	289,789
Tubes, thyratron	452,810
Tuners, r-f	206,474
Waveguide assemblies	134,824
Wire	3,275,661
Voltage regulators	45,443
X-ray equipment	196,420

Contracts awarded by government procurement agencies during the first quarter of FY 1960

Amplifiers	861,251
Amplifiers, synchro signal	733,738
Amplifiers, traveling wave tube	34,600
Analyzers	35,752
Analyzers, digital data	49,306
Analyzers, frequency	23,632
Analyzers, spectrograph	165,550
Antennas & systems	2,858,864
Attenuators	143,360
Batteries, dry	2,323,998
Batteries, storage	832,547
Beacon, radar	54,650
Bridge, impedance	106,394
Cable assemblies	436,939
Cable electronic	669,209
Cable, telephone	1,012,787
Calibrators	32,500
Capacitors	431,471
Cells, photoelectric	90,804
Cells, solar	34,480
Chargers, battery	85,522
Circuit breakers	118,927
Coils, r-f	25,120
Computers	424,500
Computers, analog	65,950
Computers, digital	392,975
Controls, radio	342,576
Connectors	942,493
Converters, SSB	176,505
Converters, frequency	80,400
Converters, radiosonde	184,350
Crystal units	127,884
Delay lines	476,620
Direction finder sets	1,531,855
Dummy loads	45,045
Equipment, telephone	88,518
Filters, band pass	205.291
Fuzes	397,358
Fuze holders	35,862
Generators, time mark	126,197
Handsets & headsets	185,393
Integrators, video	250,000

Insulators	25,130
Inverters	333,340
Limiters	
Limiters, fuze	91,329
Loudspeakers	148,140
Meters	25,553
Meters, amp	47,775
Meters, frequency	506,025
Meters, radio interference	126,837
Meters, ohm	150,660
Meters, Q	41,125
Meters, radiac	635,887
Meters, volt	135,195
Modulators	127,000
Monitors, coordinate data	2,105,593
Multimeters	1,189,899
Multipliers	216,250
Multiplexers	125,957
Networks, communications	4,821,715
Oscillators	664,091
Oscillographs	170,632
Oscilloscopes	1,166,892
Paper, recording	86,149
Plotter, coordinate data	64,520
Potentiometers	180,473
Power supplies	758,483
Radar sets	5,609,015
Radio sets	503,462
Radiosonde equipment	1,429,353
Receivers, direction finder	80,403
Receivers, radio	9,835,527
Receivers/transmitters	901,181
Recorders, facsimile	222,440
Recorders, flight data	137,837
Recorder/reproducers & accessories	2,314,452
Recorders, video tape	259,879
Resistors	2,539,551
Reflectors, antenna	29,360
Reflectors, parabolic	58,650
Relays, armature	898,641
Relays, microwave	480,002

Relay assemblies	374,113
Relays, solenoid	44,808
Relays, time delay	167,764
Relays, thermal	53,387
Semiconductor devices	545,259
Signal generators	1,749,463
Simulator, radar signal	596,423
Solenoids	142,437
Standards, frequency	87,958
Standards, resistance	80,254
Switches	674,661
Switchboard equipment	219,635
Switches, pressure	355,037
Switches, thermostatic	126,382
Switches, toggle	68,277
Synchros	1,929,823
Systems, data processing	822,297
Systems, telemetry	289,617
Tape, magnetic	249,293
Tape reader	73,353
Teletypewriters	3,234,294
Test set, radar	724,931
Test set, radio	89,997
Testers	329,919
Thermocouple assemblies	35,000
Tower, radar	25,890
Transceivers	714,948
Transducers	50,783
Transformers	204,692
Transistors	134,761
Transmitters	3,727,270
Transmitters, coordinate data	9,000,000
Transmitters, synchros	48,390
Transmitters, telemetry	30,075
Transponders	2,663,774
Tropospheric scatter systems	10,071,000
Tubes, cathode ray	36,631
Tubes, electron	7,916,520
Tubes, klystron	231,300
Tubes, magnetron	1,705,011
Waveguide assemblies	122,368
Wire	378,619

When antenna tower heights are restricted for low frequency applications, the folded-unipole antenna offers several advantages. These advantages are described and easy methods of calculating system parameters are given.

Calculating Folded-Unipole Antenna Parameters

By GEORGE J. MONSER
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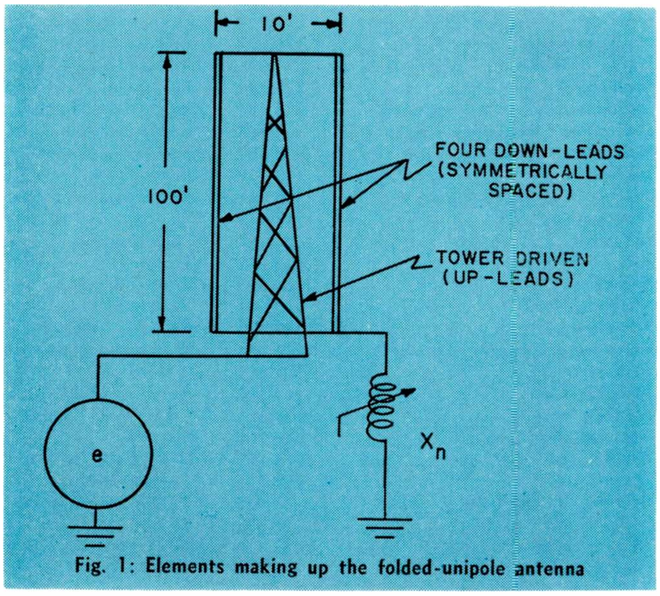


Fig. 1: Elements making up the folded-unipole antenna

PRACTICAL antenna design for use in low-frequency applications is frequently limited by the permissible height of the antenna tower. Because of this, a low value of radiation efficiency results, and a high value of capacitive reactance is presented as a load for the transmitter (final) amplifier. Considerable published data exists on methods for coupling these high-Q antennas to the transmitter, and also on methods of decreasing the antenna Q by loading. Much of the literature is devoted to discussing means for effecting this reduction, when a grounded-stub antenna is used, while little published data exists for folded-unipole antenna configuration. A single exception appears to be the treatment given by Leonard, Mattuck and Poté,[1] in which the possibilities of a folded unipole antenna configuration as an impedance transformer were considered. Beyond this point, very little experimental data has been published on such important quantities as radiated field intensities.

This article extends the excellent (Poté) treatment by generalizing the equivalent circuit to include previously unspecified system parameters. Using this generalized equivalent circuit antenna performance is computed and compared to measured quantities.

Equivalent Circuits

Fig. 1 shows the elements of the folded unipole antenna (one up-lead, four downleads, and a tuning inductor (X_n). From Poté, the equivalent circuit for this configuration is shown in Fig. 2 in which;

R_a = antenna radiation resistance for the folded unipole driven as a stub
X_a = antenna reactance for the folded unipole driven as a stub
X_n = downlead tuning coil reactance as shown in Fig. 1
P = ratio of total downlead current to up-lead current when operated as shown in Fig. 1
X_L = transmission-line inductive reactance determined under the condition of $X_n = 0$ in Fig. 1

Using this circuit, the following input impedance equations result:

$$R_{mg} = \frac{R_a\,K\,(X_n\,\sqrt{K} + X_L)^2}{(R_a\,K)^2 + (X_n\,K - X_a\,K + X_L)^2} \qquad (1)$$

$$X_{mg} = -\,PX_n + \frac{(X_n\,\sqrt{K} + X_L)\cdot[\,(R_a\,K)^2 - (X_a\,K - X_n\,P\,\sqrt{K})\,(X_nK - X_a\,K + X_L)\,]}{(R_a\,K)^2 + (X_n\,K - X_a\,K + X_L)^2} \qquad (2)$$

where $K = (1 + P)^2$, and $P = 3$ (assumed)

Then using measured values of R_a, X_n and X_L, as previously defined, calculation of the components of driving point impedance (Z_{mg}) was given by Poté, showing that a considerable impedance transformation of antenna stub impedance (Z_a) is possible for selected values of X_n. Also their work indicated that this circuit can be used to calculate Z_{mg} reasonably close using stub measured values, and comparing the computed value with the measured value when connected as a folded unipole.

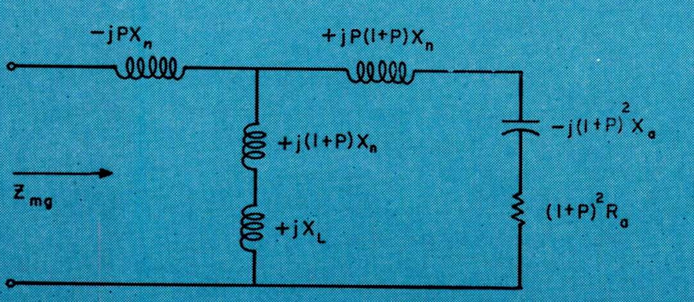


Fig. 2: Folded-unipole equivalent circuit (Poté)

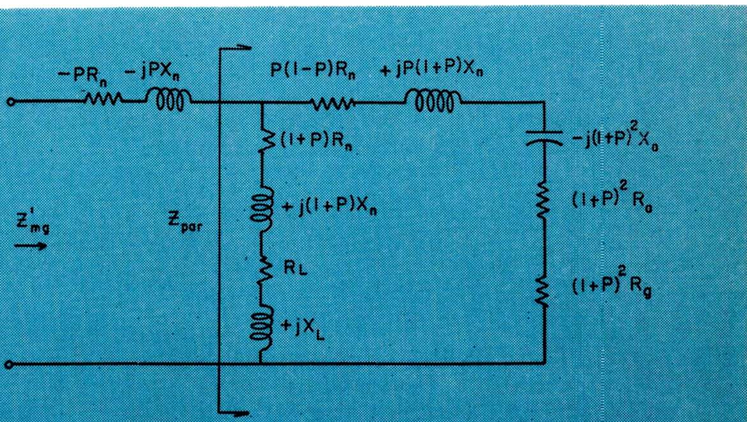


Fig. 3: Equivalent circuit for folded-unipole (losses included)

As the circuit exists (Fig. 2), however, the determination of radiation efficiency can not be easily effected because the following elements have not been specified:

R_n = tuning-coil resistance

R_g = equivalent ground loss resistance

R_L = transmission-line resistance determined under the condition

X_n = 0 in Fig. 1

R_i = equivalent dielectric and insulator leakage loss

Fig. 3 illustrates the equivalent circuit, when the above values are included. In this circuit R_i has not been shown, because its effect is considered negligible. As will be shown, radiation efficiency and driving point impedance are determinable to a reasonable accuracy using this circuit thus supporting the validity of this circuit.

Antenna Tests

The folded-unipole configuration of one up-lead (tower) and four-down leads (parallel) to the tower axis) with instrumentation for measuring driving point impedance is sketched in Fig. 4. Antenna driving-point impedance was measured at 450 kc. Then tuning-coil X_n was removed and the downleads were terminated at the driving point. Stub parameters were then measured.

To make field intensity measurements a test transmitter capable of 13 watts output was connected to the antenna base through a suitable coupling network. An rf ammeter measured the antenna base current (See Fig. 5).

With a selected antenna current reading, a Stoddard PRM-1 Field Strength Meter was placed at a pre-measured distance from the base of the antenna. Measurements were taken of field strength vs. radial distance to assure no propagational anomalies. Similar data for the unit operated as a stub was then obtained. This latter data permitted a comparison between stub and folded-unipole performance.

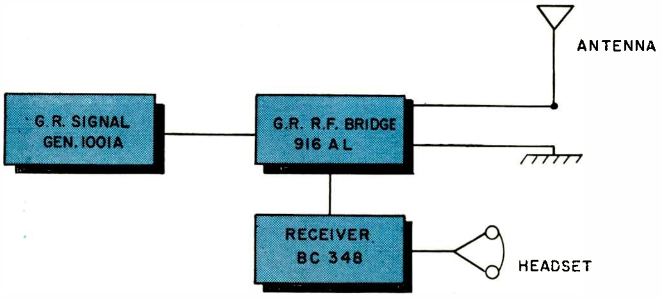
In the above tests, the ground system for the antenna consisted of a ground screen of 120, #16 copper wire radials, each 20 feet long, and 60, #16 radials each 1200 feet long. A peripheral wire of #6 copper wire joined the ends of the screen radials to the longer radials, forming a circle 40 feet in diameter.

Verification of Equivalent Circuit

A. Driving-Point Impedance:

From the above tests the following circuit parameters were determined for the 100-foot folded-unipole configuration at 450 kc,

Fig. 4: Test setup for measuring driving point impedance



Antenna Calculations *(Continued)*

R_a = 0.92 ohms
X_a = 456 ohms
X_L = 93 ohms
R_L (assumed negligible)
R_n = 2.22 ohms
X_n = 979 ohms
P^* = 3.5 (assumed)
R_g = 1.0 ohms

The equations for R_{gm} and I_{mg} as given by Poté were modified to include the loss resistances, Then;

$$R'_{mg} = -PR_n + \frac{R_T K (X_n \sqrt{K} + X_L)^2}{(R_T K)^2 + (X_n K - X_a K + X_L)^2} \quad (1a)$$

$$X'_{mg} = -PX_n + \frac{(X_n \sqrt{K} + X_L) \cdot [(R_T K)^2 - (X_a K - X_n P \sqrt{K}) (X_n K - X_a K + X_L)]}{(R_T K)^2 + (X_n K - X_a K + X_L)^2} \quad (2a)$$

where $R_T = R_a + R_g + R_n$

Upon substitution of the given values,

$Z'_{mg} = 7.5 - j830$ ohms – computed

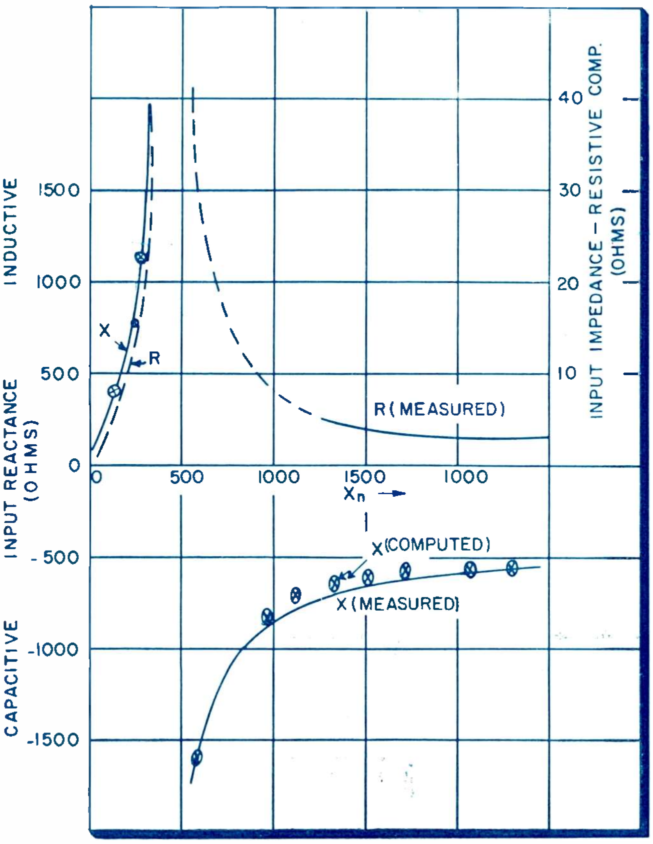


Fig. 6: Graph of folded-unipole driving point impedance as a function of the tuning coil reactance

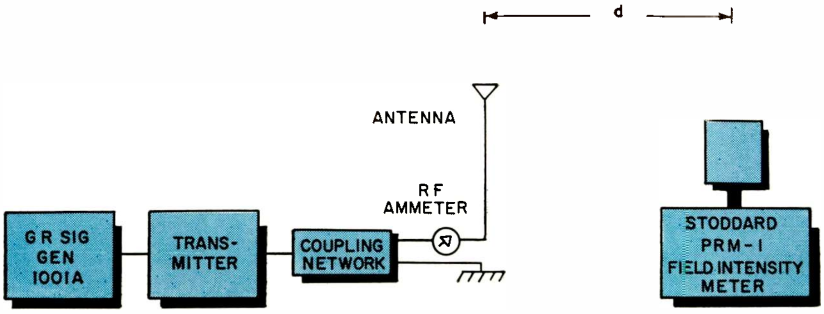


Fig. 5: Radiated field intensity measurements setup

which compares favorably with

$Z'_{mg} = 7.3 - j833$ ohms – measured

Additional points were determined and are plotted in Fig. 6.

B. Radiation Efficiency:

Referring to Fig. 3,

$$I_R = I_{in} \frac{Z\ par.}{Z_R}$$

$$P_a = I_R^2 (1 + P)^2 R_a$$

$$P_{in} = I^2_{in} R'_{mg}$$

$$\eta_a = \frac{P_a}{P_{in}} \text{ x } 100$$

where

I_{in} = driving point current
I_R = radiation branch current
P_a = radiated power
P_{in} = input power
η_a = antenna efficiency

Substitution of the stated values gives;

η_a = 43%—computed

as compared with:

η_a = 44%—measured

Similar calculations were repeated for different X_n's and the results plotted in Fig. 7.

Discussion of Results

From the results of the previous section (Fig. 6), it may be seen that the driving-point impedance can be adjusted to have a much lower Q than a conventional stub (normally 100-300). The condition for obtaining this very low $Q_{D.P.}$ occurs when $Z_n = 0$, which unfortunately results in about zero radiation efficiency (Fig. 7). However, when Z_n is made sufficiently inductive,

$$X_n > \frac{1 + P}{P} X_a.$$

$Q_{D.P.}$ is again reduced to a low value, and a reasonable good efficiency is obtained. Efficiency values under this condition appear above the knee of the curve (Fig. 7). Of interest, however, is the fact that while the $Q_{D.P.}$ is low, the radiation branch Q_R is high, thus causing a narrower radiated bandwidth. Upon making Q_R approach $Q_{D.P.}$ by decreasing the tuning-coil Q_n, a reduction in efficiency results. To emphasize the difference in the Q's, Fig. 8 showing Q_R and $Q_{D.P.}$ plotted as a function of Q_n is given.

As a final point, consider Fig. 9 in which field

(*Continued on page* 172)

---

* Poté assumed a value of $P = 3$, the value 3.5 used here permitted a closer agreement between calculated and measured values. Also, if desired an analytical method for determining P is given in reference 2.

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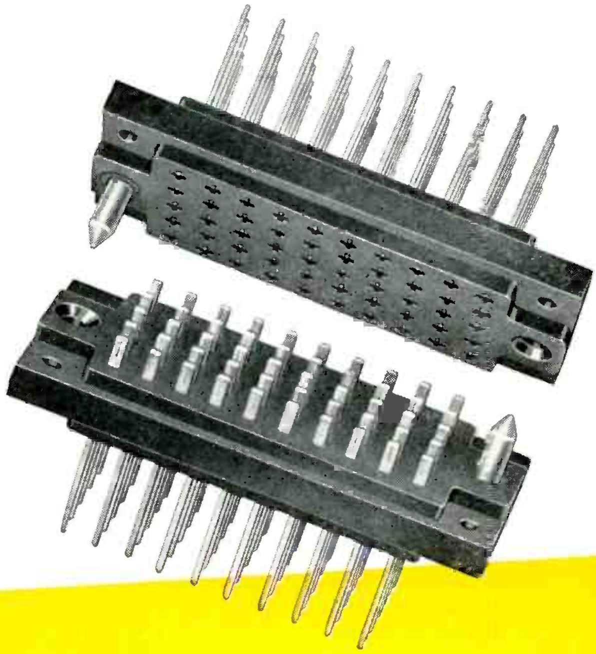

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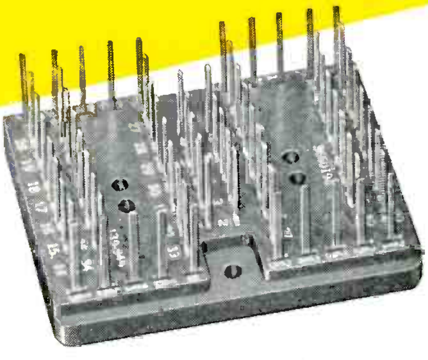

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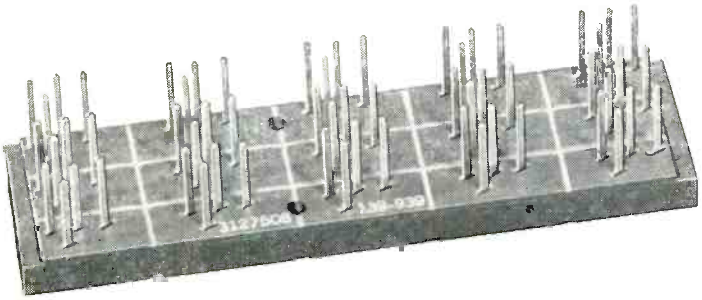

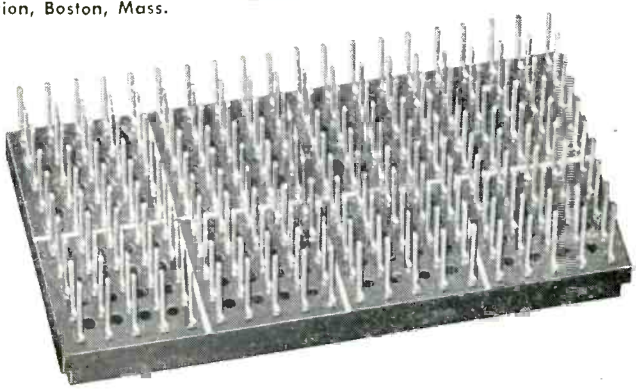

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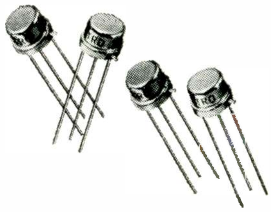

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pnp alloy junction germanium COMPUTER transistors to MIL-T-19500A

- Medium to high speed switching
- Medium gain
- Tight parameters
- Very linear current amplification factor

TYPE	V_{CER} R_{BE}=5K volts	f_{ab} typ mc	h_{FE} typ $I_C=-1$ ma $V_{CE}=-0.25V$	h_{FE} typ $I_B=-10$ ma $V_{CE}=-0.35V$	Rsat (typ) $I_B=-10$ ma $I_C=-100$ to −200 ma ohms
2N425	−30	4	30	20	2.2
2N426	−25	6	40	25	2.2
2N427	−20	11	55	25	1.3
2N428	−15	17	80	35	1.1

- Medium gain, fast switching
- High reliability at maximum ratings
- Tight parameters
- Low leakage current at high temperatures

TYPE	V_{CER} R_{BE}=1K volts	f_{ab} typ mc	h_{FE} typ $I_C=-10$ ma $V_{CE}=-1V$	I_{CBO} max $V_{CBO}=-20V$ μa	I_{EBO} max $V_{EBO}=-10V$ μa	V_{CEsat} typ $I_C=-10$ ma volts @ I_B
2N1284	−20	8	90	−6	−6	−1.5 −.5 ma

Floating base replacement for 2N123

- General purpose HF switching
- Low leakage current at high temperatures
- Tight parameters
- High reliability at maximum ratings

TYPE	V_{CEX} V_{BE}=0.1V volts	f_{ab} typ mc	h_{fe} typ —	I_{CBO} max $V_{CBO}=-12V$ μa	I_{EBO} max $V_{EBO}=-12V$ μa	C_{ob} typ μμf
2N413	−25	2.5	30	−5	−5	12
2N414	−20	7	60	−5	−5	12
2N414B	−24*	7	60	−6 @ −20V	−5	12
2N416	−15	10	80	−5	−5	12
2N417	−12	20	140	−5	−5	12

*V_{BE}=0.2V

- High gain
- HF fast switching
- Low leakage current at high temperatures
- High reliability at maximum ratings

TYPE	V_{CEX} V_{BE}=0.25V volts	f_{ab} typ mc	h_{FE} typ $I_C=-20$ ma $V_{CE}=-1V$	I_{CBO} max $V_{CBO}=-15V$ μa	I_{EBO} max $V_{EBO}=-5V$ μa	V_{BE} max $I_C=-20$ ma $V_{CE}=-1V$
2N1344	−15	12	90	−10	−10	−.6V

- Medium to high gain
- HF switching
- Low leakage current at high temperatures
- Tight parameters
- Very linear current amplification factor

TYPE	V_{CER} R_{BE}=1K volts	f_{ab} typ mc	h_{FE} typ $I_C=-10$ ma $V_{CE}=-1V$	h_{FE} min $I_C=-200$ ma $V_{CE}=-0.35V$	V_{CEsat} typ $I_C=-50$ ma volts @ I_B
2N1353	−16	3.5	70	10	−0.1 −5 ma
2N1354	−20	4.5	70	10	−0.1 −5 ma
2N1355	−25	8	80	15	−0.08 −3.3 ma
2N1357	−20	12	85	20	−0.07 −2.5 ma

Floating base replacement for 2N394, 2N395, 2N396, 2N397

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Semiconductor Symbols

A complete listing of all symbols, pertinent to semiconductors, which have been adopted as standard by the Institute of Radio Engineers.

MATERIAL for this section was obtained from IRE Standards on Letter Symbols for Semiconductor Devices, 1956 (56 IRE 28. S1), and IRE Standards on Graphical Symbols for Semiconductor Devices, 1957 (57 IRE 21. S3).

What might seem to be an illogical progression of paragraphs is encountered when advancing from letter to graphical symbols. This condition is caused by the retention of the paragraph designations used in the individual standards. The system was used to facilitate reference.

This standard provides a uniform system of letter symbols for electrical quantities and parameters as applied to semiconductor devices. The standard has been divided into three sections:

1) Electrical quantities, dealing primarily with voltage, current, and time quantities.
2) Electrical parameters, dealing with the relationship between specific electrical quantities.
3) List of letter symbols in alphabetical order.

Electrical quantities at the device terminals are defined in Section 1. The electrical parameters of Section 2 are ratios of the terminal electrical quantities; *i.e.*, they are two terminal-pair open- and short-circuit ratios. Letter subscripts are used for these ratios throughout this standard; numeric subscripts following the matrix convention may be used when convenient, especially in the analysis of electric circuits.

1. Electrical Quantities

1.1 Quantity Symbols

1.1.1 Instantaneous values of current, voltage, and power, which vary with time, are represented by the lower case letter of the proper symbol.

Examples: i, v, i_e, v_{EB}

1.1.2 Maximum, average (dc), and root-mean-square values are represented by the upper case letter of the proper symbol.

Examples: I, V, I_e, V_{EB}

1.2 Subscripts for Quantity Symbols

1.2.1 DC values and instantaneous total values are indicated by upper case subscripts.

Examples: i_C, I_C, v_{EB}, V_{EB}, p_C, P_C

1.2.2 Varying component values are indicated by lower case subscripts.

Examples: i_c, I_c, v_{eb}, V_{eb}, p_c, P_c

1.2.3 If necessary to distinguish between maximum, average, or root-mean-square values; maximum or average values may be represented by the addition of a subscript *m* or *av*.

Examples: i_{cm}, I_{cm}, I_{CM}, I_{cav}, i_{CAV}

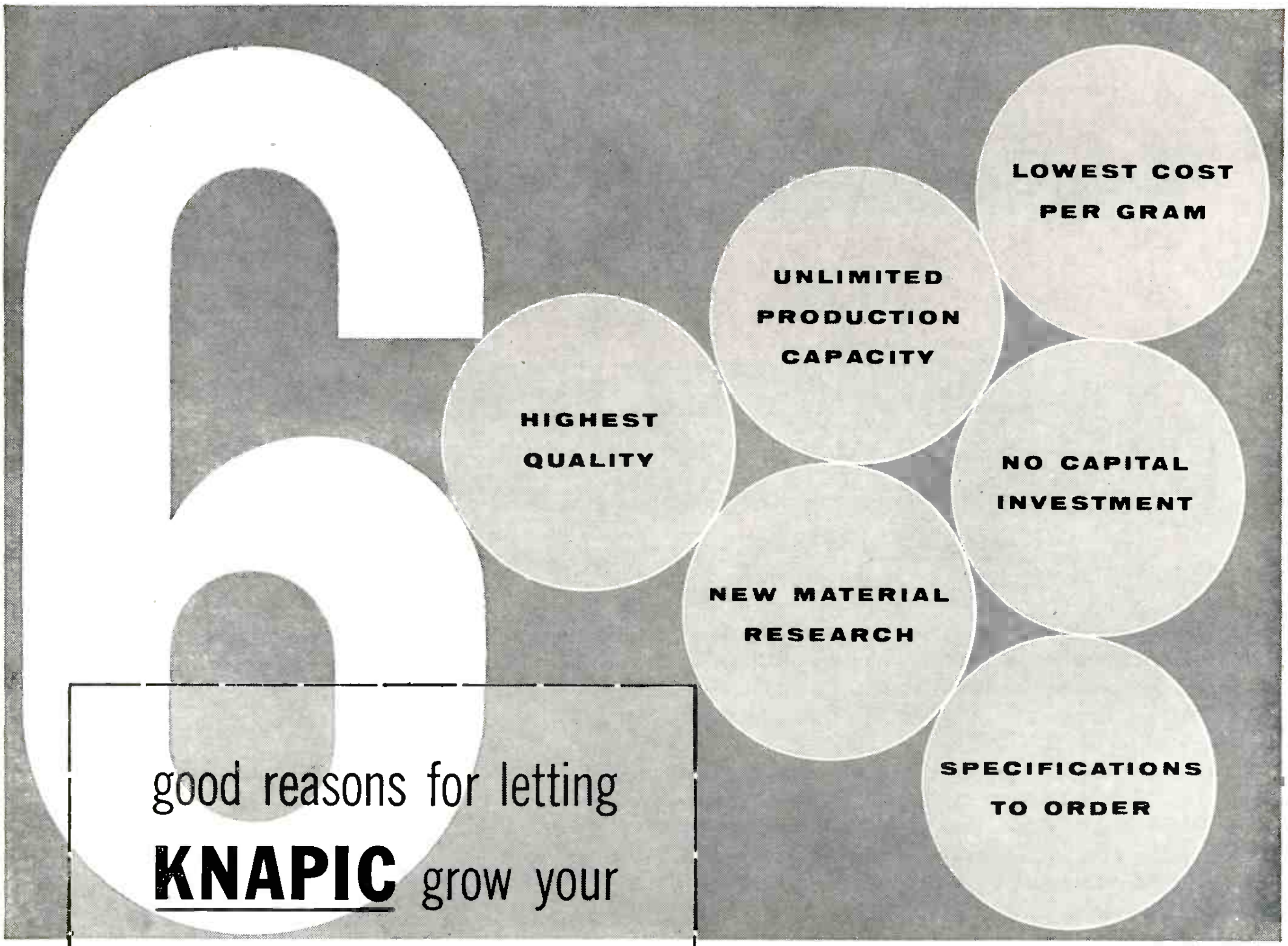
1.2.4 Abbreviations to be used as subscripts. (For example, see Fig. 1 and Basic Symbols Chart 1.2.5.)

E, *e* = emitter electrode
B, *b* = base electrode
C, *c* = collector electrode
J, *j* = electrode, general
X, *x* = circuit node
M, *m* = maximum value
AV, *av* = average value
Q = average (dc) value with signal applied.

1.2.5 Basic Symbols Chart (Table I)

TABLE I

		SYMBOLS	
		i, v, p	I, V, P
Subscripts	e b c j	**Instantaneous Varying Component Value**	**RMS or Effective Varying Component Value**
	E B C J	**Instantaneous Total Value**	**Average (dc) Value**



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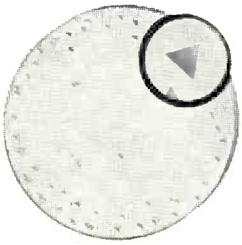

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1.3 The Subscript Sequence Conforms to the Mathematical Convention for Writing Determinants from a Set of Fundamental Kirchoff's Equations

1.3.1 The first subscript designates the electrode at which the current is measured, or where the electrode potential is measured with respect to the reference electrode, or circuit node, designated by the second subscript. (Conventional current flow into the electrode from the external circuit is positive.) When the reference electrode or circuit node is understood, the second subscript may be omitted, where its use is not required to preserve the meaning of the symbol.

1.3.2 Supply voltage may be indicated by repeating the electrode subscript. The reference electrode may then be designated by the third subscript.

Examples: V_{EE}, V_{CC}, V_{BB}, V_{EEB}, V_{CCB}, V_{BBC}.

1.3.3 In devices having more than one electrode of the same type, the electrode subscripts are modified by adding a number following the subscript and on the same line.

Example: *B2*

In multiple unit devices the electrode subscripts are modified by a number preceding the electrode subscript.

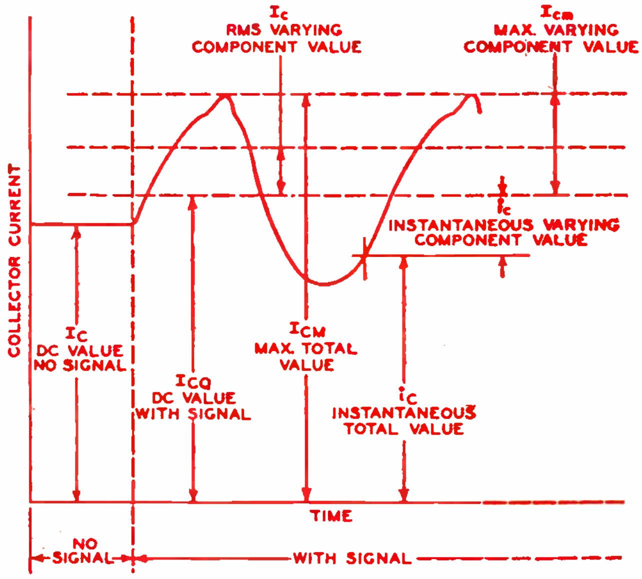
Example: *2B*

Wherever ambiguity might arise, the complete electrode designations are separated by hyphens or commas.

Example: $V_1C_{1-2}C_1$

1.3.4 When necessary to distinguish between components of current or voltage the symbols may be used as shown in Fig. 1. The illustration shows a case where a small varying component is developed in the collector circuit of a transistor

Fig. 1: Illustration of the proper use of symbols when it is necessary to distinguish between components of current and voltage.



2. Electrical Parameters

2.1 Parameter Symbols

2.1.1 Values of four-pole matrix parameters, or other resistances, impedances, admittances, *etc.*, inherent in the device, may be represented by the lower case symbol with the proper subscripts.

Examples: h_{ib}, z_{fb}, y_{oe}, α_{fb}, h_{IB}, α_{FB}

2.1.2 Values of four pole matrix parameters or other resistances, impedances, admittances, etc., in the external circuits, may be represented by the upper case symbols with the appropriate subscripts.

2.2 Subscript for Parameter Symbols

2.2.1 Static* values of parameters are indicated by the upper case subscript.

Examples: r_B, h_{IB}, α_{FB}

2.2.2 Small-signal values of parameters are indicated by the lower case subscript.

Examples: r_b, y_c, h_{ib}, z_{ob}, α_{fb}

2.2.3 The first subscript or subscript pair in matrix notation, identifies the element of the four-pole matrix.

i or *11* = input
o or *22* = output
f or *21* = forward transfer
r or *12* = reverse transfer

Examples:

$$V_i = h_iI_i + h_rV_o \qquad V_1 = h_{11}I_1 + h_{12}V_2$$
$$I_o = h_fI_i + h_oVo \qquad I_2 = h_{21}I_1 + h_{22}V_2$$

Note: Voltage and current symbols in matrix notation are designated with a single digit subscript. The subscript 1 = input. The subscript 2 = output.

2.2.4 The second subscript or the subscript following the numeric pair identifies the circuit configuration. When the common electrode is understood, the second subscript may be omitted.

e = common emitter
b = common base
c = common collector
j = common electrode, general.

Examples: (common base)

$$I_i = y_{ib}V_{ib} + y_{rb}V_{ob} \qquad I_1 = y_{11b}V_{1b} + y_{12b}V_{2b}$$
$$I_o = y_{fb}V_{ib} + y_{ob}V_{ob} \qquad I_2 = y_{21b}V_{1b} + y_{22b}V_{2b}$$

2.2.5 Electrical parameters characterizing the behavior of a device with associated circuitry are designated by upper case symbols with an appropriate subscript; *e.g.*, Z_i, Z_o. The termination may be indicated by an additional subscript such as: *o* = ac open circuit termination; *s* = ac short-circuit termination; *a* or other appropriate subscript for other terminations. This additional subscript may be omitted.

Examples: Z_{io}, Z_{is}, Z_{ia}, $Z_{i\,\mathrm{match}}$

---

* The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve.

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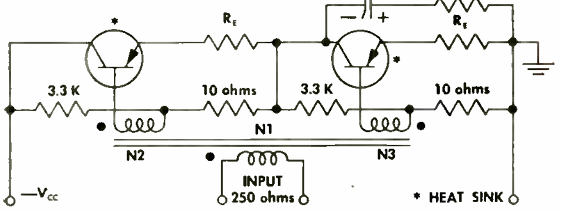
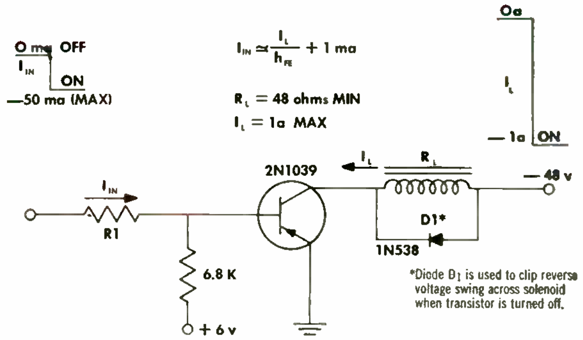
TRANSISTOR	V_{CC} volts	R_L ohms	Efficiency %	Distortion % at P_o=10w	R_E ohms
2N1042	35	10	58	2.7	1
2N1043	55	25	57	1.8	2.5
2N1044	70	40	56	1.6	4
2N1045	85	60	53.5	1.6	6

Transformer: N_1:N_2:N_3 = 1:1:1
To Minimize Cross-Over Distortion the Coils Should be Bifilar Wound.



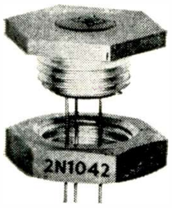
TYPICAL SOLENOID RELAY DRIVER



*Diode D1 is used to clip reverse voltage swing across solenoid when transistor is turned off.

20-w power transistors:

switching circuits • relay drivers • audio and pulse amplifiers



ACTUAL SIZE

TI 2N1042 series alloy-junction transistors **guarantee** 20 w dissipation at 25°C with voltage ratings of —40, —60, —80, and —100 v. You get guaranteed 20-to-60 beta spread at —3 amps and low 0.16 ohm saturation resistance at the —3 amp maximum collector rating.

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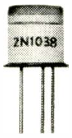

ACTUAL SIZE

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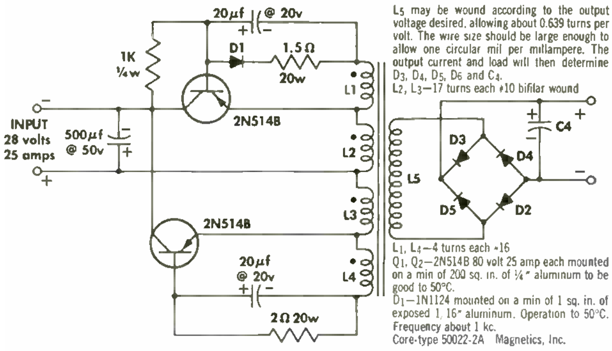
Type	Dissipation at 25°C Watts	Max Collector Voltage Volts	Max Collector Current Amps	h_{FE} min	h_{FE} max	Collector Reverse Current I_{CO} max	Typical Saturation Resistance R_{CS} Ohms
2N456	50	—40	—5	10 @ —5a	50	—2ma @ —40v	0.048
2N457	50	—60	—5	10 @ —5a	50	—2ma @ —60v	0 048
2N458	50	—80	—5	10 @ —5a	50	—2ma @ —80v	0 048
2N511	80	—40	—10	10 @ —10a	30	—2ma @ —20v	0.025
2N511A	80	—60	—10	10 @ —10a	30	—2ma @ —30v	0.025
2N511B	80	—80	—10	10 @ —10a	30	—2ma @ —40v	0.025
2N512	80	—40	—15	10 @ —15a	30	—2ma @ —20v	0 025
2N512A	80	—60	—15	10 @ —15a	30	—2ma @ —30v	0.025
2N512B	80	—80	—15	10 @ —15a	30	—2ma @ —40v	0.025
2N513	80	—40	—20	10 @ —20a	30	—2ma @ —20v	0.025
2N513A	80	—60	—20	10 @ —20a	30	—2ma @ —30v	0.025
2N513B	80	—80	—20	10 @ —20a	30	—2ma @ —40v	0 025
2N514	80	—40	—25	10 @ —25a	30	—2ma @ —20v	0.025
2N514A	80	—60	—25	10 @ —25a	30	—2ma @ —30v	0.025
2N514B	80	—80	—25	10 @ —25a	30	—2ma @ —40v	0.025
2N1021	50	—100	—5	10 @ —5a	30	—2ma @ —100v	0.08
2N1022	50	—120	—5	10 @ —5a	30	—2ma @ —120v	0.08
2N1038	1.25	—40	—1	20 @ —1a	60	—125µa @ —20v	0.2
2N1039	1.25	—60	—1	20 @ —1a	60	—125µa @ —30v	0.2
2N1040	1.25	—80	—1	20 @ —1a	60	—125µa @ —40v	0.2
2N1041	1.25	—100	—1	20 @ —1a	60	—125µa @ —50v	0.2
2N1042	20	—40	—3	20 @ —3a	60	—125µa @ —20v	0.16
2N1043	20	—60	—3	20 @ —3a	60	—125µa @ —30v	0.16
2N1044	20	—80	—3	20 @ —3a	60	—125µa @ —40v	0.16
2N1045	20	—100	—3	20 @ —3a	60	—125µa @ —50v	0.16
2N1046	35	—80	—3	20 @ —3a	160	—1ma @ —40v	0.9

germanium and silicon transistors
silicon diodes and rectifiers
tan-TI-cap solid tantalum capacitors
precision carbon film resistors
sensistor silicon resistors

TEXAS

DC-TO-DC POWER CONVERTER 630-WATT OUTPUT AT 90% EFFICIENCY



L_5 may be wound according to the output voltage desired, allowing about 0.639 turns per volt. The wire size should be large enough to allow one circular mil per millampere. The output current and load will then determine D_3, D_4, D_5, D_6 and C_4.

L_2, L_3—17 turns each #10 bifilar wound

L_1, L_4—4 turns each #16

Q_1, Q_2—2N514B 80 volt 25 amp each mounted on a min of 200 sq. in. of ¼" aluminum to be good to 50°C.

D_1—1N1124 mounted on a min of 1 sq. in. of exposed 1/16" aluminum. Operation to 50°C. Frequency about 1 kc.

Core-type 50022-2A Magnetics, Inc.

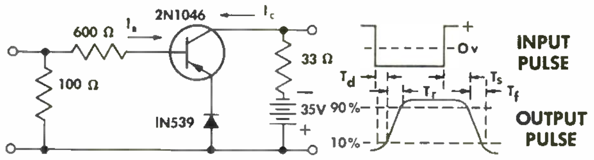
ACTUAL SIZE

10 to 25-amp switchers:

high current switching applications

TI 2N511 series alloy-junction transistors **guarantee** collector currents of **−10, −15, −20, and −25 amps** in −40, −60 and −80 v ratings. All units provide low 0.025 ohm saturation resistance and typical switching times at 25°C of 12.5 μsecs (t_{on}) and 8.0 μsecs (t_{off}).

TYPICAL SWITCHING CHARACTERISTICS



TYPICAL SWITCHING TIMES

T_d	Delay Time	0.3 μsec
T_r	Rise Time	0.7 μsec
T_s	Storage Time	1.2 μsec
T_f	Fall Time	0.5 μsec

TEST CURRENTS

I_{B1} (Turn-on Current) = — 30mA

I_{B2} (Turn-off Current) = + 30ma

I_C (Collector Current) = — 1A

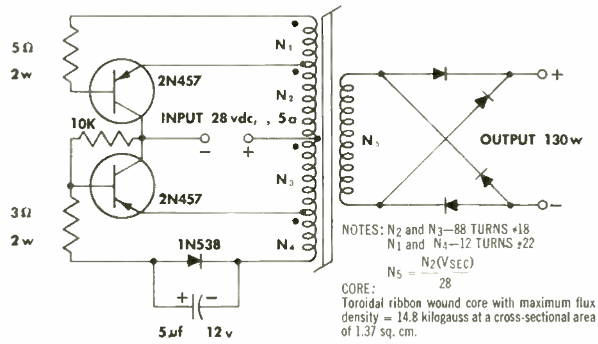
ACTUAL SIZE

high power/high frequency switchers:

computer core drivers • deflection circuits • light weight converter applications

TI 2N1046 alloy diffused transistors combine high power, high frequency and high voltage performance in a single package. **Guaranteed** 35-w dissipation, collector breakdown voltage to −80 v, and low 0.75 ohm saturation resistance with **12 mc** typical alpha cutoff insure reliable operating characteristics.

TYPICAL DC TO DC POWER CONVERTER



NOTES: N_2 and N_3—88 TURNS #18
N_1 and N_4—12 TURNS #22

$$N_5 = \frac{N_2(V_{SEC})}{28}$$

CORE:
Toroidal ribbon wound core with maximum flux density = 14.8 kilogauss at a cross-sectional area of 1.37 sq. cm.

ACTUAL SIZE

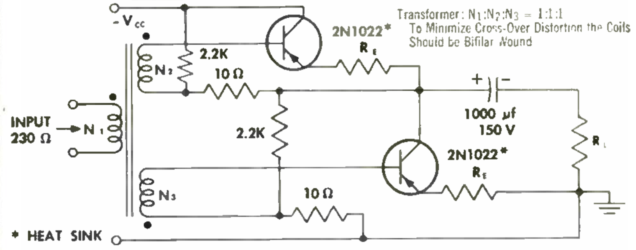
high beta power amplifiers:

audio amplifiers • current switchers • power converters

TI 2N456 series alloy-junction transistors with **guaranteed** 50-w dissipation, **−40, −60, and −80** BV_{CBO} ratings and less than 0.048 ohm saturation resistance provide optimum performance characteristics.

TYPICAL 20 WATT AMPLIFIER POWER GAIN = 23 db

TRANSISTOR	V_{cc} V	R_L Ω	EFFICIENCY	DISTORTION 20 WATTS	R_E Ω
2N1021	-80	30	66%	2%	3
2N1022	-100	50	66%	2%	5



Transformer: N_1:N_2:N_3 = 1:1:1
To Minimize Cross-Over Distortion the Coils Should be Bifilar Wound

ACTUAL SIZE

high voltage power converters:

audio • servo • power applications

TI 2N1021 and 2N1022 alloy-junction transistors **guarantee** maximum operating voltages of **−100 v and −120 v** respectively, low 0.08 ohm saturation resistance, and typical betas of 60 at −1 amp, 23 at −5 amps. You get **guaranteed** collector reserve current of −2 ma maximum at full rated voltage.

Check the specifications at left for the unit most suited to your particular requirements.

INSTRUMENTS

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

Write on your company letterhead *to your nearest TI sales office* describing your application for specific details on TI products.

Circle 56 on Inquiry Card

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[1] The algebraic sign of α for the common base configuration is taken as positive in accordance with established usage, therefore $\alpha_{fb} = -h_{fb} = -h_{21b}$.

between the fall of a pulse applied to the input terminals and the fall of the carrier-generated pulse at the output terminals.

z_{rs}, z_{rbs}, z_{rcs}, z_{res}—The small-signal short-circuit reverse transfer impedance (the reciprocal of y_r).

NOW P DIFFUSED

FAIRCHILD SEMICONDUCTOR CORPORATION

THE ONLY MANUFACTURER OF SILICON MESA TRANSISTORS OFFERING A YEAR AND A HALF OF PRODUCTION EXPERIENCE, A WHOLE FAMILY* OF PRODUCTS IN VOLUME PRODUCTION WITH ASSURED DELIVERIES ON SCHEDULE AND THE ULTIMATE IN QUALITY OF WORKMANSHIP.

***GENERAL PURPOSE** types suitable for switching RF and DC applications over a wide current range.

2N696 & 2N697

***PNP COMPLEMENT** to the 2N696 and 2N697

2N1131 & 2N1132

***HIGH VOLTAGE** type particularly suited to video amplifiers and RF oscillators.

2N699

***LOW STORAGE** types optimized for high current saturated switching circuitry.

2N1252 & 2N1253

***HIGH SPEED LOGIC** transistor suitable for saturated switching circuitry without sacrificing speed.

2N706

AVAILABLE IN QUANTITIES OF 1-999 FROM DISTRIBUTOR STOCKS OR DIRECT FROM THE FACTORY FOR ORDERS OF 1,000 OR MORE. COMPLETE SPECIFICATIONS FROM EITHER SOURCE.

FAIRCHILD
SEMICONDUCTOR CORPORATION

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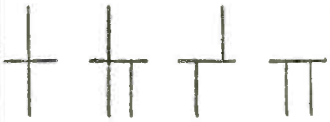
Graphical Symbols

THE symbols and paragraph designations used in this section are the same as those used in the IRE Standards on Graphical Symbols for Semiconductor Devices, 1957 (57 IRE 21, S3). All references pertain to paragraphs contained within this section.

1.0 Basic Rules and Symbol Elements

THIS section sets forth the basic rules and symbol elements for the construction of graphical symbols for semiconductor devices. See *1.17* (on page 112) for full details of graphical construction.

1.1 Semiconductor region with one ohmic connection. (In the illustration, the horizontal line indicates the base region and the vertical line indicates the ohmic connection.

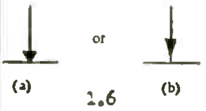


1.2 Semiconductor region with a plurality of ohmic connections. (In the illustrations, the horizontal lines indicate base regions and the vertical line indicate ohmic connections).

1.3 Transition between P and N regions (either P to N or N to P). (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2.9 and 2.11 as examples)

1.4 Intrinsic (I) region between regions of dissimilar conductivity type. (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2.14 and 2.15 as examples).

1.5 Intrinsic (I) region between regions of similar conductivity type. (Slant lines indicating transitions shall be appreciably shorter than collector and emitter lines. Note that the transition is along the horizontal line and that no ohmic connection is made to the slant line. See 2.16 and 2.17 as examples).

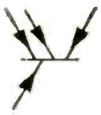


1.6

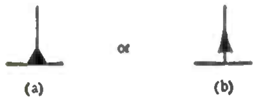
1.7

1.6 P region on N region (rectifying junction).

1.7 P emitter on N region. (The slant line with arrow head represents the emitter and the horizontal line represents the N region.

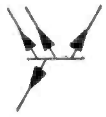


1.8 Plurality of P emitters on N region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).



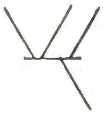
1.9 N region on P region (rectifying junction).

1.10 N emitter on P region. (The slant line with arrowhead represents the emitter and the horizontal line represents the P region).



1.11 Plurality of N emitters on P region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).

1.12 Collector on semiconductor region of dissimilar-conductivity type. (The slant line represents the collector, and the horizontal line does not undergo a transition at the point where the slant line meets it).

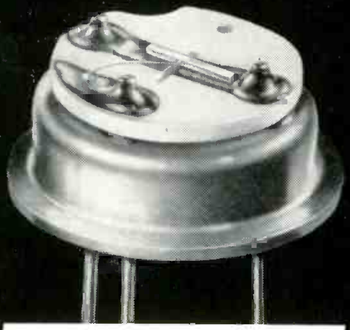


1.13 Plurality of collectors on semiconductor region. (When possible, the electrodes on the symbol drawing should have the same relative order as the electrodes on the device).

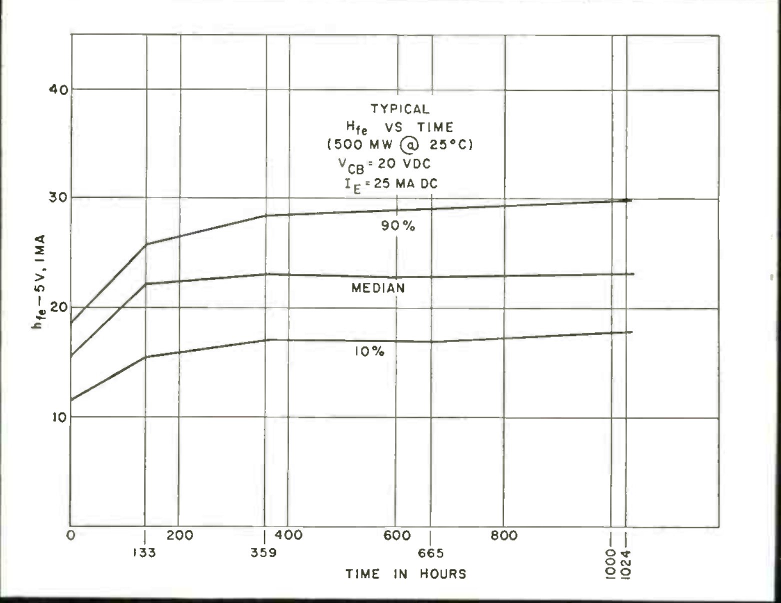
1.14 Collector separated from a region of opposite-conductivity type by an intrinsic region. The intrinsic region is the region between the slant lines, and the collector connection is made to the long solid slant line.

1.15 Collector separated from a region of the same conductivity type by an intrinsic region. The intrinsic region is the region between the slant lines.

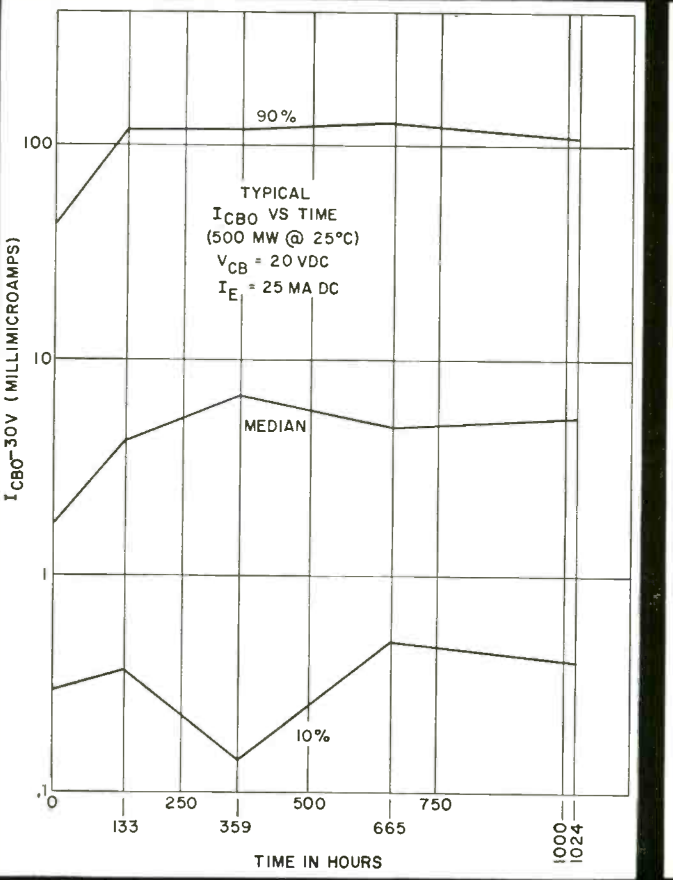
New silicon triodes dissipate

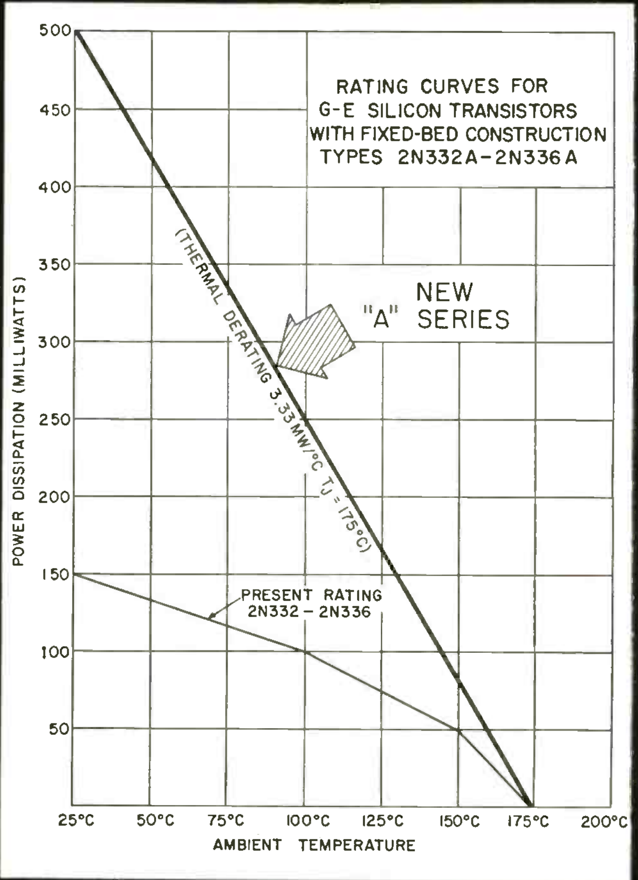


Greatly magnified photo of silicon transistor showing Fixed Bed Construction. All parts are firmly fastened, with no suspended parts except wire lead. Transistor reacts as a solid block in resisting shock and vibration. Power dissipation is inherently higher.



Power dissipation of the 2N332A-through-2N336A silicon transistors (see chart below) ranges from 500 mw at 25°C to 83 mw at 150°C without heat sink. Note also (see chart below, left) the extremely low I_{CBO} throughout 1000 hours of testing. Nearly 90% of units fall within 100 mμa. Beta spread (chart above) is stable out to 1000 hours.





500 mw without heat sink at 25°C

FIXED BED MOUNTED TRANSISTORS 2N332A-through-2N336A ALSO FEATURE: 4 VOLT V_{EB} . . . GUARANTEED 45 VOLT V_{CE} . . . .005 μa MAX. I_{CBO} AT 25°C AND 30 VOLTS . . . PHYSICAL AND ELECTRICAL STABILITY

The 2N332A-through-2N336A line of silicon NPN triodes is a new series of amplifier and switching transistors capable of much higher performance than ever before achieved.

Collector dissipation without heat sink is 500 mw at 25°C . . . 83 mw at 150°C. Since reliability is related to junction temperature, even those designs which do not require maximum-rated power may be enhanced greatly by this device series because of the wide safety-factor potential provided.

FOUR OTHER ADVANTAGES—Collector-to-emitter voltage is guaranteed at 45 volts. Collector leakage current is a maximum of 500 mμa at 30 volts and 25°C. Collector-to-emitter leakage current is 60 μa at 150°C. Minimum cutoff frequency is 2.5 mc, typical f_{ab} is 10 to 15 mc.

FIXED BED MOUNTING—Fixed Bed Mounting is an exclusive G-E construction technique which contributes to the extreme stability obtained by this series of transistors. Storage and operating tests have resulted in a performance rate of better than 99.2% after 1000 hours.

Besides the demonstrated electrical characteristics, General Electric's silicon transistors can absorb physical punishment far beyond normal specifications. All parts are solidly fixed together and react as a solid block in resisting shock and vibration. Test units have been fired from a shotgun, struck with a golf club and rattled freely in an auto hubcap for 700 miles—and worked afterward.

IMMEDIATELY AVAILABLE—All types are available now from warehouse stock. Call your General Electric Semiconductor Sales Representative for complete details on the "hot" transistor line that operates the coolest. General Electric Company, Semiconductor Products Dept., Electronics Park, Syracuse, N. Y.

TYPE 2N333-THROUGH-2N335 SILICON TRANSISTORS MEET MIL-T-19500/37A SPEC.

Designing to the new MIL-T-19500/37A Spec? General Electric types 2N333, 2N334 and 2N335 can be supplied from warehouse stock to meet this specification.

SPECIFICATIONS

Absolute Maximum Ratings (25°C)

Voltages		
Collector to Base	V_{CB}	45 volts
Collector to Emitter	V_{CE}	45 volts
Emitter to Base	V_{EB}	4 volts
Current		
Collector	I_C	25 ma
Power		
Collector Dissipation RMS	P_C	500 mw @ 25°C (Free Air)
	P_C	83 mw @ 150°C (Free Air)
Temperature		
Storage	T_{STG}	−65 to 200°C
Operating Junction	T_J	−65 to 175°C

Electrical Characteristics (Typical at 25°C)

D C Characteristics		2N332A	2N333A	2N334A	2N335A	2N336A	
Forward Current Transfer Ratio (low current) (I_C=1 ma, V_{CE}=5 V)	h_{FE}	16	27	36	45	75	
Saturation Voltage (I_B=1 ma, I_C=5 ma)	V_{CE} (Sat)	.5	45	.42	.4	.4	volts
Cutoff Characteristics							
Collector Current (V_{CB}=30 V; I_E=O; T_A =25°C)	I_{CBO}	1	1	1	1	1	mµa
Collector Emitter Current (V_{CE}=30 V; I_B=O; T_A =150°C)	I_{CEO}	60	60	60	60	60	µa
Low Frequency Characteristics (V_{CB}=5 V; I_E= −1 ma; f=1000 cps)							
Forward Current Transfer Ratio	h_{fe}	16	30	38	52	95	
Input Impedance	h_{ie}	750	1300	1700	2000	3700	ohms
Output Admittance	h_{oe}	3.5	5.0	6.0	7.0	8.0	µmhos
Output Admittance	h_{ob}	.25	.2	.18	.15	.13	µmhos
High Frequency Characteristics (Common Base) (V_{CB}=5 V; I_E= −1 ma)							
Output Capacity (f=1 mc)	C_{ob}	7	7	7	7	7	µµf
Cutoff Frequency	f_{ab}	10	11	12	13	15	mc
Power Gain (common emitter) (V_{CE}=20 V; I_E= −2 ma; f=5 mc)	G_e	11	11	12	12	12	db

GENERAL ELECTRIC

Circle 67 on Inquiry Card

1.16 The line enclosing the device symbol is for recognition purposes and its use is recommended.

1.17 Arrowheads on both N- and P-emitter symbols shall be of 45 degrees included angle. They shall be filled and approximately half their length away from the semiconductor-region symbol. The emitter and collector symbols as well as the transition lines shall be drawn at approximately 60 degrees to the semiconductor-region symbol.

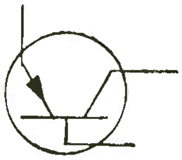
1.18 The following device properties may be indicated with the aid of identifying letters placed within the enclosure or adjacent to the symbol:

B — Breakdown Device
τ — Storage Device
T — Thermally Actuated Device
λ — Light-actuated Device
C — Capacitive Device

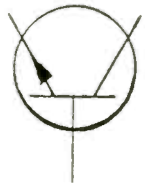
It is recognized that all semiconductor devices are light and temperature sensitive and exhibit breakdown and storage characteristics. The letters listed above are to be used only if these properties are essential to the operation of the circuit.

DEVICE SYMBOLS

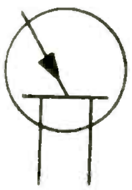
In this section, a listing is made of some semiconductor devices, together with their graphical symbols. It is recognized that in many cases it is possible to develop other device symbols using the standard symbol elements shown in Section 1.0. In general, the angle at which a connecting lead is brought to a graphical symbol has no particular significance. Orientation, including a mirror-image presentation, does not change the meaning of a symbol.



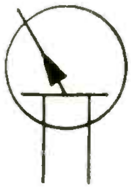
2.1 P-N-P transistor (also P-N-I-P transistor, if omitting the intrinsic region will not result in ambiguity).



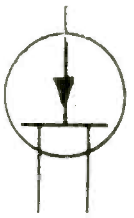
2.2 N-P-N transistor (also N-P-I-N transsistor, if omitting the intrinsic region will not result in ambiguity).



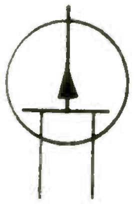
2.3 P-type unijunction transistor (sometimes called double-base diode or filamentary transistor).



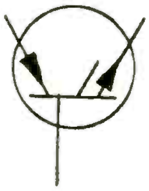
2.4 N-type unijunction transistor (sometimes called double-base diode or filamentary transistor).



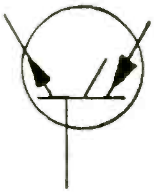
2.5 P-type field-effects transistor.



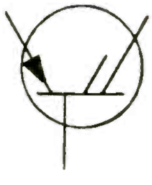
2.6 N-type field-effects transistor.



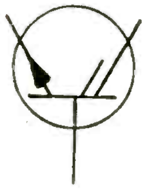
2.7 P-N-P-N transistor (hook or conjugate-emitter connection).



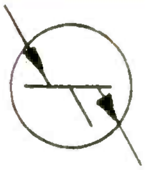
2.8 N-P-N-P transistor (hook or conjugate-emitter connection).



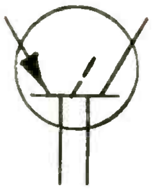
2.9 P-N-P-N transistor (remote base connection).



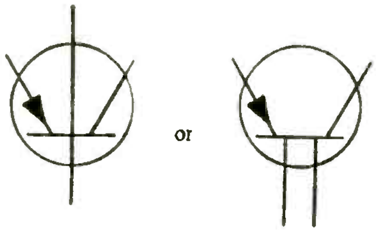
2.10 N-P-N-P transistor (remote base connection).



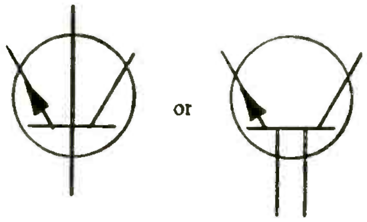
2.11 P-N-P-N transistor without base connection.



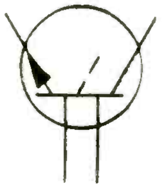
2.14 P-N-I-P transistor with ohmic connection to the intrinsic region.



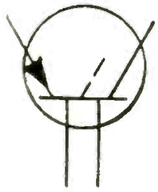
2.12 P-N-P tetrode.



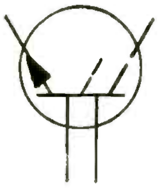
2.13 N-P-N tetrode.



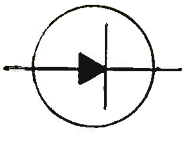
2.15 N-P-I-N transistor with ohmic connection to the intrinsic region.



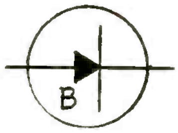
2.16 P-N-I-N transistor with ohmic connection to the intrinsic region.



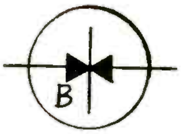
2.17 N-P-I-P transistor with ohmic connection to the intrinsic region.



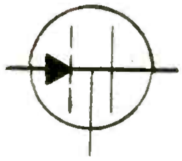
2.18 P-N diode. (The arrowhead shall be of 60 degrees included angle; the point of the arrow head shall touch the adjacent element symbol).



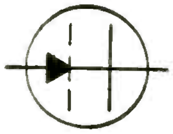
2.19 Breakdown P-N diode. (The arrowhead shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol).



2.20 Bipolar voltage limiter. (The arrowhead shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol).



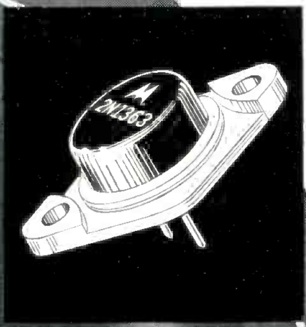
2.21 P-I-N triode*.



2.22 P-I-N diode*.

** It will be noted that these symbols do not conform exactly to the rules of Section 1.0. They are, in effect, the transition between the diode and the multielement-device symbols. Arrowheads shall be of 60 degrees included angle; the point of the arrowhead shall touch the adjacent element symbol.*

NEW 3 AMP 100 VOLT POWER TRANSISTORS from *MOTOROLA*



Motorola's new 2N1362 and 2N1363 high-voltage power transistors, another addition to the popular 2N375-2N618 series, offer three advantages to the circuit designer:

1 They provide greater protection from surge currents in low voltage applications. Many circuits having inductive loads, even when operating at low-voltages, have high voltage transients.

2 The high voltage rating frequently makes possible the use of one unit in place of several low-voltage units in series . . . reducing the number of transistors and other components required.

3 Since each lot is subjected to a 500-hour life test and a 100% dynamic sweep test, a high degree of reliability and stability is assured.

The conservatively rated 2N1362 and 2N1363 are ideal for use in 28 volt and 64 volt power supplies for aircraft, military ground vehicles and railroad applications. The welded TO-3 package is designed to meet the mechanical and environmental requirements of MIL-T-19500A.

PRODUCTION QUANTITIES are available from Motorola stock for immediate delivery. For engineering quantities, contact your nearest Motorola Semiconductor distributor.

WHAT IS YOUR POWER NEED? Motorola's complete range of industrial power transistors gives you power for every purpose. Three separately designed series offer guaranteed gain at currents of 3, 10 and 25 amp . . . and a wide range of voltage ratings to suit your individual requirements.

POWER TRANSISTOR	Maximum Ratings			Typical Electrical Characteristics	
	Type Number	BV_{CBO} volts	BV_{CES} volts	h_{FE} @	I_C amps
3 AMP TO 100 VOLTS	2N1362	100	75	22	3
	2N1363	100	75	35	3
	2N375	80	60	22	3
	2N618	80	60	35	3
	2N297A	60	50	35	2
	2N1011	80	80	45	3
	2N1359	50	40	22	3
	2N1360	50	40	35	3
	$T_J = 100°C$				
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
	2N1120*	80	70	20	10
	$T_J = 100°C$				
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
	$T_J = 100°C$				

*Supplied in TO-3 package with solder terminals.

FOR COMPLETE TECHNICAL INFORMATION on Motorola Power Transistors contact the nearest Motorola Semiconductor office.

MOTOROLA SALES OFFICES:

RIDGEFIELD, NEW JERSEY
540 Bergen Boulevard
WHitney 5-7500
from New York WI 7-2980

CHICAGO 39, ILLINOIS
5234 West Diversey Avenue
AVenue 2-4300

HOLLYWOOD 28, CALIFORNIA
1741 Ivar Avenue
HOllywood 2-0821

DETROIT 27, MICHIGAN
13131 Lyndon Avenue
BRoadway 3-7171

"DEPENDABLE QUALITY – IN QUANTITY"

MOTOROLA SEMICONDUCTORS

MOTOROLA INC., 5005 E. McDOWELL, PHOENIX, ARIZONA

IN CANADA WRITE:
MOTOROLA, Inc.
Semiconductor Products Division
4545 West Augusta Boulevard
Chicago 51, Illinois

OUTSIDE USA & CANADA WRITE:
MOTOROLA INTERNATIONAL, S. A.
4545 West Augusta Boulevard
Chicago 51, Illinois

Circle 59 on Inquiry Card

New Tech Data for Engineers

Electrical Contacts

Engineering catalog is a general compilation of information on electrical contact theory and practice. Included are: Engineering Services and Facilities; Electrical Contact Phenomena; Design Factors; Selection, Classification, and Properties of Contact Materials; Specific data on the Company's precious metals and their alloys, contact backing materials, composite and laminated materials, and other factors applicable to design problems. C. S. Brainin Co., 320 Washington St., Mt. Vernon, N. Y.

Circle 187 on Inquiry Card

Commutating Switch

Bulletin ATL-19 from Advanced Technology Laboratories Div. American-Standard, 369 Whisman Road, Mountain View, Calif., gives tech data and applications on Deltaswitch, a commutating device utilizing a mercury stream for a wiper arm. It has no brushes—avoiding problems of high noise, contact bounce, arcing, mechanical wear and duty cycle changes.

Circle 188 on Inquiry Card

High Voltage Bushings

Bulletins A-20 and A-35 from Alite Div., U. S. Stoneware, Inc., 60 East 42nd St., New York, New York, describes the company's facilities and standard Alite High Voltage Bushings. Alite—a high-alumina ceramic developed by U. S. Stoneware—withstands severe physical and thermal shock without leaks or cracking.

Circle 189 on Inquiry Card

Transistor

Data sheet on 2N1176,A,B "Yeoman" transistor, a versatile, low-priced driver transistor includes ratings and small Signal Parameters. Bendix Aviation Corp., Red Bank Div., Long Branch, N. J.

Circle 190 on Inquiry Card

Microwave Power

"PRD Reports," Vol. 6, No. 3, "Dry Calorimetric Power Meters," discusses an accurate method for the measurement of microwave power at higher frequencies. It describes power meter instrumentation for dry calorimeters which reduce readout time from about 10 min. to 45 sec. and eliminates calibration charts for power level and ambient temperature. Polytechnic Research and Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y.

Circle 191 on Inquiry Card

Swept Audio Measurements

Frequency response and distortion measurements of amplifiers, speakers and other high-fidelity equipment are discussed in The Panoramic Analyzer, No. 5, from Panoramic Radio Products, Inc., 514 S. Fulton Ave., Mt. Vernon, N. Y. Automatic techniques for testing tape and disk recorders and pickups are also described.

Circle 192 on Inquiry Card

! MORE !

The literature mentioned here has been selected for contribution to or advancement of the electronic industries. These items are combed from several hundred bulletins, catalogs, and data sheet announcements received during the past month by ELECTRONIC INDUSTRIES. To keep interested readers informed of all new developments, a summary record is kept of ALL new products and tech data announcements received. For a copy of this month's list, please send your request on company letterhead to Readers' Service Dept., Electronic Industries, 56th & Chestnut Sts., Phila., Penna. or Circle No. 161 on Inquiry Card.

Magnetic Tape

How Magnetic instrumentation tapes of Mylar^R provide reliability is the subject of a brochure from E. I. duPont de Nemours & Co., Inc., Film Dept., 350 Fifth Ave., New York 1, N.Y. Problems discussed include those caused by cupping, swelling and shrinking, breaking, and stretching. Included are graphs, charts, tables, a glossary of terms, and other tech data.

Circle 193 on Inquiry Card

Ceramic Magnets

Bulletin 5650 from Allen-Bradley Co., 136 West Greenfield Ave., Milwaukee 4, Wis., describes a new isotropic ceramic permanent magnet with uniform magnetic properties. The high coercive force of the M-1 magnets make it possible to use shorter lengths than with metallic magnets. Some specs are: peak energy product (B_dH_d max), 1.0 x 10^6 gauss-oersteds; residual induction (B_r), 2200 gauss; coercive force (H_c), 1800 oersteds; resistivity at 25°C, 1.0 x 10^6 ohms per cm^3; magnetizing field for saturation, 10,000 oersteds; reversible permeability, 1.2; Curie temp. approx. 450°C.

Circle 194 on Inquiry Card

Failure Analysis

The development of equations to determine the physical basis of failures is the subject of a booklet, PIB 12, from Product Information, General Electric Co., 3198 Chestnut St., Philadelphia 4, Pa. Containing 22 diagrams, the booklet establishes a general mathematical basis for predicting the point of failure. The author emphasizes that the relations developed have application to problems of missile reliability.

Circle 195 on Inquiry Card

Transducer

Bulletin from Bourns, Inc., P. O. Box 2112, Riverside, Calif., has specs on Model 717 Absolute Pressure Transducer. This pressure instrument employs a bourbon tube movement that assures reliable and accurate operation to 35 g's at 2000 CPS vibration.

Circle 196 on Inquiry Card

Power Connectors

Catalog on Series 14, 16, EZ and GA continental connectors, miniature rectangular power connectors, designed for heavy-duty applications in guided missiles, aircraft and electronic equipment requiring high dielectric and mechanical strength combined with high precision and reliability, feature specs, outline dimensions, illustrations and general information. Electronic Sales Div., De-Jur Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.

Circle 197 on Inquiry Card

Electronic Hardware

Catalog from Atlas E–E Corp., 47 Prospect St., Woburn, Mass., has information on the Company's lines of locking clips, fuse and resistor clips, inserts for tube shields, tube cooling shields, trimming capacitors, component holders and various other components and hardware. Complete data including dimensional drawings, graphs and specs are given.

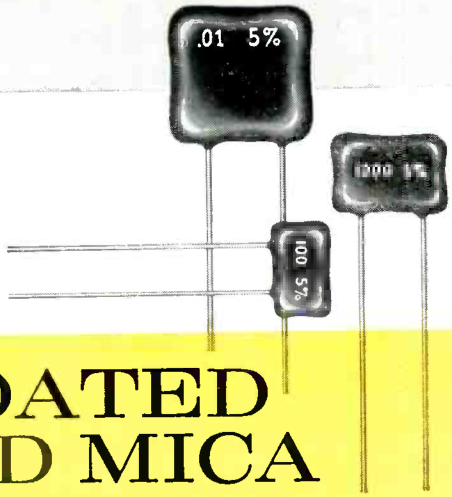
Circle 198 on Inquiry Card

Heat Treating Furnaces

"Temperature Control of Heat Treating Furnaces," GER-1206, 24-page bulletin contains information about thermocouples, control instruments, control elements, control systems and special systems. Author discusses all phases of temperature control listing definitions, basic types, and how to select the proper item. General Electric Co., Schenectady 5, N. Y.

Circle 199 on Inquiry Card

OUTSTANDING
IN
PERFORMANCE



type D

RESIN-COATED SILVERED MICA CAPACITORS

Sangamo Type D mica capacitors combine the excellent electrical performance characteristics of silvered mica with a multi-layer, protective case of high moisture-resistant thermo-setting resins.

temperature range

The Type D is designed to operate over the temperature range of —55°C to +125°C at rated working voltage without derating.

tolerances

Available in capacitance tolerance values of ±20%, ±10%, ±5%, ±2%, ±1% (or ±1 mmfd, whichever is greater).

insulation resistance

The insulation resistance of these capacitors will exceed 3,000 megohms at 125°C.

moisture resistance

Insulation resistance shall be greater than 1000 megohms as measured in accordance with paragraph 2.6.2 of EIA specification RS-186-A, Method 2. Paragraphs 2.4 and 2.6.1 do not apply. The test shall continue for 10 cycles, as described in paragraph 2.5.

thermal and immersion cycling

Insulation resistance shall be greater than 3000 megohms after being subjected to temperature cycling between —55°C and +125°C, as outlined in Method 102-A, Test Condition D, and followed by Method 104-A, Test Condition A, of MIL-STD 202A.

Write for Bulletin TSC-118C

TYPE	DC WORKING VOLTAGE - VOLTS.	CAPACITANCE RANGE - MMF.
D-15	500	5-400
	300	5-800
D-20	500	100-2000
	300	100-4000
D-30	500	1000-10000
	300	1000-20000

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

SC-59-10

Circle 60 on inquiry Card

New Tech Data for Engineers

Electronic Wiring

"The Systems Approach to Electronic Wiring and Connections," from Methode Mfg. Corp., 7447 W. Wilson Ave., Chicago 13, Ill., a 28-page book is divided into 3 parts. First is a section on "Case Histories" on printed circuit and wiring device applications, designed to stimulate new application ideas. Second are check lists to assist in specifying, designing and integrating multiple wiring device components, tolerances on printed circuits, connectors and sockets, and multi-conductor cable and flexible harness. Third is a section on Methode's design, tooling, manufacturing and inspection facilities. The book also offers engineering analysis, designed to assist in packaging and inter-connecting high density electronic assemblies.

Circle 200 on Inquiry Card

Blast Cleaning

A guide to pressure type abrasive blast cleaning operations and a catalog of machines and accessories, catalog 3594, contains information on open top and closed top pressure type sandblast machines; nozzles to be used; data tables on ratios of nozzle bore sizes to compressor capacities etc. Sanstorm Manufacturing Co., Dept. EI-2, P.O. Box 1173, Fresno, Calif.

Circle 201 on Inquiry Card

Magnetic Tape

Honeywell Magnetic tape loop transports and reel-to-loop adapter are shown in Specs DS 3191 and 3210. Three instrumentation-grade transports are listed, for max. loop lengths of 35, 80 and 100 ft. Adapter converts Series 3170 reel transports to run 2½ to 15 ft. loops. Memory, time delay and wave analyses are among applications described, and there are threading and loop-playing-time charts. Minneapolis-Honeywell-Regulator Co., 10721 Hanna St., Beltsville, Md.

Circle 202 on Inquiry Card

Detecting Radioactivity

Catalog I-60, 36-pages, illustrates, describes and prices the complete line of proportional counters, scalers, pulse height analyzers, universal shields, monitoring systems, portable survey meters, counting ratemeters, well counters, and medical laboratory instruments built by Nuclear Measurements Corp., 2460 N. Arlington, Indianapolis 18, Ind. Data show how each instrument can be used independently or as part of an integrated system to handle virtually any problem in measuring radioactivity.

Circle 203 on Inquiry Card

Typing Math Symbols

A method of using an electric typewriter for typing special symbols and equations used in mathematics is the subject of a booklet, R 8964.10, from Remington Rand, Div. of Sperry Rand Corp., 315 Park Ave. So., New York 10, N. Y. It is the third in a series designed to show how many different fields can make profitable use of interchangeable typewriter type. The others dealt with electronics and electricity and with chemistry.

Circle 204 on Inquiry Card

Transformers

A 4-page brochure, "Encapsulated Transformers," describes characteristics and applications of HR/Epseal and Electroseal transformer constructions. Three basic design improvements are illustrated along with photographs of typical transformer configurations. Units are designed from microwatt ratings to 250 KVA for commercial and Mil-T-27A (Grade 2 or 5) applications. Electro Engineering Works, 401 Preda St., San Leandro, Calif.

Circle 205 on Inquiry Card

Power Transistors

Bulletin E-360 from CBS Electronics, Semiconductor Operations, 900 Chelmsford St., Lowell, Mass., describes a line of complementary npn-pnp power transistors in industrial packages. They are mounted in TO-10 (male) and TO-13 (female) packages and are supplied with solder lugs or flying leads. All types max. collector current is 3 a, min. large-signal current gain is 30, and max. thermal resistance is 3° C/W.

Circle 206 on Inquiry Card

Permanent Magnets

Alnico VII A is the subject of an engineering bulletin, Form 351, from the Indiana Steel Products Co., Valparaiso, Ind. It lists magnetic and material characteristics of the oriented and non-oriented forms, as well as a demagnetization and energy product curve. Applications for Alnico VII A, which develops an energy value of 2.8 million (oriented), are also discussed.

Circle 207 on Inquiry Card

Power Supplies

Two-page bulletin describes line of transistorized power supplies. Featured are plug-in amplifiers, bias supplies and relay units with protective circuitry. Mid-eastern Electronics, Inc., 32 Commerce St., Springfield, N. J.

Circle 208 on Inquiry Card

Quartz Crystals

Catalog of military quartz crystals from Scientific Radio Products, Inc., 2303 W. 8th St., Loveland, Colo., lists more than 50 military and scientific crystals in all desired frequency ranges. Specs include military holder, frequency range, tolerances, temp. ranges, static capacity, resonance, capacitance, mode of operation, test set and armed services specification numbers.

Circle 209 on Inquiry Card

Components

Ground support equipment systems, components and capabilities for aircraft and missiles are described in a 4-page brochure from Lear, Inc., P. O. Box 688, Grand Rapids 2, Mich. The basic building blocks described in the brochure are available for use as either components in themselves or as groupings for complex systems.

Circle 210 on Inquiry Card

Acoustic Noise Generator

Four-page bulletin describes a 166 db acoustic noise generator developed by the Avco Research and Advanced Development Div., 201 Lowell St., Wilmington, Mass. The generator uses an electro-mechanical transducer of moving-coil type producing 166 db of random noise and 170 db at discrete frequencies.

Circle 211 on Inquiry Card

Inverters

Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Tex., has compiled a brochure with their latest designs in static inverters. With an introduction to the theory of static inverters, it gives a concise look at single and three phase inverters. Voltage regulation and frequency control are also discussed.

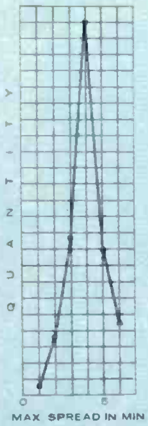
Circle 212 on Inquiry Card

Scatter Antenna Systems

Two papers on scatter antenna system research are available from GB Electronics Corp., Hook Creek Blvd., Valley Stream, L. I., N. Y., entitled "Design Considerations on Modern Scatter Systems" and "Far Field Patterns of Circular Paraboloidal Reflectors," represent the compiled data of research programs conducted at General Bronze. The works display original designs for scatter antenna systems and present a recommendation for future scatter antenna paraboloidal installations.

Circle 213 on Inquiry Card

SYNCHROS *for* GYRO PLATFORMS by cppc



6′ max. error spread Synchro for Gyro Pick-Off

The SG-17- and ST-17- type pancake synchros (SG-18- and ST-18- with housings) are our most standard line for gyro pick-off applications.

These units have been manufactured in large quantity and are readily available for prototype breadboarding. The high accuracies shown on the left are obtainable in standard 26v or 115v units.

Pancake Resolver for Gimbal Mounting

Clifton Precision produces special pancake resolvers for direct gimbal mounting. They were developed for use in cascaded amplifierless resolver systems and have been trimmed for 10K input impedance, 0° phase shift and a constant transformation ratio, with temperature, at 900cy. Accuracies of 4′, perpendicularities of 3′ and nulls of 1mv/v of output or less can be held.

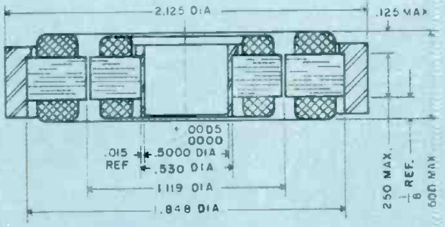
Special techniques maintain concentricity between rotor and stator — thus reducing difficulties commonly encountered in gimbal mountings.

Custom Designed Pancakes

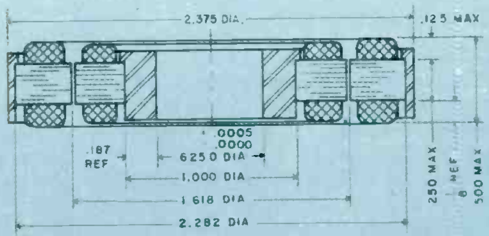
CPPC has developed a number of special pancakes (drawings below) with relatively large bores and narrow stack heights.

Means have been devised to minimize error due to clamping pressures on these thin units.

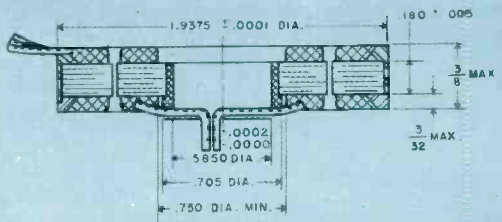
Special accuracies have been maintained where required. Let us know your needs.



RESOLVER



TRANSMITTER OR RESOLVER



TRANSMITTER

ENGINEERS — Join the leader in the rotating components field. Write David D. Brown, Director of Personnel, Dept. J7

cppc **CLIFTON PRECISION PRODUCTS Co., INC.**

CLIFTON HEIGHTS, PENNSYLVANIA

Sales Office: 9014 W. Chester Pike, Upper Darby, Pa., HIlltop 9-1200 • TWX Flanders, Pa. 1122—or our Representatives

Circle 61 on Inquiry Card

New Products . . . for the Electronic Industries

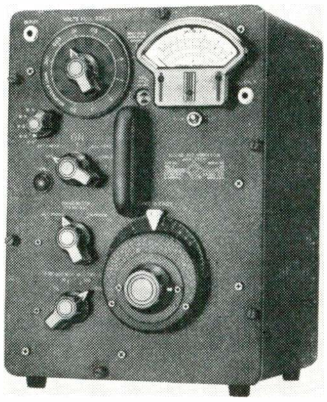
NEON INDICATOR

Low voltage neon indicator unit, LVN-Series, generates its own ignition voltage from any applied dc voltage of 4 or more volts. The "Tec-Lite" may be operated directly from the source voltage, or it may be additionally controlled by a low voltage high impedance input signal. It is designed for portable, battery operated, or any low voltage equipment. The unit mounts in a ⅜ in. hole and is available in a variety of lens shapes and colors. Transistor Electronics Corp., 3357 Republic Ave., Minneapolis 26, Minn.

Circle 162 on Inquiry Card

VIBRATION ANALYZER

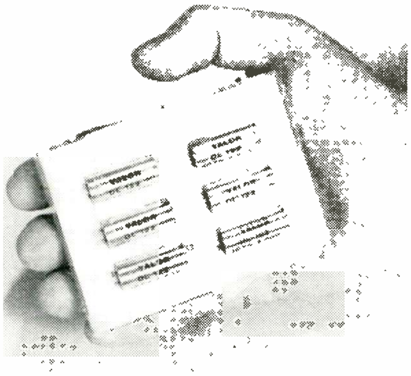
A portable, Sound and Vibration Analyzer, Type 1554-A, with a 10:1 span on each of 4 ranges, features ⅓-octave bandwidth (1.26:1), narrow bandwidth (8%, constant with frequency) and all-pass response. It is a tunable voltmeter whose bandwidth is a constant percentage of the center frequency. Narrow-band max. response is flat ± 2 db over the tuning range; ⅓-octave max. response is flat ± 4 db over range; and the all-pass response is flat from 2.5 to 25,000 CPS ± 2 db. General Radio Co., West Concord, Mass.



Circle 164 on Inquiry Card

DELAY LINES

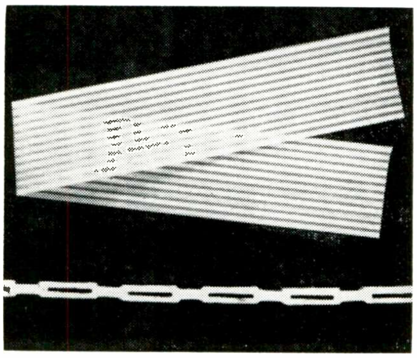
Six lumped constant delay lines, Kit #122, with delays of 0.1, 0.14, 0.2, 0.3, 0.5 and 0.7 μsec. Each has a 3 to 1 delay to rise time ratio and is molded in a 0.4 x 1 in. hermetically sealed brass tube with a fused tin plate finish. Subminiature powdered iron toroidal inductors and temp. compensating ceramic disc capacitors are used in these phase and frequency compensated delay lines. For transistor and printed circuit applications. Valor Instruments, Inc., 13214 Crenshaw Blvd., Gardena, Calif.



Circle 165 on Inquiry Card

RIBBON CABLES

Multi-Tet cables are treated to make the surfaces bondable by: a coating of silica partially imbedded in the outer surfaces of the insulation; or the cable can be treated with a solution of metallic sodium. Either treatment produces a surface on the Teflon insulation that gives good adhesion with silicone adhesives, epoxy resins, phenol formaldehyde, and rubber adhesives. Also potting compounds of all types will tightly anchor the treated cables. W. L. Gor & Assoc., Inc., 487 Papermill Rd., Newark, Del.



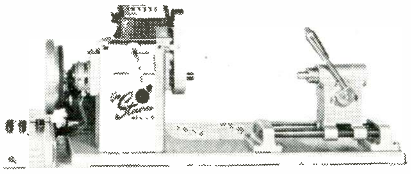
Circle 163 on Inquiry Card

! MORE !

The New Products mentioned here have been selected for contribution to or advancement of the electronic industries. These items are combed from several hundred new product releases received during the past month by ELECTRONIC INDUSTRIES. To keep interested readers informed of all new developments, a summary record is kept of ALL new products received. For a copy of this month's list, please send your request on company letterhead to Readers' Service Dept., Electronic Industries, 56th & Chestnut Sts., Phila., Penna. or Circle No. 161 on Inquiry Card.

HAND WINDER

Heavy duty hand winder, Model 510-AM, designed for laboratory and production use permits winding speeds of 300, 400, and 800 and 1800 RPM at full ½ HP torque rating. It winds wire gauges as heavy as #10 AWG on spools up to 8 in. dia. as well as extremely fine wires at speed selected by conveniently located shift lever. Max. coil OD is 12 in. max. loading distance between headstock and tailstock 12 in. and output end of spindle ¾ in., keyed slot. Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 46, Ill.

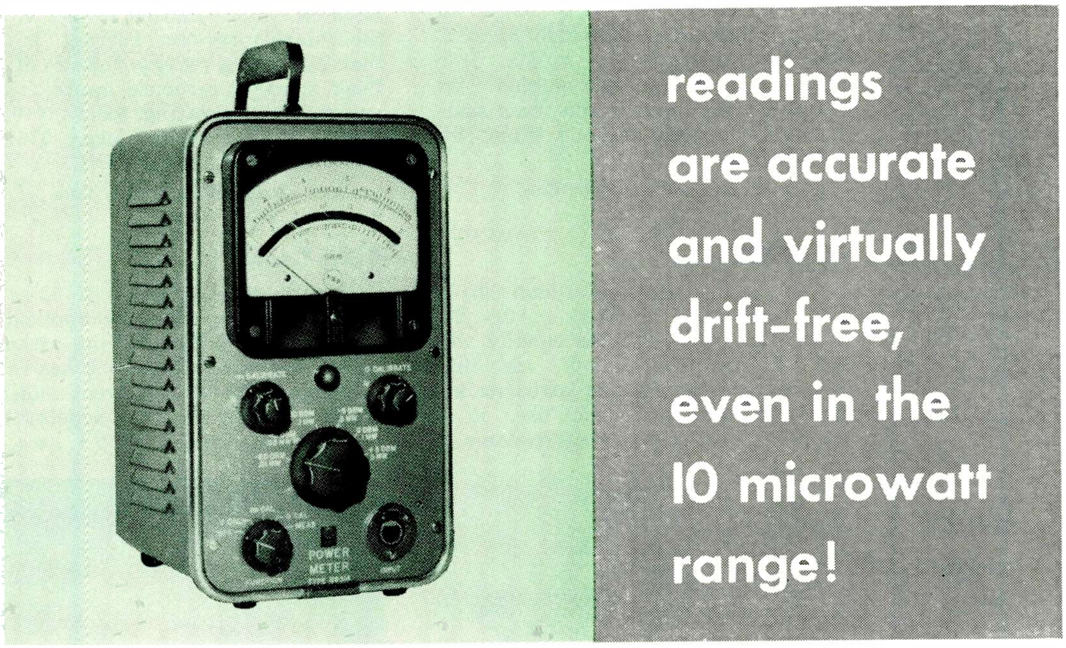


Circle 166 on Inquiry Card

FXR's
TEMPERATURE COMPENSATED
POWER METER

Measures RF and Microwave Power with Incredible Stability!

When used in conjunction with an FXR Series 218 Temperature Compensated Thermistor Head, the *Power Meter* is a hundred times more stable than comparable instruments, due to a unique method of compensating for ambient temperature changes.



Model B831A, Price $335.00

Complete details for the asking.

F X R, Inc.
Design • Manufacture • Development
26-12 Borough Place
Woodside 77, N. Y.

Precision Microwave Equipment • High-Power Pulse Modulators • High-Voltage Power Supplies • Electronic Test Equipment

Circle 63 on Inquiry Card

New Products

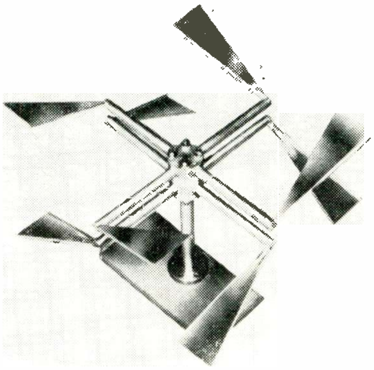
DIELECTRIC CAPACITORS

Polystyrene dielectric capacitor has high stability (±0.1% max. drift under long term full rated operating conditions). High insulation resistance, low dielectric absorption and low dissipation factor are featured. Capacitance range is 0.002 to 5.0 mfd. at voltage ratings of 100 vdcw thru 1000 vdcw. Operating temp. range is −55°C to +85°C. Dielectric absorption is extremely low, 0.1% max. Dissipation factor is 0.02% at 1 KC. Temp. coefficient −120 ±15 ppm/°C. Standard tolerance is ± 5%. Hermetically sealed in non-magnetic enclosures with compression glass seals. Arco Electronics, Inc., 64 White St., New York 13, N. Y.

Circle 167 on Inquiry Card

ANTENNA

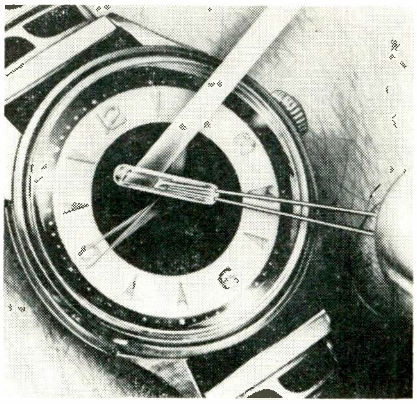
Circularly - polarized, omni - directional telemetry antenna covers 216 to 260 MC, and operates equally well for transmitting and receiving. Suited for ground and airborne application, and airborne use, it is supplied with a fiberglass radome of ⅛ inch thickness. Pattern similar to quarter wave stub, except circularly-polarized. Impedance 51 ohms, VSWR less than 2 to 1. Dynatronics, Inc., Box 2566, Orlando, Florida.



Circle 168 on Inquiry Card

LIGHT DETECTOR

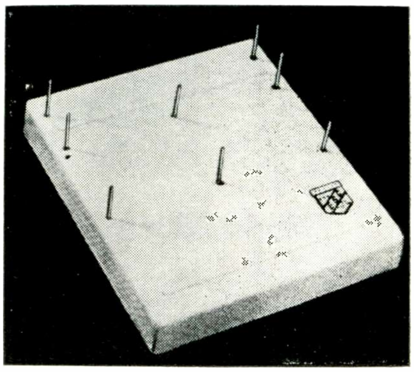
A "detector capsule" enclosing a sensitive silicon light sensing element, the Type EA7 photo-voltaic detection device, is for use where higher light sensitivity and small size are of prime importance. The unit will generate a min. of 300 μa into a 1,000 ohm load at level of 1,250 ft. candles of tungsten light at 2,800°K, color temp. Response time is less than 20 μsec. Active area is about 0.13 x 0.05 in. Reverse bias is limited to —1 v. and the "dark" reverse current is less than 10 μa at a reverse voltage of 1 v. Peak spectral response approx. 8,500 angstrons. Operating temp. is 55°C. Hoffman Electronics Corp., 3761 S. Hill St., Los Angeles, Calif.



Circle 169 on Inquiry Card

DELAY LINE

New delay line, Model 15-52 is for high reliability computer application. Designed for printed wiring assembly techniques, the Model 15-52 has raised bearing surfaces to prevent moisture trapping. The unit has a delay time of 0.5 μsec. tapped at 0.1 μsec. intervals; impedance is 100 ohms; rise time is 0.1 μsec. Dimensions are: 0.375 inches x 2 inches x 2.28 inches. ESC Corporation, 534 Bergen Boulevard, Palisades Park, N. J.



Circle 170 on Inquiry Card

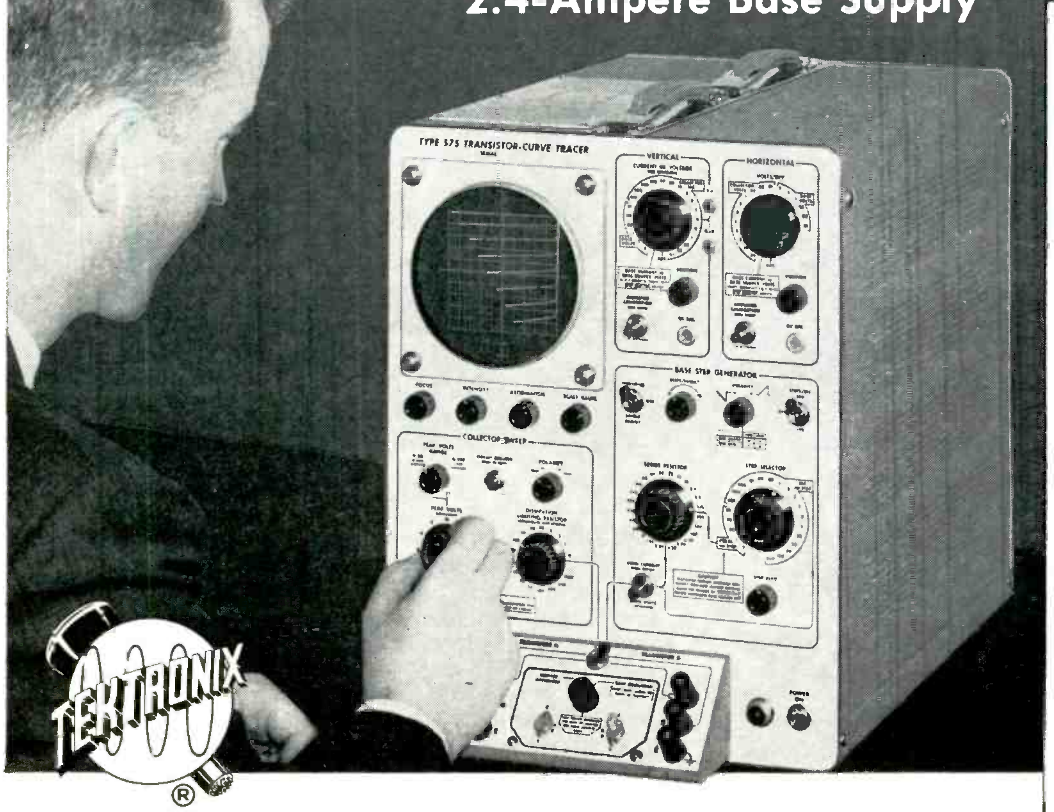
TEKTRONIX

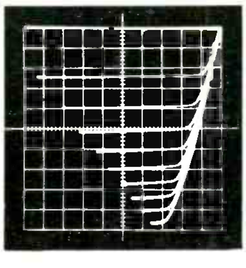
TRANSISTOR CURVE TRACER

Displays 4-12 curves per family

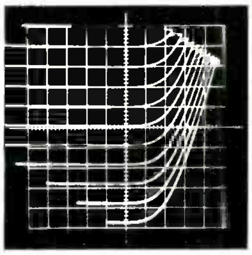
20-Ampere Collector Displays
(10-ampere average supply current)

2.4-Ampere Base Supply

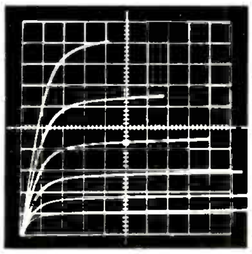




HIGH COLLECTOR CURRENT
PNP transistor, collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 5 v with a 0.25-ohm load, base current is 100 ma/step. Vertical deflection is 2000 ma/div, horizontal 0.5 v/div.



HIGH INPUT CURRENT
PNP transistor, collector current vs collector voltage with base grounded and constant-current emitter steps. Collector sweep is 0 to 1.5 v, emitter current 200 ma/step. Vertical deflection is 200 ma/div, horizontal 0.1 v/div. Zero voltage is at center scale.



LOW INPUT CURRENT
NPN transistor, collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 1.5 v, base current 1 microamp/step. Vertical deflection is 10 microamp/div, horizontal 0.1 v/div.

Input Current from 1 MICROAMP/STEP to 200 MILLIAMPS/STEP

TYPE 575 CHARACTERISTICS

Calibrated Display
- Vertical axis—
  - Collector current, 1 ma/div to 2 amps/div.
- Horizontal axis—
  - Collector volts, 11 steps from 0.01 v/div to 20 v/div.
- Both axes—
  - Base volts, 6 steps from 0.01 v/div to 0.5 v/div.
  - Base current, 17 steps from 0.001 ma/div to 200 ma/div.
  - Base source volts, 5 steps from 0.01 v/div to 0.2 v/div.

Test Condition Selector
- Select either common-emitter or common-base configuration.

Positive or Negative Collector Sweep
- Collector supply—0 to 20 v, 10 amperes average current.
  - —0 to 200 v, 1 ampere average current.
- Dissipation limiting resistors—0 to 100-kilohms in 17 steps.

Positive or Negative Base Stepping
- 4 to 12 steps per family, repetitive or single family display.
- 17 current-per-step positions, 1 μa/step to 200 ma/step.
- 5 voltage-per-step positions, 0.01 v/step to 0.2 v/step, with 24 series resistance values from 1 ohm to 22 kilohms.

Price $975 **f.o.b. factory**

Tektronix, Inc.

P. O. Box 831 • Portland 7, Oregon
Phone CYpress 2-2611 • TWX-PD 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albertson, L. I., N.Y. • Albuquerque • Annandale, Va. • Atlanta, Ga. • Buffalo • Cleveland • Dallas • Dayton • Endwell, N.Y. • Houston • Lathrup Village, Mich. Lexington, Mass. • East Los Angeles • West Los Angeles • Minneapolis • Mission, Kansas Orlando, Fla. • Palo Alto, Calif. • Park Ridge, Ill. • Philadelphia • San Diego • St. Petersburg, Fla. Scottsdale, Ariz. • Stamford, Conn. • Syracuse • Towson, Md. • Union, N.J. • Willowdale, Ont.

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics, Portland, Oregon, Seattle, Wash.; Hytronic Measurements, Denver, Colo., Salt Lake City, Utah.

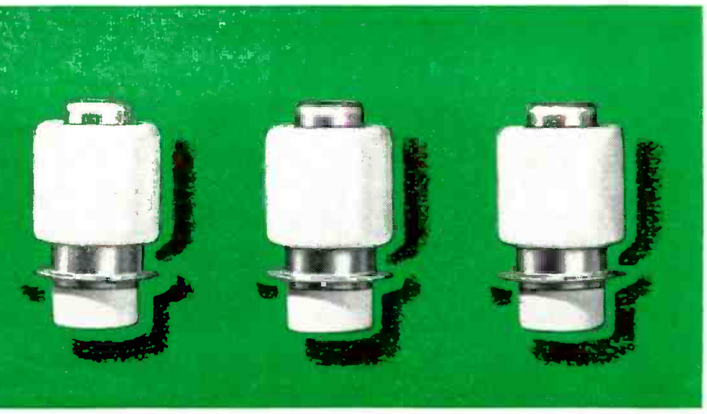
Tektronix is represented in 20 overseas countries by qualified engineering organizations.

ENGINEERS—interested in furthering the advancement of the oscilloscope? We have openings for men with creative ability in circuit and instrument design, cathode-ray tube design, and semiconductor research. Please write Richard Ropiequet, V.P., Eng.

Circle 65 on Inquiry Card

Large • small • any size between –

ALITE is geared to meet your requirements for CERAMIC-TO-METAL SEALS



Alite offers completely integrated facilities and expert engineering assistance for producing high quality, vacuum-tight, ceramic-metal components for all your mechanical and electrical requirements.

Hermetic seals and bushings embodying Alite —the high-alumina ceramic developed by U. S. Stoneware—have the ability to withstand severe physical and thermal shock without leaks or cracking. Produced to precision tolerances, Alite units have high impact and tensile strengths for gruelling environmental conditions. They maintain excellent electrical and mechanical characteristics over a wide range of frequency and temperature. The extra-smooth, hard, high-fired glaze gives superior surface resistivity.

Every manufacturing step is closely supervised in our own plant. Positive quality control assures strict adherance to specifications, absolute uniformity and reliability of completed components.

At no obligation to you, send us your drawings for recommendations or quotation.

FREE Technical Data

For complete technical data on Alite and Alite Ceramic-to-Metal Seals, write for Bulletins A-7R and A-40.

ALITE DIVISION

U. S. STONEWARE

BOX 119 ORRVILLE, OHIO

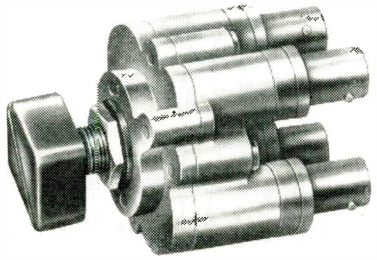
New York Office
60 East 42nd St.

118F-1

New Products . . . for the Electronic Industries

COAXIAL SWITCH

Manually-operated rotary coaxial switch, the CS-250, for use where r-f energy is to be switched. It transfers r-f energy from 0 to 1000 MC with a maximum VSWR of 1.1 up to

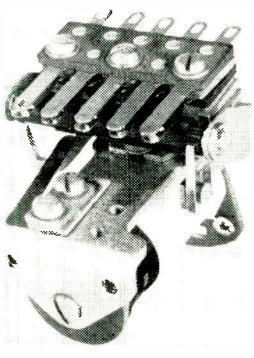


500 MC and 1.2 up to 1000 MC. It is a four terminal, two position transfer switch, coaxially mounted in a die cast metal frame. Insertion loss is less than 1/10 db to 1000 MC. Isolation between the open and closed circuit is 58 db at 100 MC and 40 db at 1000 MC. Jerrold Electronics Corporation, 15th and Lehigh Avenue, Philadelphia 32, Pa.

Circle 171 on Inquiry Card

RELAY

Series 1450, program relay, provides a wide variety of cam operated switching combinations. The cams (any configuration supplied) and ratchet wheel are molded from a material which provides unlimited life and quiet operation. Cams are pressed on a splined shaft so that any desired orientation can be obtained. Dc or ac coils can be pro-

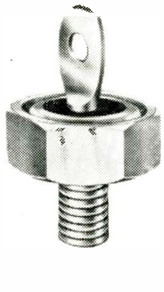


vided for any voltage to 200. Contacts for dry circuit or 7½ amps available. Standard arrangement is 12 position, 5 pole. Others available. Standard Electromagnetics, Inc., Walkersville, Md.

Circle 172 on Inquiry Card

ZENER DIODE

High power Zener diode has standard tolerance of 5% in single units. No matched pairs are needed. The new 35-watt Zener diodes are adaptable to such applications as high

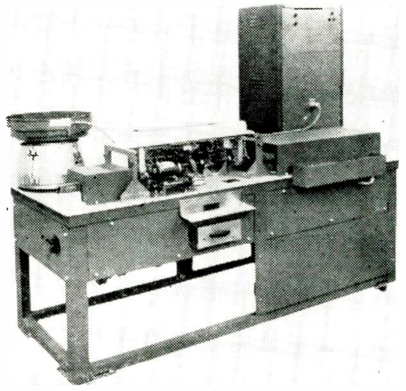


power voltage regulators, limiting and clipping devices, and over-voltage protective devices. Zener voltages range from 8.2 to 100 volts at 500 to 50 ma. Zener or dynamic impedance is low, and breakdown is abrupt over the whole Zener voltage range. U. S. Semiconductor Products, Sales Engineering Dept., 3540 W. Osborn Rd., Phoenix, Ariz.

Circle 173 on Inquiry Card

SPIRALING LATHE

Spiraling lathe, Model ABL-6, is for spiraling resistors to a predetermined electrical value over a resistance range of from 10 ohms to 10 megohms. Accuracy is dependent on such variables as speed of machine, physical size of resistor, electrical value and type of film used. Operation is automatic. Monitoring of the resistors throughout the spiraling

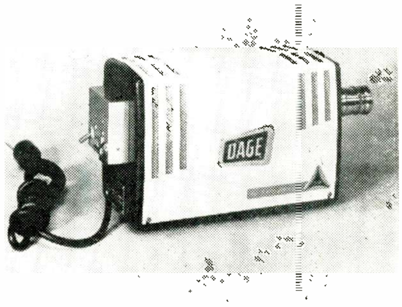


cycle is achieved by a sensitive automatic bridge. Counter provided for presetting turns-per-inch and spindle rpm. Industrial Instruments Automation Corp., 89 Commerce Rd., Cedar Grove, N. J.

Circle 174 on Inquiry Card

CLOSED-CIRCUIT TV CAMERA

A closed-circuit TV camera, Model 70-A, features a transistorized video amplifier which eliminates microphonics and provides 600-line resolution. Instantaneous adjustments are

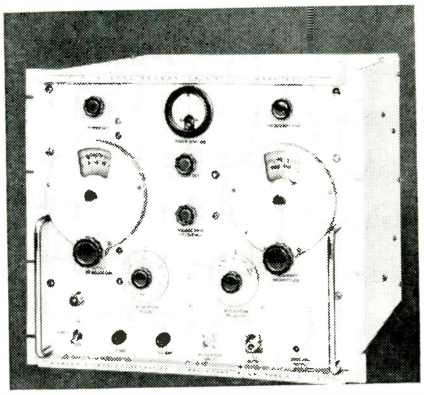


automatically made to variations in light levels. Other features include on-chassis controls to regulate horizontal and vertical size, linearity and centering; and adjustments for beam and black level. It has low internal ambient temperature rise. Requires 45 w, 115 v. 60 cycle power. Dage Television Div., Thompson Ramo Wooldridge, Inc., Michigan City, Ind.

Circle 175 on Inquiry Card

FM SIGNAL GENERATOR

FM signal generator, Model 201B, covers 1300 to 2500 MC in one band. It provides excellent FM characteristics and is designed for telemetry and data transmission applications. Featuring a 1% deviation linearity, it can be frequency modulated by applications of external signals having modulation bandwidths up to 500 KC. A nominal deviation of 2 MC peak to



peak is produced by external modulation signals having an amplitude of 1.0 v. peak to peak. R-f output is continuously variable from 0 dbm to −110. Sierra Electronic Corp., 3885 Bohannon Drive, Menlo Park, Calif.

Circle 176 on Inquiry Card

New Tech Data for Engineers

Delay Lines

Bulletin DL1159 describes a standard line of miniature lumped constant delay lines. Data are provided on electrical specs, packaging and construction techniques. Design factors that should be considered when establishing specs for special delay lines are also explained. Valor Instruments. Inc., 13214 Crenshaw Blvd., Gardena, Calif.

Circle 214 on Inquiry Card

Inertial Navigation

"An Introduction to Inertial Navigation" a 25-page, illustrated publication contains "The ABC's of Inertial Navigation," Precision Gyroscopics—New Demands on an Old Art," and The Horizontal Integrating Accelerometer." Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, New York.

Circle 215 on Inquiry Card

Digital Voltmeters

Bulletin 8159/20M, 20-pages. from Non-Linear Systems, Inc., Del Mar, California, describes features of the series 30 digital voltmeters and how they contribute to performance. It also contains information on how to design this series into measuring and data logging systems. Included are graphs, circuit diagrams, and specs.

Circle 216 on Inquiry Card

Diode Characteristics

Technical booklet on microwave diodes, 12-pages, contains complete electrical and mechanical data on all microwave diodes manufactured by Sylvania as well as a replacement guide to nearly 200 widely-used diode types. Included is information on the Micro-Min line. Sylvania Electric Products Inc., 100 Main St., Buffalo 9, N. Y.

Circle 217 on Inquiry Card

Rotary Switches

Electro Switch Bulletin No. 14A contains information on the expanded line of ESCO switches based on the Type MA-12 miniature rotary selector switch. Data are given on lever-actuated versions and on solenoid-operated switches. Dimensions, mounting data, and electrical ratings are included. Electro Switch Corp., 167 King Ave., Weymouth 88, Mass.

Circle 218 on Inquiry Card

Magnetic Clutches

"Magnetic Clutches and Their Applications," an 18-page technical booklet, has complete details on design and applications, technical and testing specifications. PIC Design Corp., 477 Atlantic Ave., E. Rockaway, L.I., N.Y.

Circle 219 on Inquiry Card

! MORE !

The literature mentioned here has been selected for contribution to or advancement of the electronic industries. These items are combed from several hundred bulletins, catalogs, and data sheet announcements received during the past month by ELECTRONIC INDUSTRIES. To keep interested readers informed of all new developments, a summary record is kept of ALL new products and tech data announcements received. For a copy of this month's list, please send your request on company letterhead to Readers' Service Dept., Electronic Industries, 56th & Chestnut Sts., Phila., Penna. or Circle No. 161 on Inquiry Card.

Thermal Elements

A 29-page booklet from Metals & Controls Div., Texas Instruments Incorporated, 34 Forest St., Attleboro, Mass., describes the origin and operation of the snap-acting, disc type thermal element, called the Spencer Disc. used for actuating Klixon thermostats, circuit breakers, and inherent overheat motor protectors.

Circle 220 on Inquiry Card

Digital Tape Handler

A 3-color, 8-page brochure on the FR-400 digital magnetic tape handler includes specs. Machines are available with ½, ¾ or 1 in. tape, providing up to 32 data channels. Instrumentation Div., Ampex Corp., 934 Charter St., Redwood City, Calif.

Circle 221 on Inquiry Card

Power Supplies

Two-page bulletin from Mid-eastern Electronics, Inc., 32 Commerce St., Springfield, N. J., describes the company's line of transistorized power supplies. Features of design are plug-in amplifiers, bias supplies and relay units with protective circuitry.

Circle 222 on Inquiry Card

Laminated Plastics

"Shape Laminated Parts by Low-Cost Postforming," a 3-page article. from Taylor Fibre Co., Norristown. Pa., tells what types of laminated plastics are recommended for postforming, discusses mold design, and gives correct temperatures and pressures for best results. A table lists the blister time for sheets of various thicknesses.

Circle 223 on Inquiry Card

Facilities

An 11-page booklet from Sky Data. 21301 Cloud Way, Hayward, California, describes the company's facilities for producing amplifiers, beacons, cable assemblies, and harnesses, communication systems, computer subassemblies, converters, electronic controls, instrumentation equipment, power supplies, nuclear instruments. radar amplifiers, and many other classes of electronic equipment.

Circle 224 on Inquiry Card

Wire and Cable

A 16-page catalog of electronic wire and cable, including zipper tubing and lacing cord from Alpha Wire Corp., 200 Varick St., New York 14. N. Y., lists 324 wire and cable items. with application information and specs. The catalog also contains a section on 70 tubing and sleeving items.

Circle 225 on Inquiry Card

Pressure Switches

An 88-page catalogue, covering their line of pressure actuated switches and sensing devices ranging from 30 in. Hg. vacuum to 12,000 psi, is available from Meletron Corp., 950 N. Highland Ave., Los Angeles 38, Calif. Included is the Melex snap action switch that will operate in temp. from −300° to +500° F and will withstand 40 to 50 g's at 2000 CPS.

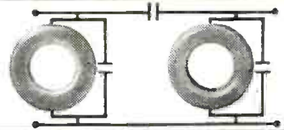
Circle 226 on Inquiry Card

Data Recording

Bulletin No. 350-8 from Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif., describes automatic multipoint digital data recording system. It was designed for the automatic testing of vacuum tubes on a mass-production basis and may also be used for recording data where input voltages in the form of EMF's in the 0-10 mv range are available.

Circle 227 on Inquiry Card

PUTTING MAGNETICS TO WORK



Smaller filters ease the squeeze!

Filter designers! First 160-mu moly-permalloy powder cores pack high performance into smaller space

Filter and inductor designers specify our 160-mu moly-permalloy powder cores for low frequency applications. Where space is precious, such as in carrier equipment and telemetering filters, the high permeability of these 160-mu cores eases the squeeze.

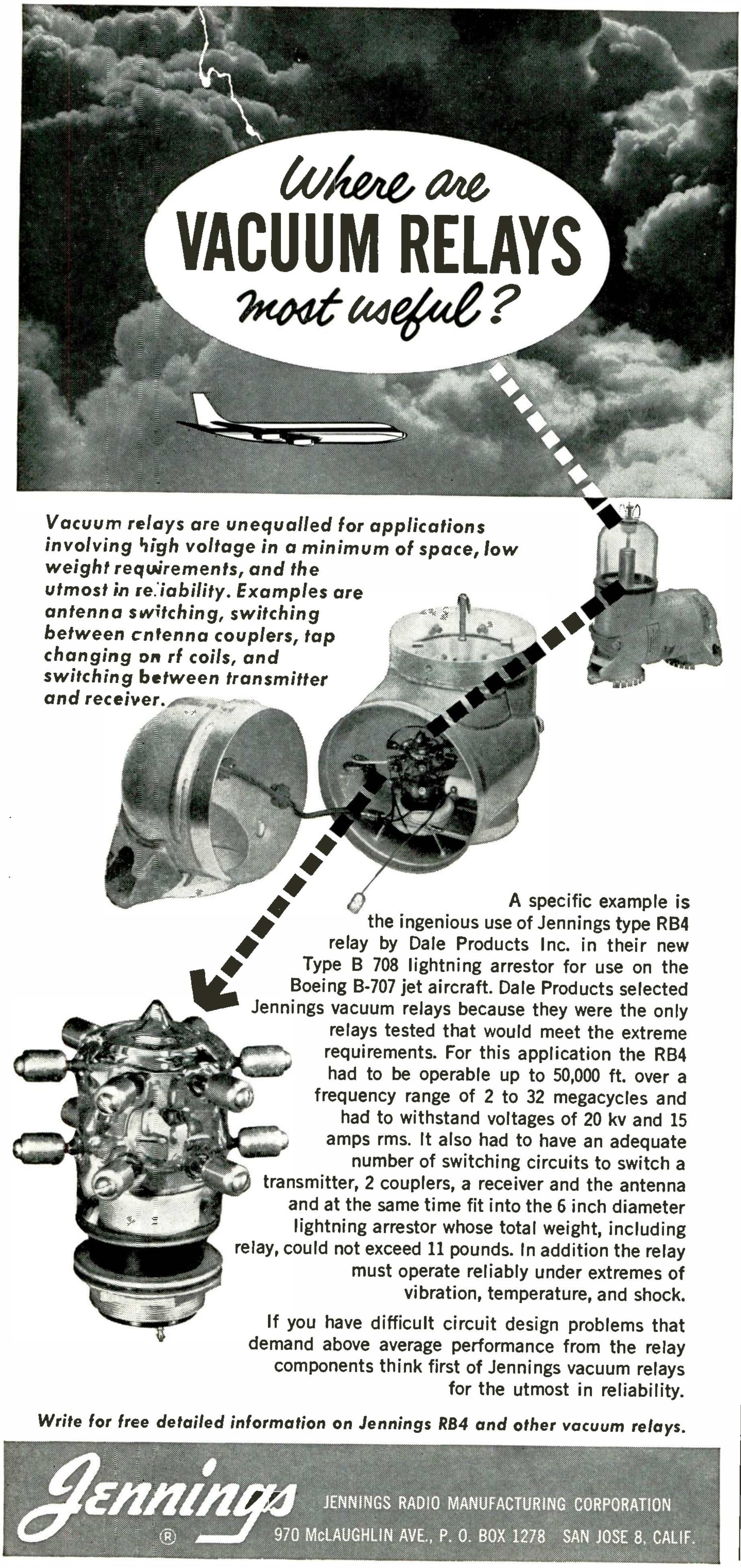
In many cases, 160-mu cores offer designers the choice of a smaller core. In others, because inductance is 28 percent higher than that of 125-mu cores, at least 10 percent fewer turns are needed to yield a given inductance.

If Q is the major factor, 160-mu cores permit the use of heavier wire with a resultant decrease in d-c resistance.

Like all of our moly-permalloy powder cores, the 160's come with a *guaranteed* inductance. We can ship eight sizes from stock, with a choice of three finishes—standard enamel, guaranteed 1,000-volt breakdown finish, or high temperature finish. Further information awaits your inquiry. *Magnetics Inc., Dept. EI-78, Butler, Pa.*

MAGNETICS inc.

Circle 62 on Inquiry Card



Vacuum relays are unequalled for applications involving high voltage in a minimum of space, low weight requirements, and the utmost in reliability. Examples are antenna switching, switching between antenna couplers, tap changing on rf coils, and switching between transmitter and receiver.

A specific example is the ingenious use of Jennings type RB4 relay by Dale Products Inc. in their new Type B 708 lightning arrestor for use on the Boeing B-707 jet aircraft. Dale Products selected Jennings vacuum relays because they were the only relays tested that would meet the extreme requirements. For this application the RB4 had to be operable up to 50,000 ft. over a frequency range of 2 to 32 megacycles and had to withstand voltages of 20 kv and 15 amps rms. It also had to have an adequate number of switching circuits to switch a transmitter, 2 couplers, a receiver and the antenna and at the same time fit into the 6 inch diameter lightning arrestor whose total weight, including relay, could not exceed 11 pounds. In addition the relay must operate reliably under extremes of vibration, temperature, and shock.

If you have difficult circuit design problems that demand above average performance from the relay components think first of Jennings vacuum relays for the utmost in reliability.

Write for free detailed information on Jennings RB4 and other vacuum relays.

Jennings ®

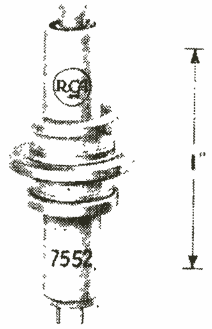
JENNINGS RADIO MANUFACTURING CORPORATION
970 McLAUGHLIN AVE., P. O. BOX 1278 SAN JOSE 8, CALIF.

Circle 68 on Inquiry Card

New Products

PENCIL TUBES

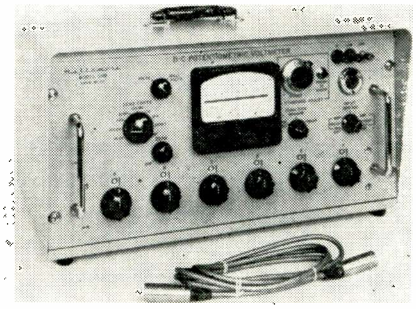
Two pencil-thin ceramic-metal electron tubes, 1½ in. long for military applications, the RCA-7552 and RCA-7554 high-mu triodes, are designed for ultra-high-frequency service in portable field equipment, missile-guidance systems and satellite-communication applications. Tube can operate at plate-seal temp. up to 225°C. Additional features include: large cathode area as compared with comparable planar types; fast warm-up time—12 sec. to reach 90% of direct operating plate current; and excellent thermal stability. Both types can be operated to 100,000 ft. without pressurization and have max. plate dissipation of 2.5 w. Radio Corp. of America, Harrison, N. J.



Circle 179 on Inquiry Card

VOLTMETER

Solid-state precision voltmeter, a dc potentiometric type, combines an electronic galvanometer with a precision resistor network to enable dial readings down to 0.5 microvolts resolution and up to 10 vdc at an accuracy tolerance of ±(0.025% + 3 μv). The resistor network is controlled by 6 decade switches covering voltage ranges from ±10 μv to ±10 volts. Hallamore Electronics Company, 714 N. Brookhurst Street, Anaheim, Calif.



Circle 180 on Inquiry Card

GENERAL INSTRUMENT SEMICONDUCTOR DIVISION

JAN TYPE

GENERAL INSTRUMENT

SILICON DIODES

1N457
1N458
1N459

When JAN type diodes are required, you can be certain that General Instrument's engineering skills and manufacturing facilities will enable us to deliver them at prices that reflect years of volume production experience.

The General Instrument line of silicon *and* germanium diodes is the most complete available to the industry, with the widest possible range of characteristics. We also make a complete line of medium and high power silicon rectifiers, including all JAN types. Complete information and data sheets are available upon request.

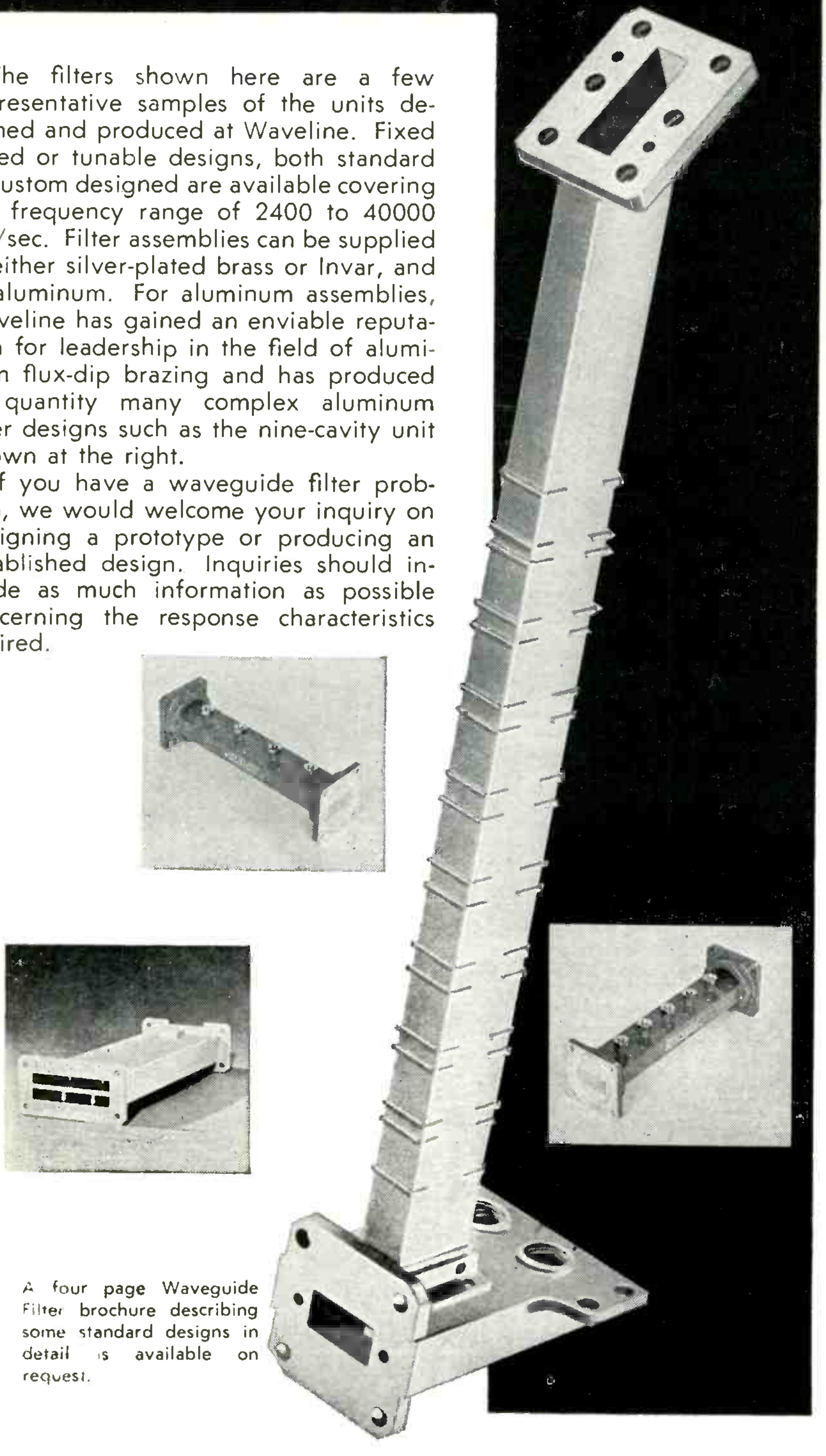
Code No.	Min. Fwd. DC Cur. @ +1V	Max. Rev. DC Cur. @ Test V.		Test Voltage	Max. Inv. Voltage	Min. Breakdown Voltage*	Avg. Fwd. DC Cur. (Max.)
		25° C.	150° C.				
1N457	20 mA	.025 μA	5 μA	60V	60V	70V	75 mA
1N458	7 mA	.025 μA	5 μA	125V	125V	150V	55 mA
1N459	3 mA	.025 μA	5 μA	175V	175V	200V	40 mA

*Reverse voltage at which a reverse current of 100 uA flows.
All ratings and characteristics are at 25° C. unless otherwise noted.
Operating temperature range −80° C. to +200° C.

Semiconductor Division
GENERAL INSTRUMENT CORPORATION
65 Gouverneur Street, Newark 4, N. J.
Midwest office: 5249 West Diversey Ave., Chicago 39
Western office: 11982 Wilshire Blvd., Los Angeles 25

GENERAL INSTRUMENT CORPORATION INCLUDES F. W. SICKLES DIVISION, AUTOMATIC MANUFACTURING DIVISION, SEMICONDUCTOR DIVISION, RADIO RECEPTOR COMPANY, INC., THE HARRIS TRANSDUCER CORPORATION, MICAMOLD ELECTRONICS MANUFACTURING CORPORATION AND GENERAL INSTRUMENT — F. W. SICKLES OF CANADA LTD. (SUBSIDIARIES)

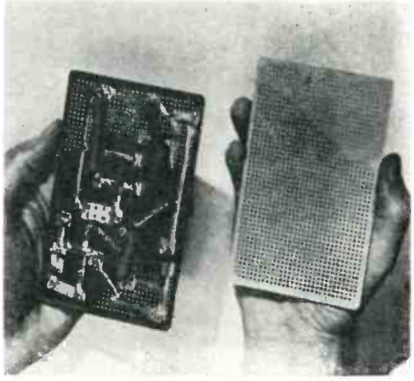
Circle 69 on Inquiry Card



New Products

GRID BOARD

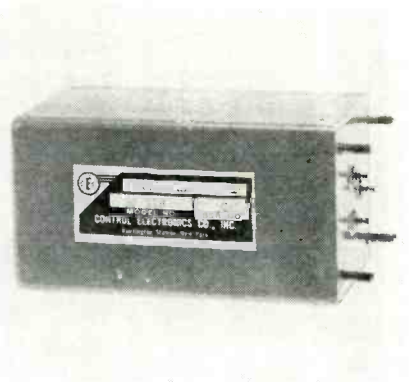
Fotoceram grid board is clad on both sides with copper that can be etched away as desired. The grid consists of 0.052 in. round holes spaced 1/10 in. apart on center. Hydrochloric acid and ammonium persulfate are used for removing excess copper. Boards are 1/16 in. thick and available in 3 sizes: 3 x 5. 6 x 8 and 9 x 12 in. Components can be soldered to the board more than 50 times without circuit run failure. Fotoceram, a glass-ceramic with high strength, high temp. resistance, and zero water absorption, is non-flammable and dimensionally stable. Electronic Components Dept., Corning Glass Works, Bradford, Pa.



Circle 181 on Inquiry Card

AUDIO FILTERS

Modular line of audio filters for multi-channel band separation use. Units have center frequencies of 1.05. 3.78, 10.6, 21.6, 36.7, and 52.6 KC. All units have input and output impedances of 2 K ohms, and an insertion loss of less than 2 db. Dimensions of the units are 2¼ in. x 2⅛ in. x 4 in. Control Electronics Co., Inc. 10 Stepar Place, Huntington Station. Long Island, N. Y.



Circle 182 on Inquiry Card

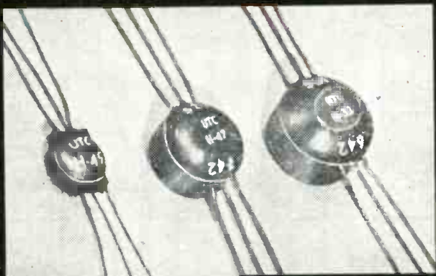
Circle 71 on Inquiry Card →

PULSE TRANSFORMERS

FROM STOCK

MINIATURE STABLE WOUND CORE HERMETIC MIL-T-27A TYPE TF5SX36ZZ

UTC miniature, wound core, pulse transformers are precision (individually adjusted under test conditions), high reliability units, hermetically sealed by vacuum molding and suited for service from —70° C. to +130° C. Wound core structure provides excellent temperature stability (unlike ferrite). Designs are high inductance type to provide minimum of droop and assure true pulse width, as indicated on chart below. If used for coupling circuit where minimum rise time is important, use next lowest type number. Rise time will be that listed for this lower type number . . . droop will be that listed multiplied by ratio of actual pulse width to value listed for this type number. Blocking oscillator data listed is obtained in standard test circuits shown. Coupling data was obtained with H. P. 212A generator (correlated where necessary) and source/load impedance shown. 1:1:1 ratio.



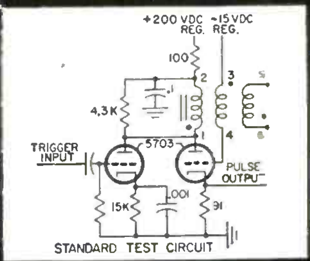
DEFINITIONS

Amplitude: Intersection of leading pulse edge with smooth curve approximating top of pulse.
Pulse width: Microseconds between 50% amplitude points on leading and trailing pulse edges.
Rise Time: Microseconds required to increase from 10% to 90% amplitude.
Overshoot: Percentage by which first excursion of pulse exceeds 100% amplitude.
Droop: Percentage reduction from 100% amplitude a specified time after 100% amplitude point.
Backswing: Negative swing after trailing edge as percentage of 100% amplitude.

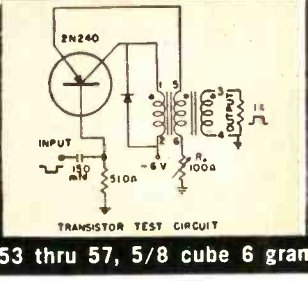
	APPROX. DCR, OHMS			BLOCKING OSCILLATOR PULSE					COUPLING CIRCUIT CHARACTERISTICS						
Type No.	1-2	3-4	5-6	Width μ Sec.	Rise Time	% Over Shoot	Droop %	% Back Swing	P Width μ Sec.	Volts Out	Rise Time	% Over Shoot	Droop %	% Back Swing	Imp. in, out, ohms
H-45	3	3.5	4	.05	.022	0	20	10	.05	17	.01	20	0	35	250
H-46	5.5	6.5	7	.10	.024	0	25	10	.10	19	.01	30	10	50	250
H-47	3.7	4.0	4	.20	.026	0	25	8	.20	18	.01	30	15	65	500
H-48	5.5	5.3	6	.50	.03	0	20	5	.50	20	.01	30	20	65	500
H-49	8	8.5	9	1	.04	0	20	10	1	24	.02	15	15	65	500
H-50	20	21	22	2	.05	0	20	10	2	27	.05	10	15	35	500
H-51	28	31	33	3	.10	1	20	8	3	26	.07	10	10	35	500
H-52	36	41	44	5	.13	1	25	8	5	23	.15	10	10	45	1000
H-53	37	44	49	7	.28	0	25	8	7	24	.20	10	10	50	1000
H-54	50	58	67	10	.30	0	20	8	10	24	.25	10	10	50	1000
H-55	78	96	112	16	.75	0	20	10	16	23	.40	5	15	20	1000
H-56	93	116	138	20	1.25	0	25	10	20	23	.6	5	10	10	1000
H-57	104	135	165	25	2.0	0	30	10	25	24	1.5	5	10	10	1000
H-60	.124	.14	.05	.05	.016	0	0	30	.05	9.3	.012	0	0	20	50
H-61	.41	.48	.19	.1	.016	0	0	30	.1	8.2	.021	0	0	15	50
H-62	.78	.94	.33	.2	.022	0	0	18	.2	7.4	.034	0	5	12	100
H-63	1.86	2.26	.70	.5	.027	2	10	20	.5	7.5	.045	0	20	25	100
H-64	3.73	4.4	1.33	1	.033	0	12	25	1	7	.078	0	15	23	100
H-65	6.2	7.3	2.22	2	.066	0	15	25	2	6.6	.14	0	10	20	100
H-66	10.2	12	3.6	3	.087	0	18	30	3	6.8	.17	0	10	20	100
H-67	14.5	17.5	5.14	5	.097	0	23	28	5	7.9	.2	0	18	28	200
H-68	42.3	52.1	14.8	10	.14	0	15	28	10	6.5	.4	0	15	30	200

Note: 0 = Negligible

Vacuum Tube Type Ratio 1:1:1



Transistor Type Ratio 4:4:1



H-45, 46, 60 thru 68 are 3/8 cube, 1 gram H-47 thru 52, 9/16 cube 4 grams H-53 thru 57, 5/8 cube 6 grams

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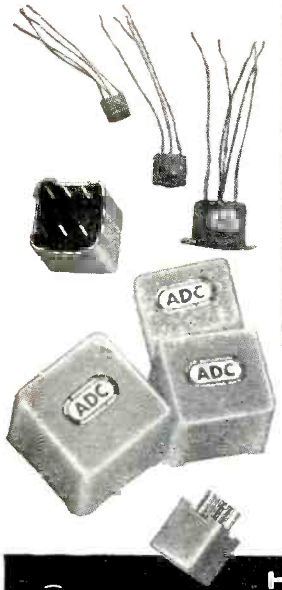
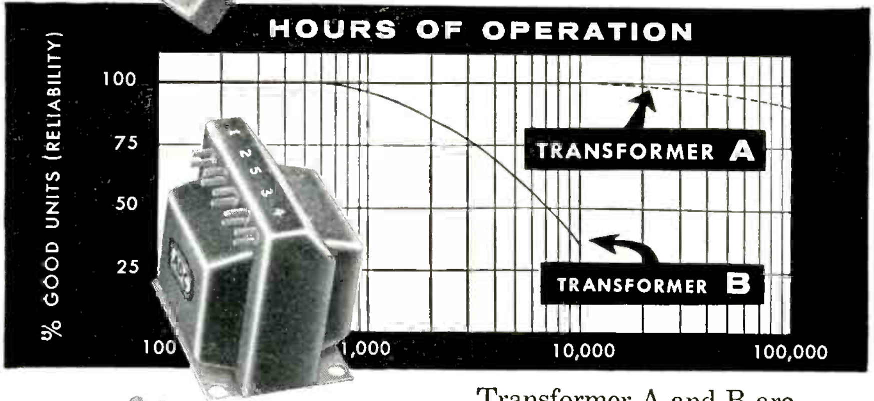
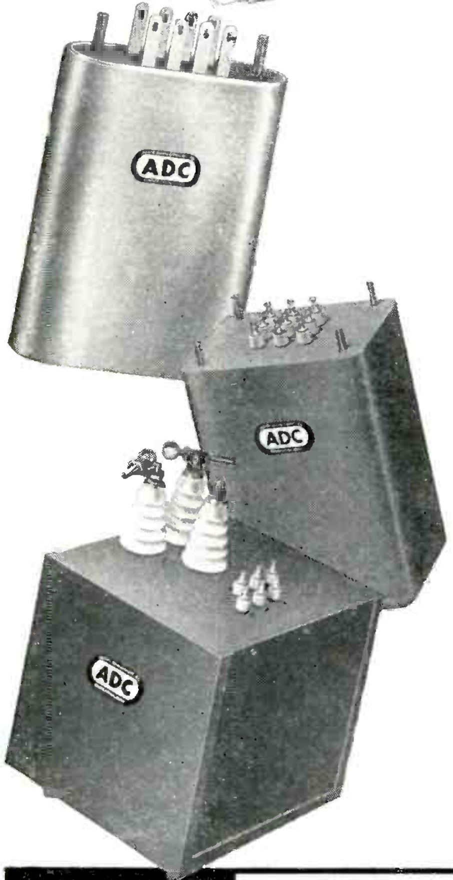


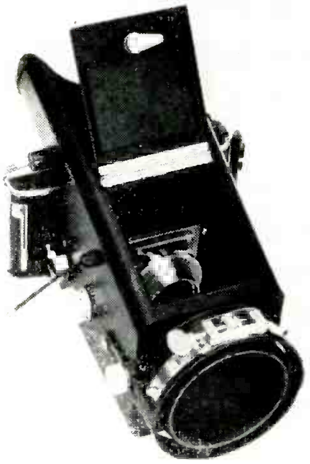




New Products

OSCILLOSCOPE CAMERA

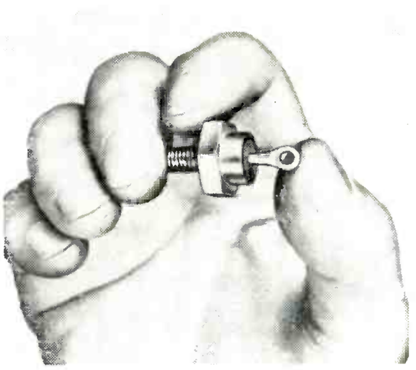
Oscilloscope camera, Model 196A, records full-sized oscilloscope patterns without distortion on Polaroid® Land film. Object to image size ratio is 1 to 0.9 to show a full 10 cm graticule width. Lens adjustments may be made without removing the camera from the scope. The camera weighs 9 lbs. and is equipped with a "quick-lock" tab for easy, one-hand mounting on the scope. While making an exposure, the operator can observe the pattern with both eyes. Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.



Circle 183 on Inquiry Card

SILICON RECTIFIER

Silicon Power Rectifier, Style 33, is rated at 37.5 a average at 25°C. ambient on a 5 x 5 x 1/16 in. copper heat sink. Peak inverse voltages range from 50 to 400 v. in 50 v. steps. Temperature range is from −75 to +175°C. Unit is mounted on a 11/16 in. hexagon stud base. Maximum height is 1 5/16 in. Typical forward dynamic resistance of 0.0035 ohms is achieved by diffused junction techniques. Syntron Co., 263 Lexington Ave., Homer City, Pa.



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New Products

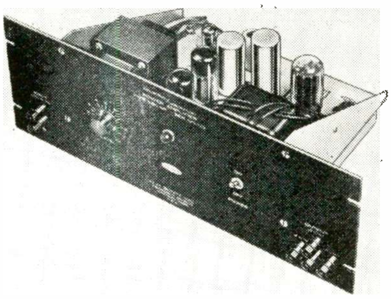
LEVELER AMPLIFIER

Broadband dc leveler amplifier, Model 700, features high gain. With external crystal detector and directional coupler, it holds r-f output from single frequency or swept microwave sources constant to ±1 db at a fixed frequency. With proper r-f components, power varies less than ±½ db over L, S, C and X bands at slow and fast sweep speeds. Operates with CW signals and internal square wave generator will modulate the r-f signal. Input may be 3 mv to 1 v. Output is 100 v. max. in the range of —50 to +100 v. Frequency response is dc to 100 KC. Alfred Electronics, 897 Commercial St., Palo Alto, Calif.

Circle 185 on Inquiry Card

POWER AMPLIFIER

Power Amplifier, 250-AR, is for production testing of loudspeakers, test signal distribution systems, etc. It fits a standard relay rack and occupies 7 in. panel space. Input and output terminals available front and rear. Binding posts on ¾ in. centers accept standard laboratory plugs or wires. High damping factor gives stable output and excellent regulation. Sensitivity—40 w output for 0.5 v. input. Features low distortion, wide frequency range (12 CPS to 60 KC), and low internal noise and hum. H. H. Scott, Inc., Instrument Div., Dept. P, 111 Powdermill Rd., Maynard, Mass.



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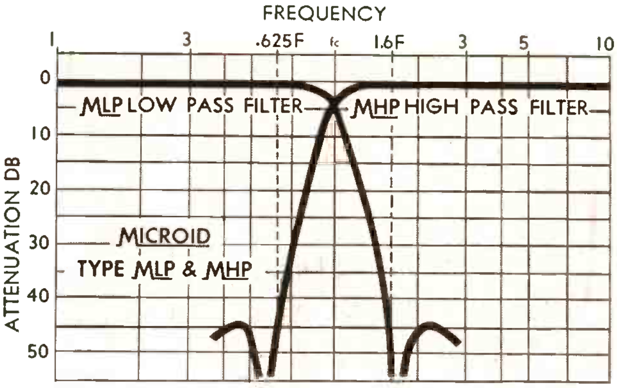

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International Electronic Sources

Up-to-the-minute abstracts of articles appearing in the leading foreign electronic engineering journals

ANTENNAS, PROPAGATION

Certain General Properties of Antenna Radiation Patterns. E. B. Korenberg. "Radiotek" 14, No. 9 (1959). 4 pp. It is shown that antenna radiation patterns have certain general characteristics whose particular cases correspond to the conclusions arrived at by H. F. Mathis (PIRE, No. 12, v42, 1954). It is also shown that for a transmitting and receiving antenna in free space there always exists a mutual orientation at which there is no coupling between them. Polarization properties of antenna directivity characteristics which have no energy zero points are determined. A conclusion is arrived at that with any polarization relation or direction of rotation, antennas without energy zero points have at least one direction in which their polarization characteristic is determined by the chosen polatization relation and direction of rotation. (U.S.S.R.)

Experimental Investigation of Distant Tropospheric Microwave Propagation with Diversity Reception. A. V. Prosin, I. P. Levshin and G. I. Sllobodenyuk. "Radiotek," 14, No. 10 (1959) 12 pp. The article deals with experimental investigation of statistical properties of tropospheric signal propagation at 3,000 Mc over a distance of 275 km, with diversity reception. Statistical analysis of test results provided data on the mean attenuation constant, antenna gain, distribution of rapid fading, and correlation of the diversity antenna spacing with respect to space and time. The test results thus obtained are in good agreement with the theory of microwave propagation, and can therefore be extended within certain limits to other frequencies and transmission distances. (U.S.S.R.)

A Swinging Beam Surface Wave Antenna. K. I. Grineva. "Radiotek," 14, No. 10 (1959). 8 pp. It was found that a double surface-wave microwave antenna has certain advantages as compared with a single one, namely a narrower radiation pattern and the possibility of controlling the direction of its beam by changing the relative phase of the two feeding voltages, without moving the antenna. Test results of a double circular surface-wave antenna with a small phase velocity retardation and certain design formulas are given. A device in the shape of a radial line for inducing surface waves on the antenna is described. For a narrower radiation pattern and larger angle of swing of the beam it will be probably possible to use treble and quadruple antennas of this type. (U.S.S.R.)

Large Area Grounding in Telecommunication Installations. O. Warmers, and A. Ziegler. "Nach. Z." Oct. 1959. 4 pp. It is proposed to replace the radial grounding network of technical equipment in telecommunication installations by a large area grounding mesh in which all grounding points are interconnected by a mesh of wires. Line screens are included into this mesh. Cable sheaths are also used as ground leads. This results in a very low grounding impedance. (Germany.)

Systems for Guiding Waves on End-Firing Radiators. G. Trentini. "Nach. Z." Oct. 1959. 8 pp. Systems for guiding the waves on end-firing radiators and data for their design are summarized. An investigation of some old and new forms by means of model tests has revealed that electromagnetic waves emerging from weakly concentrating primary radiators can be concentrated in an axial direction with the aid of traveling wave systems installed in front of these radiators. (Germany).

CIRCUITS

Schmidt Trigger with Junction Transistors. G. P. Petin. "Radiotek" 14, No. 9, (1959). 4 pp. Formulas for the calculation of threshold voltages are provided. The problem of threshold voltage temperature stabilization by means of thermistors is briefly examined. Circuits for the formation of rectangular waves from sinuseidal ones, for producing rectangular waves and rectangular pulses, for generating saw-tooth waves and linearly rising voltage pulses are proposed. (U.S.S.R.)

Frequency Discriminator Theory. V. M. Sidorov. "Radiotek" 14, No. 19, (1959). 11 pp. It is shown that the normal formula for the voltage at the output of a frequency discriminator with an imperfect voltage limiter is inaccurate, although it is used by a number of authors for analyzing the operation of FM receivers. Rigorous formulas for single ended and push-pull frequency discriminators are given. An approximate method of determining the rectified voltage is described. Formulas are also given for discriminators with parallel and series tuned circuits and imperfect voltage limiters. (U.S.S.R.)

Automatically Tuned Filters by Means of Reactance Tubes for Panoramic Radio Receivers. N. I. Svetlov. "Radiotek," 14, No. 9, (1959). 12 pp. An efficient way of extending the frequency range of panoramic amplifiers is by connecting automatically tuned filters in the first intermediate amplifier circuit. The author examines several possible reactance tube circuits and comes to the conclusion that a double RC phase shifting circuit is preferable. It provides a linear frequency characteristic in the scanning range. The author examines the frequency deviations, frequency range, stability and nonlinear distortion of the automatic filters and provides formulas for their design. (U.S.S.R.)

Superregenerative Reaction on an External Continuous or Pulsed emf. G. B. Ol'derrogge.

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 Ubertragung
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**
Rad. i Elek. **Radiotekhnika i Elektranika**
Iz. Acad. **Bulletin of Academy of Sciences USSR.**

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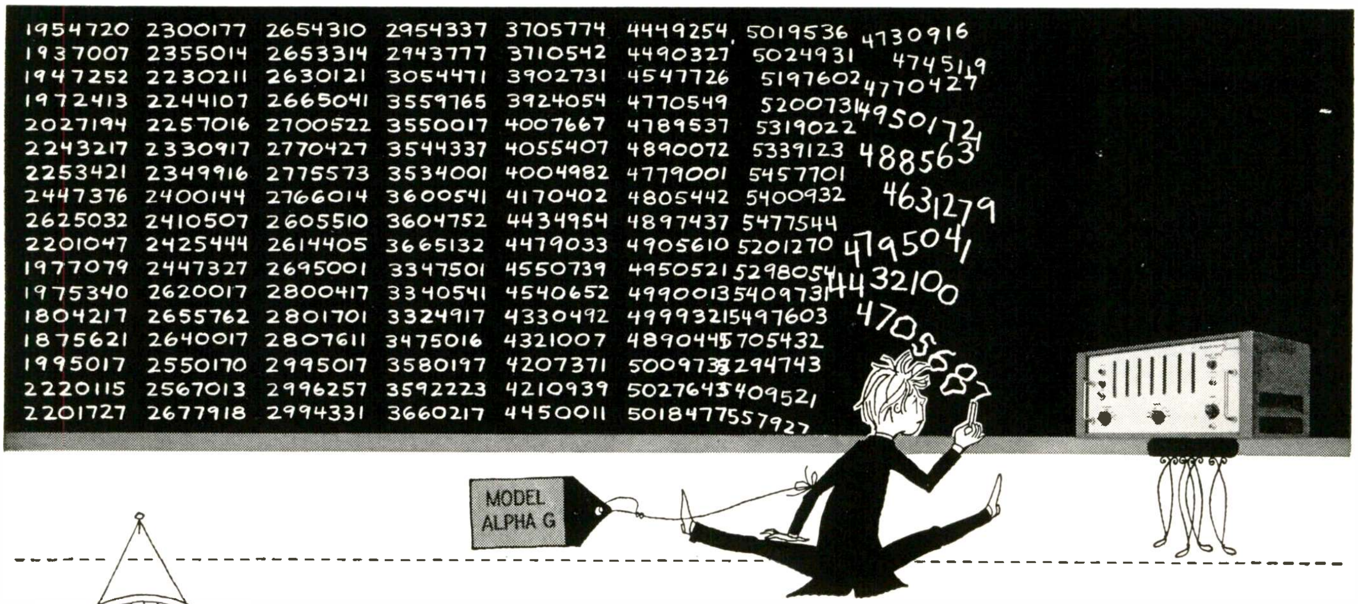
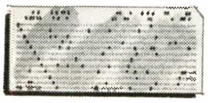
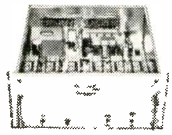


Alfonso Gotlentz, winner of the 1958 Data Conversion Competition, chalked up 16,792 Beckman counter readings in a record time of 7 hrs. 23 min. Unfortunately, Alfonso developed digitized eyeballs, a common occupational disability of mammalian data converters. Undismayed by the untimely end of his conversion career, he speedily procured electroluminescent contact lenses; now performs as a two-digit in-line display.

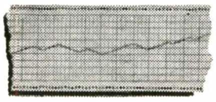
replacing Alfonso, these more clever converters . . .



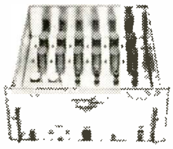
To put Beckman counter readings on punched IBM cards, you can get ----------------



Model 3110 (for serial punch) or Model 3100 (for parallel punch)

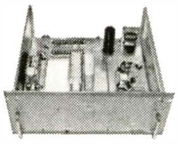


To make a strip chart record of changing counter readings, you may procure ---------

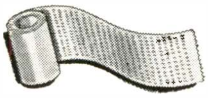


Model 3120, a digital-to-analog converter with resistance ratio output

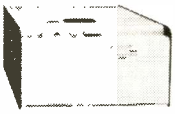
To make a punched paper tape of counter readings, ask for ---------------------



Model 3101 (drives a tape punch)



To print counter readings much faster than Alfonso, try ------------------------



Model 1452, a digital recorder that prints 7, 8 or 10 digits

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Circle 75 on Inquiry Card

"Radiotek." 14, No. 10 (1959). 10 pp. Reradiation of a superregenerative receiver in response to a pulse signal can be used as a reply signal in measuring distances. This possibility has been discussed for a long time, but only recently B. G. Rozhdestvenskii has designed such a responding device in the form of a metereological radiosond. In this connection the author of this article has attempted to investigate theoretically the operation of a superregenerative receiver responding to external pulses. Resonance and spectral characteristics of such a receiver in a linear operation condition are analyzed. Certain observations are made on its linear operating conditions. Theoretical conclusions are illustrated by practical examples. (U.S.S.R.)

An Aperiodic Phase Discriminator ("mixer" or vector amplifier), Yu. M. Bruk. "Radiotek." 14, No. 10 (1959). 7 pp. This amplifier circuit is capable of vector addition of subtraction of two different voltages ranging from a few cps to a few Mc. A paraphase amplifier is used in this circuit for obtaining anti-phase voltages instead of the usual center-tapped transformer. This circuit can also be used as a phase detector, especially suitable for low frequency or wide-band operation. With supply stabilization and modified grid circuits this device can also be used as a dc voltage comparator. It can also add or subtract pulse voltages and form pulses of a special shape. It can be used with advantage in computers. (U.S.S.R.)

On Analysis of Complicated Switching Circuits, V. F. Djachenko. "Avto i Tel." Oct. 1959. 9 pp. The paper deals with the analysis of the switching circuits which is based on determining the operation of all relays for any state of elements. There is considered the analysis of the switching circuits of II and H class with multi-winding relays and parameters ratios. (U.S.S.R.)

Use of Magnetic Amplifiers in Integrating Devices, S. B. Negnevitsky. "Avto i Tel." Oct. 1959. 4 pp. Two main cases of using magnetic amplifiers as integrating ones are considered. There are given approximate formlae for transfer functions without taking into account the amplifier constant and with it. Some drawbacks and advantages of the integrating amplifiers are determined. (U.S.S.R.)

Choice of Parameters of Rate Feedback of Magnetic Amplifiers by Means of Integral Estimating, L. V. Safris. "Avto i Tel." Oct. 1959. 11 pp. Integral estimating is used to determine inuuence of the rate feedback parameters on the transient process duration in the saturable reactor magnetic amplifier. (U.S.S.R.)

Operation of Switching Circuits in Transitional Periods, V. N. Roginsky. "Avto i Tel." Oct. 1959. 8 pp. The paper deals with revealing possible errors in the functioning of switching circuits during the operation and release times of separate relays. A procedure is recommended that makes it possible to remove these failures. (U.S.S.R.)

Theory and Design Problems of Symmetrical Transformer-Coupled Transistor Converters, A. Goral and J. Majka. "Prace ITR." Vol. III, No. 2(8). 17 pp. On the basis of the work by T. Konopinski and M. Politowski "Design of dc push-pull transistor converters," published in copy 3(6) of "Prace ITR," 1958, the operation of a symmetrical transformer-coupled transistor converter has been discussed. Conditions of work of the converter elements have been analyzed. It has been proved that the expression for working frequency of the converter was of general nature and no additional simplifying assumptions (linearity of flux changes, etc.) were required. (Poland.)

Comments on the Work by A. Goral and J. Majka "Theory and Design Problems of Symmetrical Transformer-Coupled Transistor Converters," T. Konopinski. "Prace ITR." Vol. III, No. 2(8). 7 pp. in connection with the work by A. Goral and J. Majka entitled as above, an analysis of operation of push-pull transistor converters has been carried out. It has been shown that the shape of characteristics of currents flowing in the second transformer winding depends upon the kind of material used for its core. In the case of using a material with "constant" permeability the converter working frequency was related to the inductance of the transformer windings. (Poland.)

COMMUNICATIONS

Potential Resistance to Noise of Fading Signals, L. M. Fink. "Radiotek." 14, No. 9 (1959). 10 pp. In the previous article in "Radiotek." No. 1 (1959), reception of signals with an indeterminate phase was discussed. This article deals with the determination of an optimum criterion for a single reception of discrete signals with fluctuation noise when the signals are subject to a Rayleigh type probability distribution fading. Minimum error probabilities as functions of the radio of the signal element energy to the specific noise power were calculated for certain types of systems. (U.S.S.R.)

On Increasing Effectivity of Telemetering, N. V. Pozin. "Avto i Tel." Oct. 1959. 6 pp. (U.S.S.R.)

Circuit Design of AG Type Rural Telephone Automatic Exchange, J. Trechcinski, J. Kibortt. "Prace ITR." Vol. III, No. 2(8). 53 pp. Basic design problems of rural automatic terminal exchanges elaborated for Polish conditions are discussed. These exchanges having a capacity of 25 or 50 subscribers are based on "3000" and "600" type relays and on uniselectors. They include connecting sets for local traffic and separate ones for connections with external network. Cooperation with an higher order exchange is based on open directing digits. (Poland.)

51-L Type Carrier Current Systems for Balanced Pairs, M. Toutan, et al. "Cab. & Trans." Oct. 1959. 3 pp. Carrier current systems for balanced pairs using 51-L equipment with 12, 24, 36 and 60 channels (4-wire circuits) or 12+12 channels (2-wire circuits) constitute, because of their common principle and working method, a closely related family. (France.)

The Frequency Stability of Astable Multivibrators Equipped with Transistors. "Nach. Z." Oct. 1959. 5 pp. An analysis is carried out relating to the processes determining the time constants in astable multivibrators with transistors. The analysis yields relatively simple terms for the voltage sensitivity and temperature sensitivity of the frequency and these terms agree fairly well with measured results. (Germany.)

New Recommendations Adopted by the First C.C.I.T.T. Study Group in December 1958. "Cab. & Trans." Oct. 1959. 8 pp. This paper is an account of the main points of the recommendations adopted in December 1958 by the first C.C.I.T.T. Study Group, relating to presently important transmission questions, which are the following: 12 Mc/s transmission systems on 2.6/9.5 mm coaxial pairs; noise conditions for telephone and program transmission on carrier current systems; various methods or devices for telegraphic and phototelegraphic transmission. (France.)

Errors in Ionospheric Forecasting Critical Frequencies for the E and F Layers, C. M. Minnis and G. H. Bazzard. "E. & R. Eng." Oct. 1959. 4 pp. The error in forecasting the m.u.f. for a point-to-point circuit consists of two parts: (a) the error in forecasting solar activity and the corresponding vertical-incidence critical frequency or m.u.f. factor; (b) the error in calculating the m.u.f. for a given set of conditions in the ionosphere. Only (a) can be considered as a true forecasting error. (England.)

COMPONENTS

Electro-Mechanical Filters for Use in Telecommunication Equipment, G. L. Grisdale. "Brit. C.&E." Nov. 1959. 5 pp. Electromechanical filters use the compliance and mass of suitably shaped bodies to produce a structure with mechanical filtering properties analogous to electrical wave-filters. Electrical energy is converted to mechanical energy in a transducer, filtered mechanically and re-converted to electrical energy. Because mechanical losses are often smaller than the equivalent electrical losses, the mechanical filter can have a superior performance to the equivalent electrical structure in a smaller space. (England.)

COMPUTERS

Synthesis of Automatic Pulse Linear Systems Using Dynamic Criteria, L. N. Volgin. "Avto. i Tel." Oct. 1959. 7 pp. The transfer function of the system is found as a product of a minimum polynomial which the given part of the system is reduced to, multiplied by the artificial part of the system introduced to get desirable quality. The method described makes it possible to use digital computers when calculating the automatic pulse linear systems. (U.S.S.R.)

Determination of Some Errors on Electronic Analog Computers, N. L. Sosensky. "Avto. i Tel." Oct. 1959. 11 pp. (U.S.S.R.)

Use Your Analogue Computer as a Transfer Function Analyser, K. C. Garner. "Brit. C.&E." Nov. 1959. 3 pp. Besides its normal applications as an integro-differential analyser and systems simulator, an analogue computer using dc amplifiers is an extremely useful and versatile tool for ordinary laboratory purposes. In particular it can be used as a complete transfer function analyser for measuring control system frequency responses, or indeed systems simulated within the same computer. (England.)

The Use of Computers for Optimal Planning, C. M. Berners-Lee. "Brit. C.&E." Nov. 1959. 5 pp. Optimal planning is a field in which computers have been highly successful. This article describes some of the techniques used and the kind of problems to which they are applied. (England.)

Some Aspects of the Logical and Circuit Design of a Digital Field Computer, I. F. Brown and B. Meltzer. "El. Eng." Oct. 1959. 3 pp. The principles of a new type of digital computer for the solution of field problems are described. By making the calculation at all the lattice points of the field simultaneous, this computer shortens computation time very greatly. A unitary (abacus) rather than binary or decimal arithmetic is used. The computation is done by lattice units, one associated with each lattice point of the field. The synthesis of lattice units from simpler basic units is described. (England.)

CONTROLS

On Evaluating Quality of Automatic Nonlinear Systems at Random Noises, E. P. Popov. "Avto. i Tel." Oct. 1959. 7 pp. The paper deals with a new application of a combination of statistic and harmonic linearizing methods to the investigation of the random disturbance effect on stability and dynamic properties of nonlinear automatic control systems. In this connection there was made an attempt to develop the rough theory of these phenomena with a control system design given to illustrate it. (U.S.S.R.)

Pontrjagin Maximum Principle in the Theory of Optimum Systems, L. I. Rozonoer. "Avto. i Tel." Oct. 1959. 15 pp. There are expounded most important problems of automatic control which are connected with proofing and using Pontrjagin maximum principle in the theory of optimum systems. The paper yields also some new results. The problem of optimalizing in the case of free right branch of the trajectory is considered in the first part of the paper. In the second part the maximum principle is formulated for the boundary conditions of more general type. In the third part there is ascertained connection of the dynamic programming method with the maximum principle, the way of solving optimalizing problems in discrete linear systems is proposed and some ideas are described about using the maximum principle when solving problems of a certain class which are connected with the theory of dynamic accuracy of automatic control systems. (U.S.S.R.)

Optimization of Systems Including Considerable Nonlinear Elements, E. P. Merkulova. "Avto. i Tel." Oct. 1959. 10 pp. There is described the method of determining optimum weight function of the linear part of the stationary system including any number of given considerable nonlinear elements. The input signal is a random stationary time function consisting of the useful signal and the noise. Linearization of the nonlinear elements is realized by means of the statistical method. (U.S.S.R.)

Optimum Control of Systems with Two Control Responses, E. A. Rozenman. "Avto. i Tel." Oct. 1959. 5 pp. There is considered the problem of the optimum transient process in the system with two control functions. The system is an electric motor that is controlled by means of independent change of the anchor current and the disturbance current. (U.S.S.R.)

A-C Servosystems with Signal Dependent on Error and its Derivative, N. P. Vlasov. "Avto. i Tel." Oct. 1959. 9 pp. Ac servosystems are considered. Supposing the signal depends on the error and its derivative there are determined the transfer functions of the linear network and of the servosystems stabilized with the differential network and the rate feedback. (U.S.S.R.)

Semigraphical Method of Calculation of Steady Speed of Pneumatic Servomechanism, V. N. Dmithriev, V. I. Chernyshev. "Avto. i Tel." Oct. 1959. 8 pp. The paper deals with the method of calculation of the steady motion speed of the piston pneumatic servosystem. Calculation characteristics of the servomechanism are compared with the experimental ones. (U.S.S.R.)

Present State of Research Work on Technological Problems of Scintillators in the Tele- and Radio Research Institute, Wladyslaw Riedl. "Prace ITR." Vol. III, No. 2(8). 6 pp. In the Tele- and Radio Research Institute the research work on scintillators is carried out in the following directions: 1. technology of high purity scintillation luminophors. 2. technology of plastic scintillators. 3. technology of monocrystalline scintillators. 4. radiometering and optical measurements of scintillators. So far technology has been elaborated of pure anthracene and p-terphenyl, and of polystyrene, anthracene and anthracene-terphenyl scintillators with or without (using or not using) a wavelength shifter (POPOP). The work on growth of anthracene monocrystals is coming to its end. (Poland.)

Describing the Transfer Characteristics of Control Systems for Time-Dependent Disturbances, K. Lichtblau. "rt" Sept. 1959. 5 pp. Control system characteristics can be calculated with some advantage if the disturbances are assumed not to be of a step nature but to be time-dependent. Such calculations, first of all, are more useful for practical applications and, furthermore, are of greater general validity and to a higher degree representative. This is illustrated by an example dealing with linear disturbances. (Germany.)

The Mutual Influence of the Controlled Variables in Multiple Control Loop Systems, R. Starkermann. "rt" Sept. 1959. The stability of a system containing a dual control loop is investigated with the help of a simple example. This represents a simple case selected from the wide field of systems with multiple control loops. These consist of a number of idealized proportional controllers, each feeding one regulating unit, so that mutual coupling between the control loops can take place only within the controlled plant. The system stability is determined for a specified amount of coupling in the controlled plant. (Germany.)

GENERAL

The Theory of Nonlinear Oscillations in Radio Technology, G. Sh. Kevanishvili. "Radiotek." 14, No. 9 (1959). 2 pp. A method of solving differential equations which is a variation and development of the method of "slowly changing amplitudes" is described. By means of this method it becomes possible to investigate oscillating systems with one degree of freedom. (U.S.S.R.)

Penetration Effect in Tape Recording, V. A. Geranin. "Radiotek." 14, No. 10 (1959). 3 pp. It is interesting both from the theoretical and practical point of view to determine whether the depth of magnetization penetration on the tape depends on the recorded wavelength on the tape or the frequency of the recorded signal. The author has determined experimentally that it is a function of the wavelength of recording on the tape and does not depend on the frequency of the signal. The assertion that the penetration effect is identical with the surface magnetic effect is incorrect. Since modern tapes have a very thin magnetic layer it is difficult to assume in them the presence of any appreciable eddy currents which would affect the distribution of residual magnetization along the thickness of the tape. (U.S.S.R.)

Evaluation of the Stability of a Triggered Threshold Device, I. M. Kogan and I. B. Pogozhev. "Radiotek." 14, No. 10 (1959). 7 pp. Instability of such devices is due to false operation between the control signals, mainly caused by fluctuating noise which produces voltage overshooting at the output of the device. This article deals with the probability of false operation of triggered threshold devices of various types. Since the overshoots have to operate an actuating device through a low frequency channel, the authors examine the effect of noise, represented by a gaussian uncorrelated stationary stochastic process, on the input signal of a low-frequency channel. (U.S.S.R.)

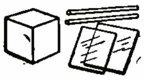
INDUSTRIAL ELECTRONICS

High-Vacuum Electron-Beam Welding, Enis B. Bas and Gregor Cremosnik. "Vak. Teck." Oct. 1959. 8 pp. By focusing an electron beam on to a very small section of a solid metal surface local melting can be achieved. This phenomenon can be used for fusion-welding of two pieces of metal in high vacuum. The power and power densities of the electron beam required for the process have been evaluated for a number of metals and the results are summarized in a table. The electron optics necessary to obtain the required welding power are described in detail for the case of an electron-beam welding equipment of the two chamber type. The advantages of such a system as compared with single-chamber arrangements are discussed. (Germany.)

Microwave Plasma Burner, W. Schmidt. "El. Rund." Nov. 1959. 3 pp. Described are constructional details and mode of operation of a plasma burner of coaxial design complete with microwave generator and its continuous-wave magnetron for the 2420-Mc/s range. (Germany.)

An Electronic Tachometer for Automobiles, M. J. Wright. "El. Eng." Oct. 1959. 4 pp. An electrical signal having a fundamental frequency proportional to engine speed is obtained from the automobile ignition system. A novel circuit, which combines filtering and limiting functions, removes undesired oscillations and feeds a fixed amplitude square wave to a diode pump frequency measuring circuit which is calibrated directly in terms of engine speed. (England.)

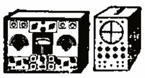
ACCESS A Static Switching System Using Cold-Cathode Tubes, R. W. Brierly. "El. Eng." Nov. 1959. 9 pp. The great strides taken recently in automating production processes has resulted in very complex control systems. The majority of these are of the on-off type using relays as the logical elements. Above a certain level of complexity, it becomes difficult to maintain a high standard of operating efficiency with such equipment. A search has begun for more reliable alternatives to the electro-mechanical relay and systems using static devices have started to emerge. One such system, using cold-cathode tubes, is described. (England.)



MATERIALS

Magnetostriction and Magnetostrictive Materials, A. Smolinski. "Roz. Elek." Vol. V, No. 2. 27 pp. In the first part of the paper, physical properties of ferromagnetism are discussed on the background of the atomic theory. The author discusses non-compensated magnetic moments of the atom, which result from the rotary movements of electrons around their own axes. Unidirectional arrangement of these magnetic moments in the crystalline network characterizes ferromagnetic materials. The domain structure—connected also with magnetrostrictive phenomena — explains the shape of static and dynamic magnetization curves. (Poland.)

An Apparatus for the Study of Magnetostriction in Ferrites, P. Fenouillet & R. Mathieu. "Cab. & Trans." Oct. 1959. 8 pp. The importance of the knowledge of the magnetostrictive properties of a magnetic material for the development of a new industrial magnetic product is a well-known fact. For this purpose the authors have built a device which directly displays the curve representing the magnetostriction factor of a ring-shaped sample of the material as a function of the intensity of the applied magnetic field. (France.)



MEASURE & TESTING

Determination of the Transient Process by Means of the Characteristic Points Method, in a Video-Pulse Passing Through a Low-Pass Filter, B. V. Elizarov, G. N. Krylov and G. I. Makarov. "Radiotek." 14, No. 10 (1959). 9 pp. Formulas, tables and graphs are given for calculating and plotting the transient process in a video-pulse passing through a low-pass filter with an arbitrary number of sections and arbitrary terminations. Calculations are based on the methods described in the authors' first article ("Radiotek" 14, No. 2) and concrete examples for single-pulse disturbances and matched loads, arbitrary resistive loads and capacitative loads at one end of the filter are appended. (U.S.S.R.)

A Method of Measuring Instantaneous Frequency of Frequency-Modulated Waves, A. A. Vasil'ev. "Radiotek." 14, No. 10 (1959). 9 pp. The reaction of a linear circuit to frequency modulated waves can be expressed by means of an instantaneous frequency. If the frequency of the input voltage changes sufficiently slowly a quasi-stationary solution is possible in which the output voltage or current of the circuit depend only on the instantaneous frequency of the input voltage. In this article a new method of measuring rapidly changing frequencies. Basic relations determining this method and its limiting accuracy are provided. (U.S.S.R.)

Experimental Determination of Characteristics of Position Power Servosystems, M. B. Tumarkin. "Avto. i Tel." Oct. 1959. 5 pp. There is considered the method of the analysis and the test of position servosystems that permits to directly record speed characteristics of the systems. (U.S.S.R.)

On Design of Electronic Functional Two-Input Generators, V. B. Smolov. "Avto i Tel." Oct. 1959. 7 pp. There are considered electronic functional generators to simulate functions of two arguments the design of which is based on the standard computer amplifier circuit, the input and the feedback of the amplifier have controlled resistances. Block-diagrams of generators to simulate the characteristic functions of two arguments are given. (U.S.S.R.)

Phase Method of Testing Frequency of Normal Oscillators by Means of a Standard Signal of 16 kc/s of a GBR Station, Andrzej Smolarski. "Prace ITR." Vol. III, No. 2(8). 4 pp. A method has been elaborated for quick and frequent testing of frequency of normal oscillators hy means of standard radio signals having a stability of the order of 10^{-9}. This method renders possible to obtain, by simple means, high accuracy of frequency in ordinary quartz oscillators of technical class. (Poland).

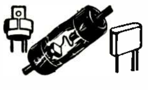
Phase Shift Measurement in Video Band, Jacek Kamler. "Prace ITR." Vol. III, No. 2(8). 6 pp. In connection with the research work on color television an instrument for phase shift mensurement based on the heterodyne principle is being developed. The report includes foundations and the general idea of the device. The measured frequencies range from 200 Kc/s up to 7 Mc/s, and the accuracy of approx. 1° is anticipated. Investigations on the design of a control vectorscope are carried on simultaneously. (Poland).

Investigations on Climatic Resistance of Telephone and Radio Elements and Equipment, Rubin Feryszka. "Prace ITR." Vol. III, No. (28). 3 pp. The different kinds of climatic investigations carried out by the Climatic Research Section of the Tele- and Radio Research Institute are presented. The equipment used is described and the first investigations made are quoted. (Poland).

RADAR, NAVIGATION

Effect of Precipitation on Radar Contrast. K. S. Shifrin and N. S. Kokovin. "Radiotek", 14, No. 9 (1959). 7 pp. The visibility of an object on a radar screen depends on the contrast it forms with the background. The study of the contrast was divided into three portions: the atmospheric between the object and the radar set, the electrical in the set itself and the visual between the radar screen and the brain of the operator. The electrical contrast was investigated theoretically and the other two experimentally. The relative mean square error of the contrasts calculated from the intensity of precipitation in the area of the object and the transmission function as compared with measured results was of the order of 25%. (U.S.S.R.)

Bright Radar Displays Through the Use of Storage Tubes, L. W. Whitaker. "Brit C.&E." Nov. 1959. 6 pp. Storage tubes are today available in many forms and are becoming extremely used for data recording, conversion and transmission. An overall survey of the development of these tubes has already appeared. This article deals more specifically with the uses of the direct-view and scan-conversion type storage tubes for increasing the brightness of radar displays. (England).



SEMICONDUCTORS

Matching in Transistor Tuned Amplifiers. V. V. Lebedev. "Radiotek" 14, No. 9, (1959) 5 pp. Conditions for maximum gain in transistor tuned amplifiers, the matching of their stages and interstage losses are examined. Cases of single and coupled tuned circuits are examined. In the first instance the author arrives at the condition of the so called "least detuning" and in the second he arrived at the conclusion that maximum gain is obtained with-critical coupling. (U.S.S.R.)

Controlled Rectifiers and Unijunction Transistors, Fundamentals and Operation, R. Tonndorf. "El. Rund." Nov. 1959. 2 pp. Two novel semiconductor components have lately been developed in the United States: The silicon controlled rectifier and the unijunction transistor (SCR and UJT respectively). The former will pass a relatively large current within microseconds after the steady-state voltage has been slightly increased; the latter is likewise basically a switching device the switching properties of which are the result of conductance modulation. (Germany).

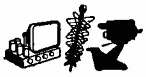
The Measurement of Semiconductor Diode Switching Characteristics, J. N. Barry, and S. F. Fisher. "Brit. C.&E." Nov. 1959. 4 pp. The measurement of the reverse switching characteristics in semiconductor diodes is of considerable importance in connection with the use of such devices in pulse systems for communication applications such as electronic telephone exchanges. A particular test equipment which evaluates the diode in terms of its effective resistance at a pre-selected time after switching is described in some detail. (England).

A Simple Transistor Tester, G. G. Yates. "El. Eng." Oct. 1959. 2 pp. A simple and inexpensive instrument is described for the measurement of the more useful parameters of low power a-f and r-f transistors. (England).

Compound Semiconductors, D. A. Wright. "El. Eng." Nov. 1959. 7 pp. This article first discusses the more important parameters governing the behavior of semiconductors. These considerations are then applied to the various types of semiconducting compound which have so far been studied, and values of the mean parameters are quoted. The usefulness of the materials for different applications is discussed in the light of these figures. In each type of compound, definite trends are observed in the relationship between the semiconducting parameters and other physical properties. (England).

Transistors in Magnetic Fields, Effect on Characteristics, P. C. Trivedi and G. P. Srivastava. "E. & R. Eng." Oct. 1959. 3 pp. The characteristics of pnp alloy junction transistors, connected in a common-emitter amplifier configuration with normal fixed bias, have been studied when the transistors are subjected to a magnetic field. The current amplification factor is measured in the audio-frequency region. As far as the cut-off frequency is concerned, the behavior is entirely different from the behavior of point-contact transistors. (England).

Transistor 'h' Parameters, R. Hutchins, and J. D. Martin. "E. & R. Eng." Oct. 1959. 5 pp. This article describes an experimental investigation made in order to develop a test-set suitable for the measurement of the complex parameters of the quadripole representing the linear performance of a transistor with small-signal input. (England).



TELEVISION

The Mean Component of a Television Signal and Information on the Black Level, S. B. Gurevich and R. E. Bykov. "Radiotek." 14, No. 9 (1959) 6 pp. The relation between the information on the black level, the information on the mean illuminance of the image and the mean component of the television signal is examined. The information on the black level transmitted by television tubes is evaluated. The authors arrive at the conclusion that if there is the possibility of correctly establishing the black level it is possible to transmit the corresponding changes in the mean illuminance. With nonlinear transformation characteristics the information on the mean illuminance is related to the information on the black level in a single valued but complicated manner. (U.S.S.R.)

Video Tape Cutting Attachment, H. Friess. "El. Rund." Nov. 1959. 2 pp. Tape-recorded video information has to be cut just like a film or a magnetic tape for sound reproduction to shorten or transfer certain scenes. The author describes the Video Finder, an attachment for the Ampex machine, permitting to hear the sound and see the picture and thus facilitating quick location of cutting points. (Germany.)

Comparison of Build-ups in Electronics and Picture Tube in Color Television, P. Neidhart. "El. Rund." Nov. 1959. 5 pp. Two types of build-up transients occur in color-television receivers: those omnipresent and those generated by commotion scenes. The former type comprises electronic and electron-optical phenomena distorting the hue and changing the luminance. The latter type transients originate from the phosphor inertia of the tube screen. The author shows how these events should be treated analytically and what chances there are to establish impirical relations on the basis of observation. (Germany.)

A Vectorscope Unit, K. G. Freeman. "El. Eng." Nov. 1959. 4 pp. A vectorscope unit is described which provides a vectorial display of NTSC-type chrominance signals. Of high sensitivity, it incorporates a number of features, including means for continuously checking gain and quadrature adjustments. The instrument permits rapid assessment of chrominance signal phase and amplitude characteristics—which are of particular importance in direct-decoding operation of single gun color television tubes. (England.)

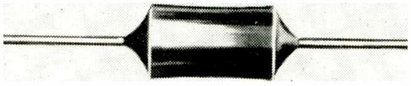
N.T.S.C. Color-Television Signals, J. Davidse. "E. & R. Eng." Oct. 1959. 7 pp. This article deals with some statistical properties of N.T.S.C. color-television signals obtained from normal picture material. Numerical data is given on the average signal excursion of the I and Q signals and on the distribution of the momentary levels of the sub-carrier amplitude and of the luminance signal. Some measurements on monochrome signals are included. The measurements are discussed briefly and a short description is given of the measuring circuits. The given values are restricted to "first-order statistics," no measurements have been carried out on correlation problems and the like. (England.)

* * *

New Products

RESISTOR

Type 1274 resistor has maximum resistance of 1 megohm. Previous max. resistance for a unit of this size was 250K. Dimensions are 3/16 inches diameter by ⅜ inches length,

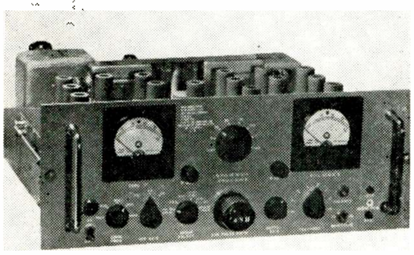


with a maximum wattage rating of 0.25 watts. Resistance tolerances as close as 0.01% and temperature coefficients as low as ±3 ppm/°C can be obtained. Type 1274 meets all characteristics of MIL - R - 93B, Amendment 3, except physical size. The Daven Company, Livingston, N. J.

Circle 228 on Inquiry Card

PDM SIGNAL SIMULATOR

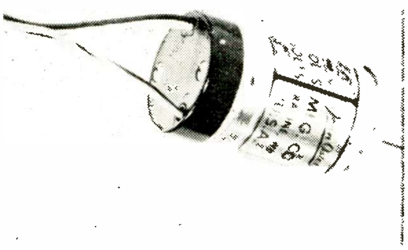
Model 52, signal simulator, generates pulse trains identical to the video data output of a standard telemetry receiver. It provides a wide range of pulse formats both stepped and continuous. Output signals exceed accuracy requirements of "Telemetry Standards for Guided Missiles," IRIG Document No. 103-56. With the front panel controls maximum, flexibility for creation of the pulse trains is available. Instrument Corp. of Florida, Post Office Box 1226, Melbourne, Fla.



Circle 229 on Inquiry Card

SIZE 8 SYNCHRO

A 400 cycle synchro control transformer with min. error variations from —55°C to +125°C, type 4227-01, has a stainless steel housing. Input voltage is 11.8 v, input current

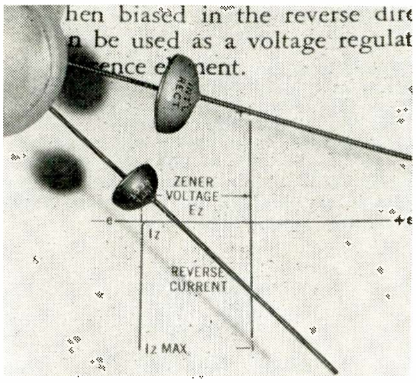


0.030 a, input watts 0.073 w, output voltage 22.5 v, phase shift 8.5° (lead), rotor resistance 316 ohms, stator resistance 67 ohms, Z_{ro} 500 + j1937 ohms, Z_{so} 79 + j350 ohms, Z_{rss} 594 + j182 ohms, null voltage 30 mv and max. error from E.Z ± 7 min. John Oster Mfg. Co., Avionic Div., 1 Main St. Racine, Wis.

Circle 230 on Inquiry Card

SILICON ZENER DIODES

Line of silicon zener diodes designed for commercial equipment applications demonstrate low zener impedance values and very sharp zener "knees." Available in 500 mw and 1 w rated series, and standard RETMA 10% voltage steps from 5.6 to 27 v. All types embody a 3-layer seal assuring high resistance to humidity, shock, vibration, temperature extremes and other adverse environmental conditions. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.



Circle 231 on Inquiry Card

for voltage stabilizing...
rectifying...controlling...

THERE'S A RAYTHEON GAS DIODE TO MATCH YOUR TOUGHEST POWER-SUPPLY 'SPEC'

VOLTAGE REGULATOR TUBES

Type	Base	D.C. Operating Voltage	Current Range	Regulation
OA2WA **CK6626/OA2WA** **CK6073, OA2**	Miniature	150 v.	5 — 30 ma.	2 v.
OB2WA **CK6627/OB2WA** **CK6074, OB2**	Miniature	108 v.	5 — 30 ma.	1 v.
OC2	Miniature	75 v.	5 — 30 ma.	3 v.
CK5787	Subminiature	98 v.	5 — 25 ma.	3 v.
CK5787WA	Subminiature	98 v.	5 — 25 ma.	1.5 v.
CK6542	Subminiature	148 v.	5 — 25 ma.	2 v.
Corona Voltage Regulators				
CK1038	Subminiature	885 — 915 v.	5 — 55 μa.	15 v. max.
CK5962	Miniature	700 v.	2 — 55 μa.	15 v. max.
CK6437	Subminiature	700 v.	5 — 125 μa.	15 v. max.
CK6438	Subminiature	1200 v.	5 — 125 μa.	20 v. max.

CIRCLE 148 ON READER-SERVICE CARD

VOLTAGE REFERENCE TUBES

Type	Base	D.C. Operating Voltage	Current Range	Regulation	Voltage Jump Max.
CK5651	Miniature	85 v.	1.5 — 3.5 ma.	1.5 v.	0.1 v.
CK5651WA	Miniature	85 v.	1.5 — 3.5 ma.	1.5 v.	0.005 v.
CK5783	Subminiature	85 v.	1.5 — 3.5 ma.	3.0 v.	0.1 v.
CK5783WA	Subminiature	85 v.	1.5 — 3.5 ma.	2.4 v.	0.005 v.
CK6213	Subminiature	130 v.	1.0 — 2.5 ma.	1.0 v.	—

CIRCLE 149 ON READER-SERVICE CARD

COLD CATHODE RECTIFIER TUBES

Type	Construction	Base	Max. Peak Inverse Voltage	Peak Plate Current	Max. D.C. Output Current
OZ4A/1003	Double Diode	Octal	880 v.	330 ma.	110 ma.
CK1005	Double Diode	Octal	450 v.	210 ma.	70 ma.
CK1006	Double Diode	4-Pin.	1600 v.	600 ma.	200 ma.
CK1007	Double Diode	Octal	1200 v.	510 ma.	85 ma.
CK5517	Diode	Miniature	2800 v.	100 ma.	12 ma.
CK6174	Diode	Miniature	2800 v.	30 ma.	3 ma.
CK6659	Diode	Subminiature	2800 v.	40 ma.	8 ma.
CK6763	Diode	Miniature	2800 v.	100 ma.	12 ma.

CIRCLE 150 ON READER-SERVICE CARD

Detailed technical data bulletins on any of these types are yours for the asking. Better yet, ask to have a Raytheon sales engineer drop in for a firsthand appraisal of your application and prototype needs — no obligation, of course. Write directly to Dept. 2528.

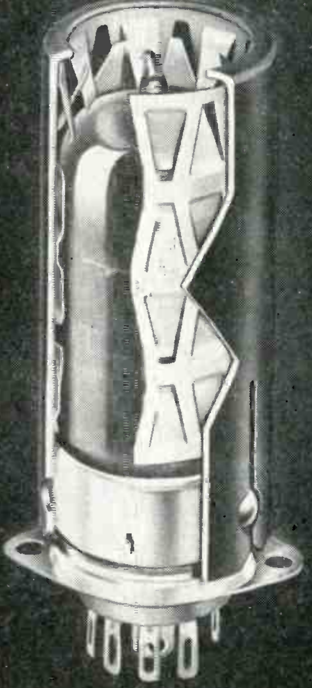
Small order and prototype quantities available directly from your local Raytheon electronics parts distributors.

Want to Receive Our Technical Data Regularly? We'll be happy to keep you informed of latest technical developments, new products, design tips, etc. An application for addition to our new Technical Information Mailing List is yours for the asking. Write on your company letterhead directly to: W. J. Davis, Dept. 2528, at division address listed.

RAYTHEON

Industrial Tube Subdivision
INDUSTRIAL COMPONENTS DIVISION
57 Chapel Street, Newton 58, Massachusetts

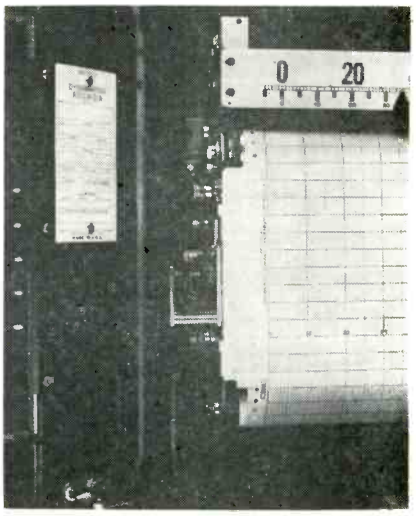
RELIABLE MINIATURE AND SUBMINIATURE TUBES • HARD-GLASS POWER TUBES • GAS TUBES • CATHODE RAY TUBES • STORAGE TUBES
LOS ANGELES, NOrmandy 5-4221 • **SAN FRANCISCO,** FIreside 1-7711 • **CHICAGO,** NAtional 5-4000 • **KANSAS CITY,** Plaza 3-5330
CLEVELAND, WInton 1-7716 • **BALTIMORE,** SOuthfield 1-1237 • **ORLANDO, FLA.,** GArden 3-1553 • **NEW YORK,** Plaza 3-3900 • **BOSTON,** BIgelow 4-7500
GOVERNMENT SALES: BOSTON, BIgelow 4-7500 • **WASHINGTON, D. C.,** MEtropolitan 8-5205 • **DAYTON,** BAldwin 3-8128



New Products

MULTI-SPEED CHART DRIVE

Chart drive can be field mounted on any standard Bristol Dynamaster strip chart recorder. Unit allows instant dialing of any 6 different chart speeds without the need of stopping the chart. It can be field mounted directly on change gear hubs. Two standard models of the multi-speed chart drive, having overall ratios to 16:1 and 32:1 are available for every different chart drive gear train used in the standard Dynamaster recorder. Insco Co., Div. of Barry Controls Inc., Groton, Mass.



Circle 232 on Inquiry Card

ATTENUATOR

Variable Fixed Attenuator, Type 609, features the following specs: (electrical) waveguide type, RG-67/U (Alum.); frequency range, 8.2 to 12.4 KMC; attenuation range, 0.3 to 30.0 db; insertion loss, 0.3 db max. (mechanical) Waveguide size O.D., 1.0 to 0.5 ins., flange type, UG-135/U; insertion length, 3.50 inches; weight, 3.5 ounces; finish, Iridite; dial setting may be secured with a screwdriver operated lock. Waveline Inc., Caldwell, N. J.

Circle 233 on Inquiry Card

HAVE TELECHROME

VIDEO TRANSMISSION TEST EQUIPMENT

WILL TRAVEL

IT'S PORTABLE

1003-C VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Produces multi-frequency burst, stairstep, modulated stairstep, white window, composite sync. Variable duty cycle. Regulated power supply.

1004-B VIDEO TRANSMISSION TEST SIGNAL RECEIVER

Very rapid and accurate measurement of differential phase and differential gain characteristics of video facilities. Responds to standard stairstep test signal modulated with 3.58 mc, or any differential phase or gain test signal.

1005-A VIDEO TRANSMISSION TEST SET

1005-A1 — Produces composite television waveforms suitable for measuring amplitude vs. frequency; differential gain vs. amplitude; dynamic linearity; differential phase vs. amplitude; high frequency transient response; low frequency transient response; low frequency phase of streaking, smears, mismatches; and other video characteristics.

1005-A2 — Supplies composite EIA Sync, blanking, horizontal and vertical drive signals and regulated B + power for itself and 1005-A1. Features magnetic core binary counters.

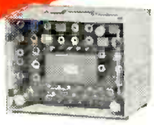
1008-A VERTICAL INTERVAL KEYER

Permits test and control signals to be transmitted simultaneously with program material, between frames of TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signal. Test signals are always present for checking transmission conditions without impairing picture quality. The home viewer is not aware of their presence.

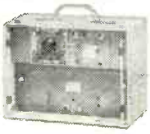
1073-CR SINE SQUARED (SIN^2) —SQUARE WAVE GENERATOR

Produces new waveform for testing TV or other pulse unit or system for amplitude and phase characteristics. Sin^2 — Square Wave pulse is equivalent to TV camera signal and is more sensitive than a Square Wave in indicating ringing. Video test signal adjustable for 1.0 volts or 1.4 volts peak to peak. Now in use by major TV networks and telephone companies.

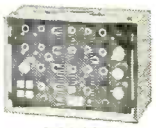
ALSO ASK ABOUT TELECHROME SPECIAL EFFECTS GENERATOR



Waveform Generator



Remote Control Unit



Switching Amplifier

Full Specifications & Details Available on Request

TELECHROME MANUFACTURING CORP

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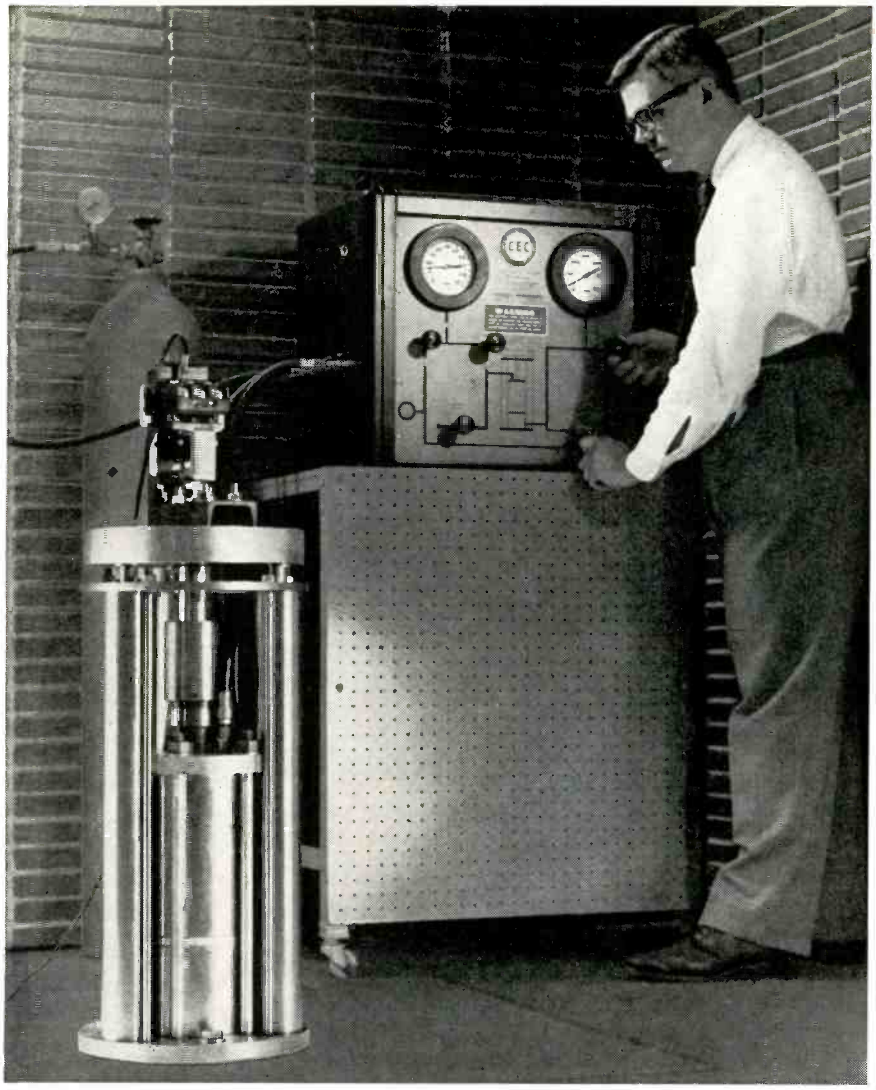
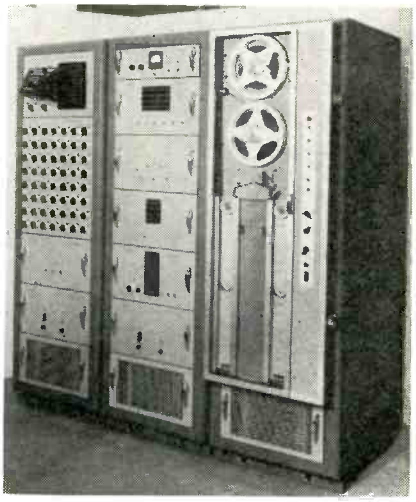
Midwest Engineering Division — 106 W. St. Charles Rd., Lombard, Ill., MAyfair 7-6026
Western Engineering Division — 13635 Victory Blvd., Van Nuys, Calif., STate 2-7479
Southwestern Division — 4207 Gaston Ave., Dallas, Tex., TAylor 3-3291



New Products

TRANSLATOR-EDITOR SYSTEM

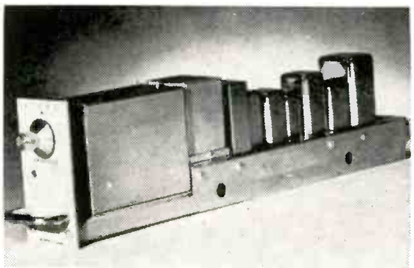
High-speed translator and editor system compresses an input of analog voltage data into a computer-compatible digital magnetic tape recording of only significant data. Input can be direct from any number of channels or from analog magnetic tape recording. Playback speed is a max. of 100 times recording speed. signal frequency is a max. of 600 cycles per sec. The system recognizes and digitizes only during defined voltage peaks, bands, or zones which are established by mathematical criteria. Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.



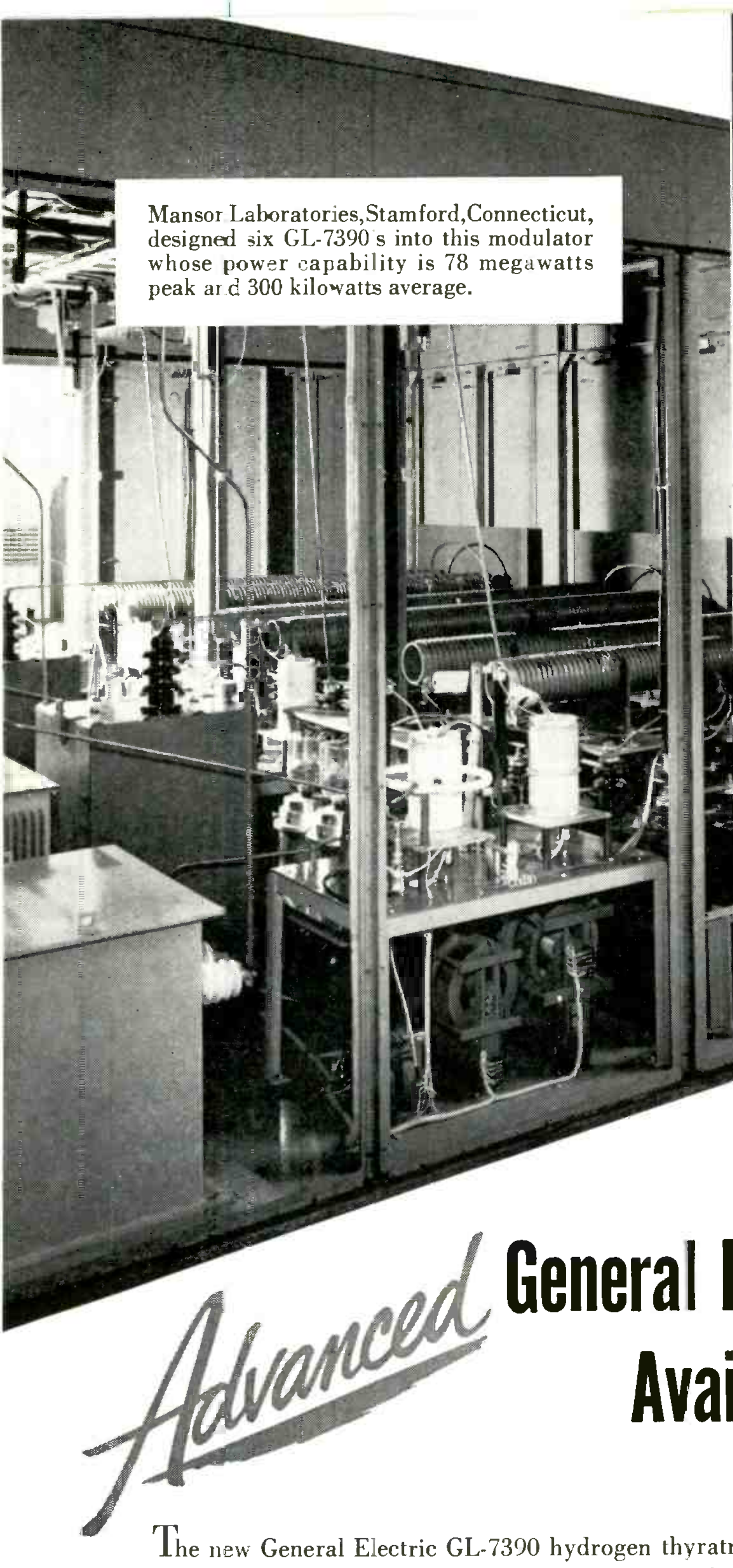
Circle 234 on Inquiry Card

DIFFERENTIAL AMPLIFIER

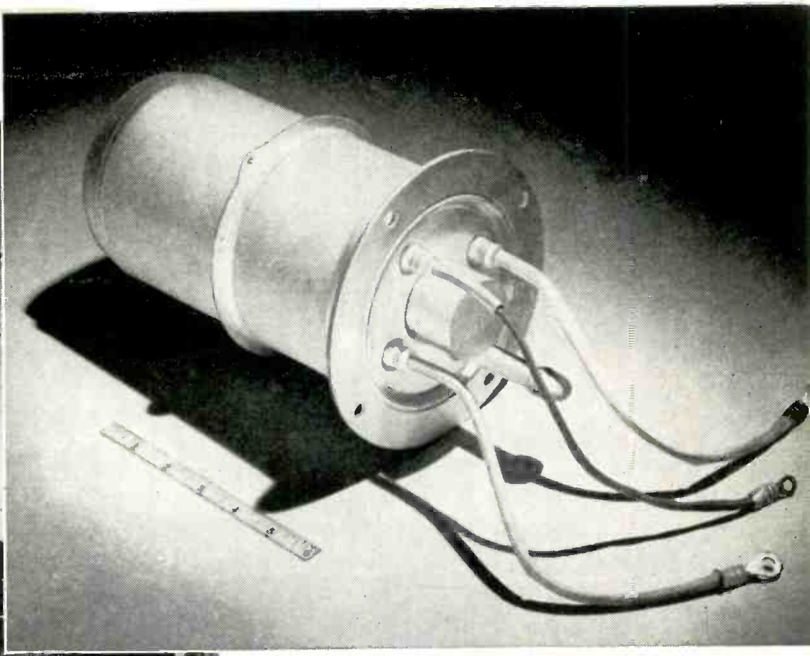
The Fitgo, a guarded, differential, dc amplifier with high input impedance, makes available gains up to 5000 in as many as 5 fixed steps. Bandwidth has been extended to 300 CPS on standard models and to 1000 CPS on special order. Other specs for model having bandwidth of 80 CPS at gain of 50: gain accuracy, 0.02% at dc; noise, 3.3 μv (RTI); zero-offset, 1.075 mv (RTO); common-mode rejection, 500,000:1 (114 db) at 60 CPS without filter. Beckman Systems Div., Beckman Instruments, Inc., 325 N. Muller Ave., Anaheim, Calif.



Circle 235 on Inquiry Card



Mansor Laboratories, Stamford, Connecticut, designed six GL-7390's into this modulator whose power capability is 78 megawatts peak and 300 kilowatts average.



Below are shown the approximate envelope sizes and power outputs of two thyratrons now in use in high-power radar, as compared to the new General Electric tube.

Type 1257	Type 5948	New G-E Development (GL-7390)
8½"x20"	5"x16"	6"x11"
Avg. Power 33KW Peak Power 33MW	Avg. Power 12.5KW Peak Power 12.5MW	Avg. Power 66KW Peak Power 33MW

CHARACTERISTICS:

Peak Anode Voltage ....33 KV
Average Anode Current .... .4 amperes
Peak Anode Current ....2,000 amperes
Anode Dissipation Factor ....30×10^9

Advanced General Electric Hydrogen Thyratron Available NOW from Stock!

The new General Electric GL-7390 hydrogen thyratron, which has the highest known power handling capability of any hydrogen thyratron now available, can be shipped immediately from stock. Designed for high-power radar pulse modulators, the GL-7390 features metal-ceramic construction for great mechanical ruggedness, smaller size for important space savings, and ability to switch extremely high average and peak power.

The external anode and grid construction allows direct convection cooling of the anode and grid. Reduced anode and grid temperatures during operation minimize the possibility of arc-back and/or grid emission.

Ceramic-metal construction provides a rugged envelope which enables the GL-7390 to withstand shock and vibration conditions beyond the limits of glass designs. The anode and grid are in the form of solid metal cups solidly brazed to the ceramic body. This is a far stronger design than conventional glass seals and lead supports.

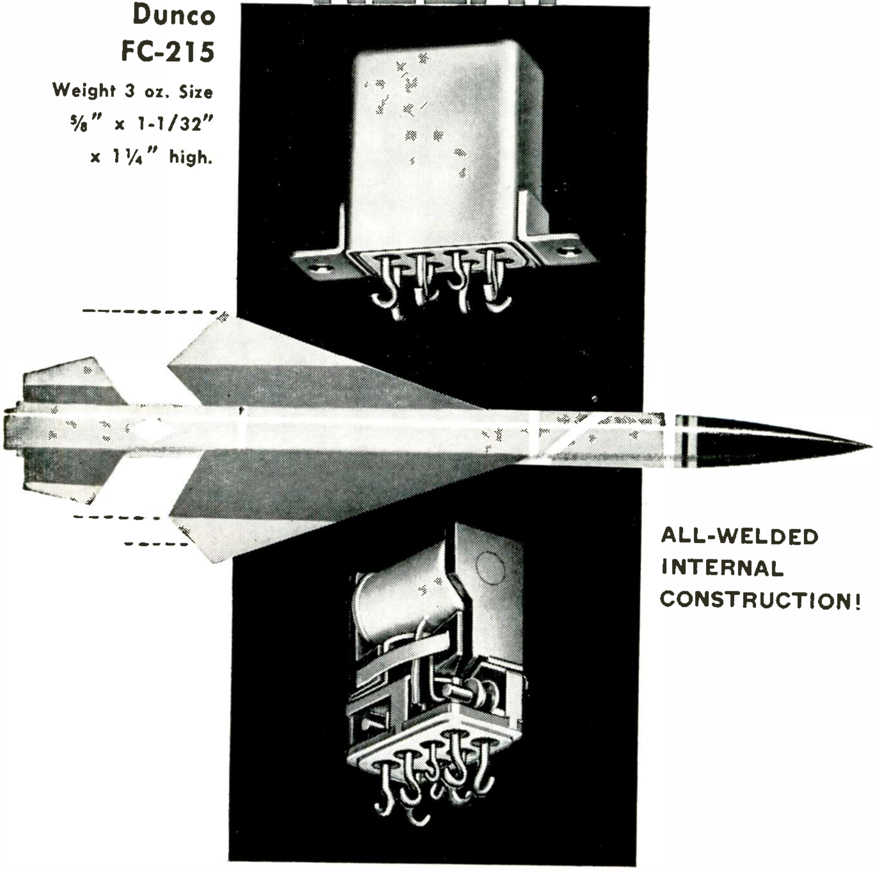
The metal-ceramic construction allows close, accurate, and rigidly fixed spacings of the anode and grid. The result is very reliable high-voltage operation. Application assistance available from your regional General Electric power tube office. *Power Tube Department, General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

9545-8481-23

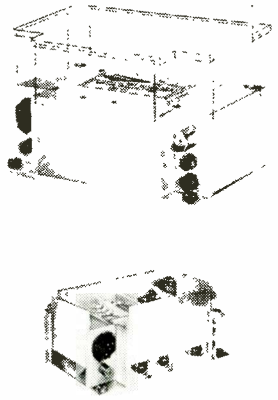
Circle 80 on Inquiry Card



New Products

TELEMETERING TRANSMITTER

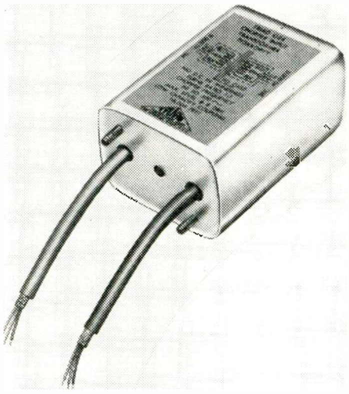
Model 1483-A1 true FM Telemetering Transmitter is a completely modularized missile transmitter. Circuits are mounted on individual bulkheads for easy maintenance. Output is 2 to 6 w at 215 to 250 MC. Lightweight and small, it measures only 1.64 x 2.75 x 4 in. Features are AFC loop crystal controlled for ±0.005% carrier stability and silicon transistors for low noise and high efficiency. It will withstand extreme environmental missile conditions including vibration and heat beyond 100° centigrade. Telechrome Mfg. Corp., 28 Ranick Drive, Amityville, L.I., N.Y.



Circle 236 on Inquiry Card

INPUT TRANSFORMER

Chopper input transformer, G-24, for use with frequencies of 60 to 500 cycles per second and with an impedance ratio of 40,000 ohms CT to 40,000 ohms CT. It exceeds MIL-T-27A standards and has a MIL designation of TF3RO9YY. Primary and secondary are 100% reversible. Capacitive coupling is reduced to less than 0.05 $\mu\mu$f. Triad Transformer Corporation, 4055 Redwood Avenue, Venice, California.



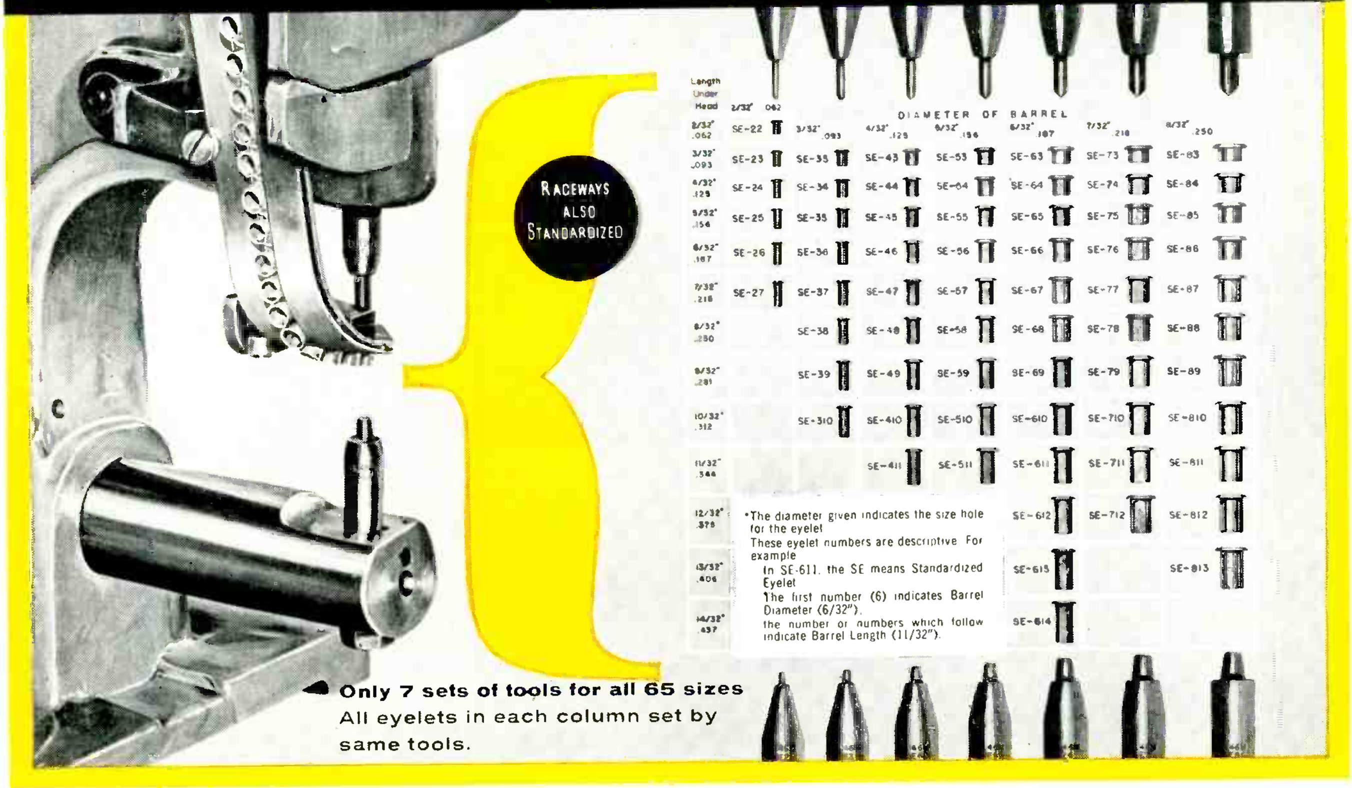
Circle 237 on Inquiry Card

STOP the EYELET HUNT

Simplify design
Speed production
Save money

You can speed eyelet selection and application, and save yourself countless hours of design and production time by using the United system of Standardized Sizes. Our records of more than 20 years prove that most eyelet work can be done with only 7 United Standardized diameters.

Use UNITED Standardized Sizes



Length Under Head	2/32" .062	3/32" .093	4/32" .125	5/32" .156	6/32" .187	7/32" .218	8/32" .250
2/32" .062	SE-22						
3/32" .093	SE-23	SE-33	SE-43	SE-53	SE-63	SE-73	SE-83
4/32" .125	SE-24	SE-34	SE-44	SE-54	SE-64	SE-74	SE-84
5/32" .156	SE-25	SE-35	SE-45	SE-55	SE-65	SE-75	SE-85
6/32" .187	SE-26	SE-36	SE-46	SE-56	SE-66	SE-76	SE-86
7/32" .218	SE-27	SE-37	SE-47	SE-57	SE-67	SE-77	SE-87
8/32" .250		SE-38	SE-48	SE-58	SE-68	SE-78	SE-88
9/32" .281		SE-39	SE-49	SE-59	SE-69	SE-79	SE-89
10/32" .312		SE-310	SE-410	SE-510	SE-610	SE-710	SE-810
11/32" .344			SE-411	SE-511	SE-611	SE-711	SE-811
12/32" .375					SE-612	SE-712	SE-812
13/32" .406					SE-613		SE-813
14/32" .437					SE-614		

DIAMETER OF BARREL

*The diameter given indicates the size hole for the eyelet

These eyelet numbers are descriptive. For example

In SE-611, the SE means Standardized Eyelet

The first number (6) indicates Barrel Diameter (6/32").

the number or numbers which follow indicate Barrel Length (11/32").

Only 7 sets of tools for all 65 sizes
All eyelets in each column set by same tools.

What United Standardized Sizes Mean. To simplify production tooling costs, Standardized Sizes are offered in increments of 1/32" in both diameter and length. The range is from 2/32" to 8/32" in diameter, and from 2/32" to 14/32" in length. Within this system there are 65 sizes carried in stock by the millions, and are immediately available through our branch offices listed below.

How You Profit from this System. These Standardized Sizes conform to standard drill and punch sizes. Only 7 sets of United setting tools will set all 65 sizes! This cuts tooling costs, saves set-up time, reduces inventory, and cuts the cost of both the fastener and the setting operation. Our high volume of Standardized Sizes makes these the lowest cost fastener you can use.

Your Plus from Us. In addition to the advantage of using Standardized Sizes, we offer a tremendous range of special eyelets, and a complete line of the finest eyelet machines available. These machines are backed by more than 50 years' experience in the design and manufacture of precision, high volume, dependable production machinery. We build equipment that will automatically feed and set up to 8 eyelets or more at a time — sometimes in different sizes and lengths.

Call or write us today and investigate without obligation how you can benefit by using United as your source for both eyelets and eyelet machines.

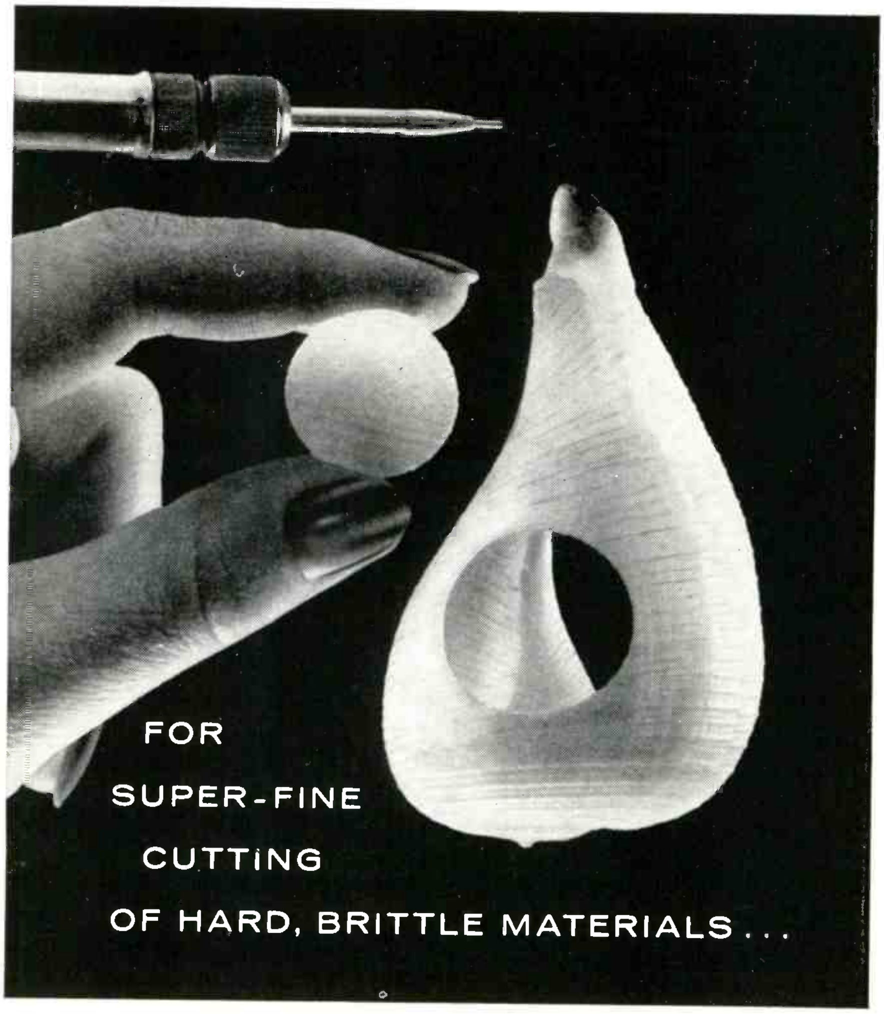
Free Eyelet Selector helps decide which eyelet you need for given hole size and grip.

United

UNITED SHOE MACHINERY CORPORATION
BOSTON 7, MASSACHUSETTS

Branches: ATLANTA, GA. • CHICAGO, ILL. • CINCINNATI, CLEVELAND, OHIO • DALLAS, TEXAS • HARRISBURG, PA. • JOHNSON CITY, N. Y. • LOS ANGELES, CALIF. LYNCHBURG, VA. • MILWAUKEE, WISC. • NASHVILLE, TENN. • NEW YORK, N. Y. • PHILADELPHIA, PA. • ROCHESTER, N. Y. • ST. LOUIS, MO.

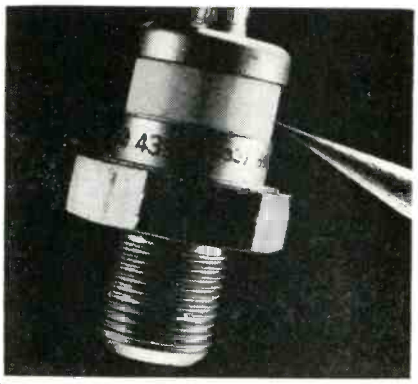
Circle 82 on Inquiry Card



New Products

SILICON POWER RECTIFIER

Silicon power rectifier (Type 439) for high-current, high-voltage applications can provide up to 240 a of forward current per cell with max. peak inverse voltage ratings up to 600 v. Max. reverse leakage current is 50 ma at the rated peak inverse voltage. Features include: operation at high ambient temp. (up to 190°C at the junction); solid copper base for ruggedness; and small size (max. cell length is 3 in.). Weight is 8 oz. Rectifier is nickel-plated and has ceramic insulation. Westinghouse Electric Corp., P.O. Box 2088, Pittsburgh 30, Pa.



Circle 238 on Inquiry Card

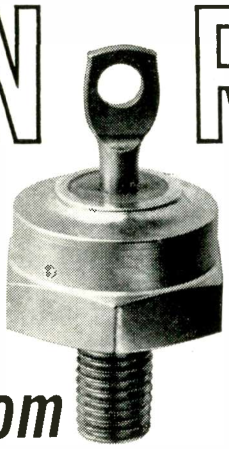
TAPE RECORDER

Two-channel recorder for small spaces and with low power consumption, meets MIL-E-4158A. It measures 5 x 4 x 2 in. including electronics. Weight is 2 lbs. Power requirements are 2½ w (dc source). Unit included electronics for record and reproduce and a timing reference source. Latter is 1 KC, ±0.01%. It will operate at tape speeds to 48 ips, bi-directional, with end-of-tape sensing. Frequency response is to 160 KC, ±3db at 48 ips. It employs 4 in. coaxially stacked reels which hold 900 ft. of ½ mil tensilized Mylar tape, ¼ in. wide. Precision Instrument Co., 1011 Commercial St., San Carlos, Calif.

Circle 239 on Inquiry Card

Announcing . . .

SILICON RECTIFIERS



from

DELCO RADIO

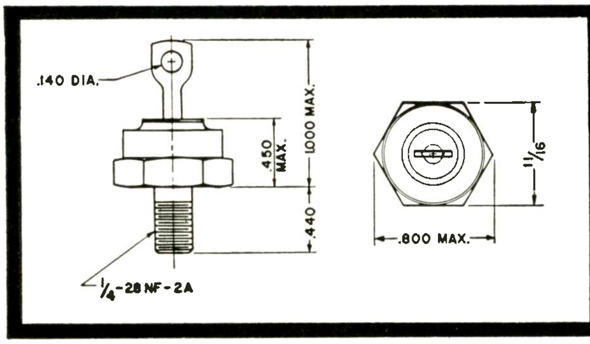
High Quality

High Performance

Extreme Reliability

From the leading manufacturer of power transistors, new Silicon Power Rectifiers to meet your most exacting requirements. Even under conditions of extreme temperatures, humidity and mechanical shock, these diffused junction rectifiers continue to function at maximum capacity! Thoroughly dependable, completely reliable—new Delco Rectifiers are an important addition to Delco Radio's high quality semiconductor line.

Conservatively rated at 40 and 22 amperes for continuous duty up to case temperatures of 150°C.



TYPE	AVG. DC CURRENT	PIV	NORMAL MAX. TEMP.	MAX. FORWARD DROP	MAX. REVERSE CURRENT
1N1191A	22A	50V	150°C	1.2V at 60 amps.	5.0 MA
1N1192A	22A	100V	150°C	1.2V at 60 amps.	5.0 MA
1N1193A	22A	150V	150°C	1.2V at 60 amps.	5.0 MA
1N1194A	22A	200V	150°C	1.2V at 60 amps.	5.0 MA
1N1183A	40A	50V	150°C	1.1V at 100 amps.	5.0 MA
1N1184A	40A	100V	150°C	1.1V at 100 amps.	5.0 MA
1N1185A	40A	150V	150°C	1.1V at 100 amps.	5.0 MA
1N1186A	40A	200V	150°C	1.1V at 100 amps.	5.0 MA at 150° C case temperature and rated PIV

For full information and applications assistance, contact your Delco Radio representative.

Newark, New Jersey
1180 Raymond Boulevard
Tel: Mitchell 2-6165

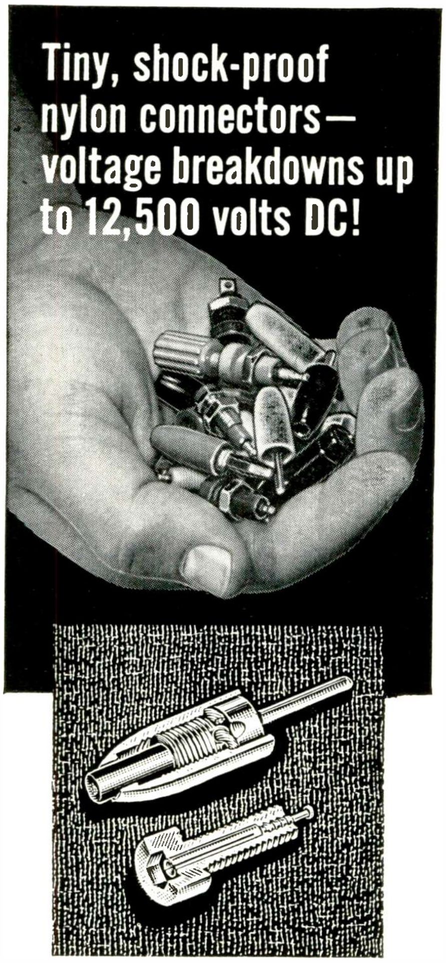
Chicago, Illinois
5750 West 51st Street
Tel: Portsmouth 7-3500

Santa Monica, California
726 Santa Monica Boulevard
Tel: Exbrook 3-1465

Division of General Motors • Kokomo, Indiana

DELCO
RADIO

Circle 84 on Inquiry Card



Tiny, shock-proof nylon connectors—voltage breakdowns up to 12,500 volts DC!

Complete Line of Nylon Jacks, Binding Posts and Solderless Plugs. Metal-Clad Tip Jacks to MIL Specs!

This rugged group of connectors will meet severe mechanical, electrical, temperature, and humidity requirements. Tough, low-loss nylon won't chip or crack even when subjected to extreme temperature changes or abnormal mechanical stress. Connectors are designed for fast, easy mounting—available in 13 bright colors for coded applications.

MILITARY—Tip Jack complies with MS-16108 of MIL-STD-242A. Heavy nickel-plated brass jacket meets federal specification QQ-N-290. High insulation resistance of nylon body complies with MIL-P-17091. (Full specifications available on request.)

OTHER CONNECTORS—Johnson also manufactures a complete line of standard connectors in addition to the nylon line described above. For complete information, write for newest components catalog described below.

New Catalog

Write today for our newest components catalog, listing complete specifications and prices!

• Capacitors • Knobs and Dials • Sockets • Inductors • Pilot Lights • Connectors • Insulators

E. F. JOHNSON CO.

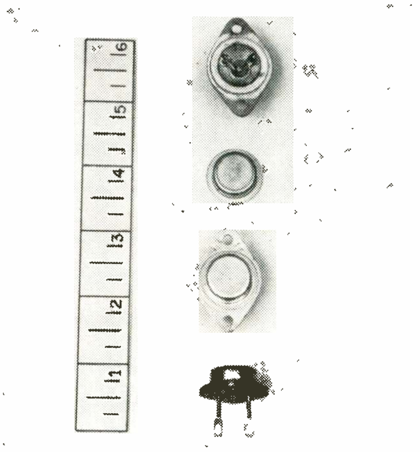
2024 Second Ave., S.W. • Waseca, Minn.

Circle 85 on Inquiry Card

New Products

SWITCHING TRANSISTOR

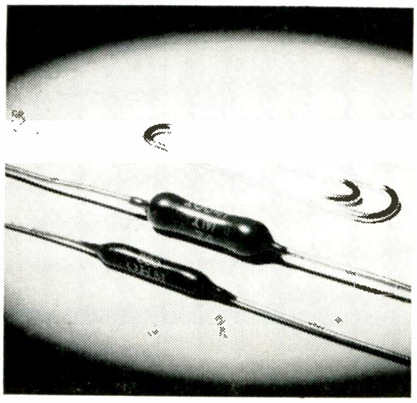
High-current, high-power switching transistor. The military type 2N1120 has been designed to meet the specification MIL-T-19500/68 (SigC). Maximum collector current rating is 10adc (appropriate for high current switching application). Collector-emitter voltage rating is 70 vdc. The 2N1120 will readily dissipate 45 watts at a 25°C mounting base temperature. Transistor features very high reliability. Bendix Semiconductor Products, 201 Westwood Avenue, Long Branch, N. J.



Circle 240 on Inquiry Card

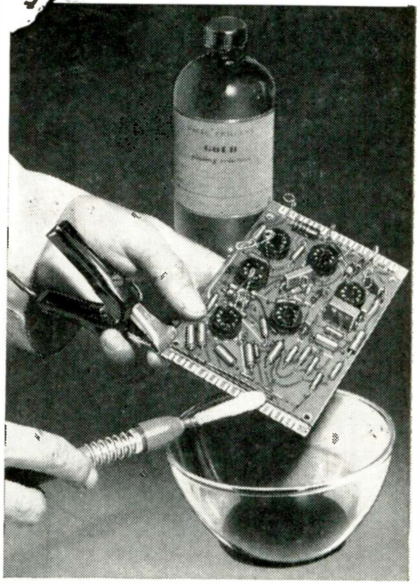
RESISTORS

"Hot-Coat" versions of deposited-carbon precision resistors in ⅛ and ¼ watt sizes. These "Hot-Coat" plastic-compound Type CEL (⅛ watt) and CEH (¼ watt) 1% resistors are protected by a physically thicker and non-reactive coating. "Hot-Coat" materials allow higher temperature ratings and because of coating thickness, many dielectric strength requirements may be met. Clarostat Manufacturing Co., Inc., Dover, N. H.



Circle 241 on Inquiry Card

DALIC SELECTIVE PLATING for ELECTRONIC COMPONENTS



Plating circuit contacts without dismantling electronic components.

Quick Accurate Way to Plate:

- Semi-Conductors.
- Flexible Circuits.
- On site field repair of Electronic Computer Contacts.

Speeds Production in:

- Automatic plating of Transistor Tabs.
- Gold-plating on Aluminum.
- No-flux soldering on Aluminum and Stainless Steel.

Plate selected areas rapidly without disassembling components. Dalic Process accurately controls thickness of deposits. Produces quality plating.

No Immersion Tanks. Mobile Equipment.

Plating equipment can be moved to the job. Quick, easy to use with Dalic hand-stylus, power pack, and the Dalic plating solutions. Mechanized production can be devised.

Write for Descriptive Brochure.

SIFCO METACHEMICAL, INC.
935 East 63rd Street • Cleveland 3, Ohio
A Subsidiary of
The Steel Improvement & Forge Co.

AGENTS

MARLANE DEVELOPMENT CO.
153 East 26th Street
New York 10, N.Y.

PIDDINGTON & ASSOCIATES LTD.
3219 East Foothill Blvd.
Pasadena, California

OHIO METACHEMICAL, INC.
2742 Second Street
Cuyahoga Falls, Ohio

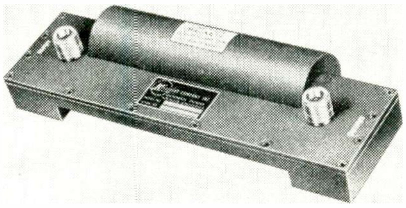
D & S AVIATION CO., LTD.
671 Laurentides Blvd.
Pont Viau, Montreal, Quebec

Circle 86 on Inquiry Card

New Products

S-BAND ISOLATOR

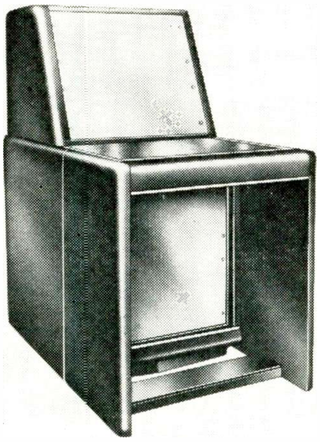
Model WD-2106 Octave S-Band Ferrite Isolator for use in telemetry, radar systems, and transponders. Characteristics include: Frequency range, 2.1 to 4.3 KMC; isolation, 20 db min.; insertion loss, indicated at 2 db max.; input VSWR, 1.5 max. with Type N connector; with peak power at 1000 w max. and average power at 5.0 w max. Temperature Amb. is 65°C max. Kearfott Company, Microwave Division, 14844 Oxnard Street, Van Nuys, California.



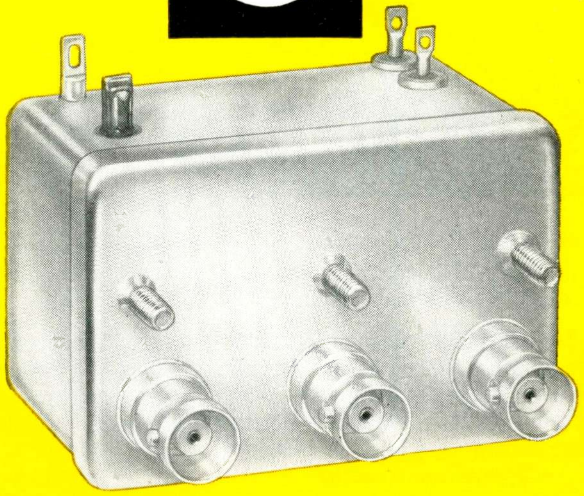
Circle 242 on Inquiry Card

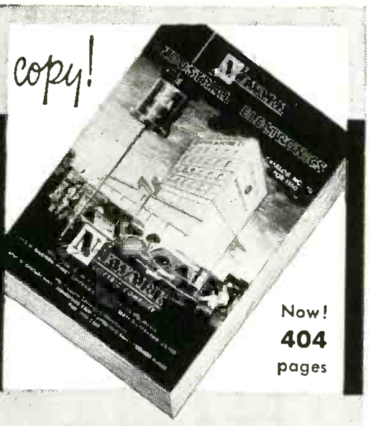
DESK ASSEMBLIES

Single desk assembly with a high slope desk cabinet mounted at the rear of a unit containing a full depth tabletop, has formica top. Finished in light and dark gray hammertone enamel. Provision is made in the pedestal rack for panel mounting angles, shelves, detachable side panels, photo drawers, louvered or blank panels, and other accessories. Units are flexible so that accessories may be moved to different positions within the units without affecting the assembly. Par-Metal Products Corp., 32-62 49th St., Long Island City 3, N. Y.



Circle 243 on Inquiry Card





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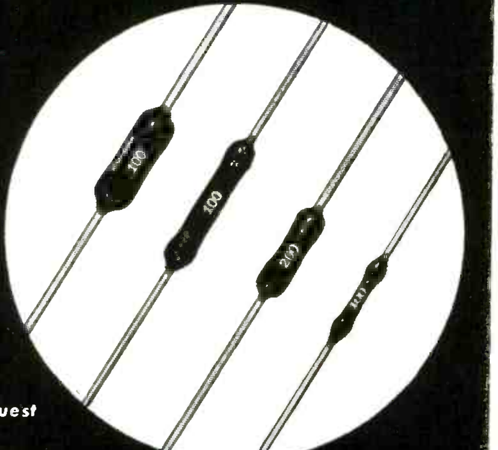

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AXIAL-LEAD
PRECISION
WIRE WOUND
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STANDARD SIZES OF
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and 20 WATTS

MINIATURE SIZE
ALL WELDED CONSTRUCTION
MEETS STRINGENT MILITARY REQUIREMENTS
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2800 N. MILWAUKEE AVE. CHICAGO 18, ILL.

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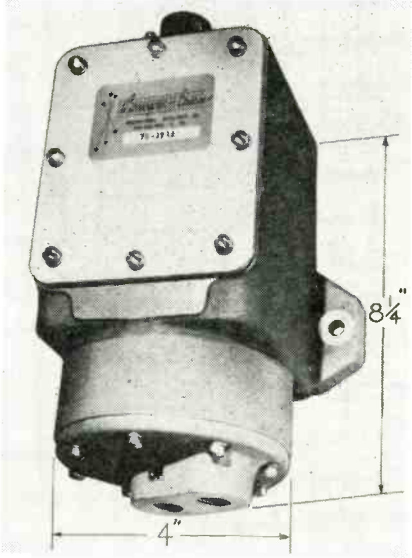
New Products

PRESSURE TRANSDUCER

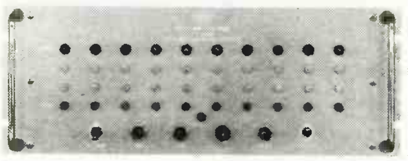
Pressure transmitter, the Computran Low Pressure Cell, has a minimum life of 10 million cycles. It delivers high-level output signals, up to 1.5 vac, or up to 100 mv dc with accessory demodulator. Standard ranges available are from 0-1.5 psi to 0-60 psi, with four intermediate ranges, and accuracies of up to ±0.15% of full range and has manual adjustment of zero and range. It is sealed in a NEMA Class IV housing, permitting operation in humid or corrosive environments. International Resistance Co., Computer Components Div., 401 N. Broad St., Phila. 8, Pa.



Circle 244 on Inquiry Card

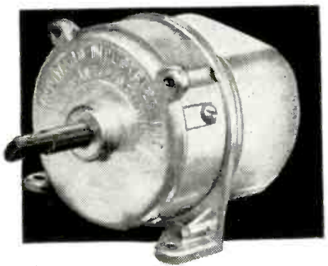
CHANNEL SEPARATOR

The Arnoux SCB-1B subcommutator Channel Separator, decommutates ten 100 per cent duty-cycle channels, one of which is employed as a full-scale reference channel. All ten separated outputs are available to drive oscillographs, pen amplifiers, meters, and servo channels. The unit accepts subcommutated wave trains at any rate from 30 to 120 pulses per second at approximately 0 to 40 volts for 0 to 100 per cent information. Arnoux Corporation, 11924 W. Washington Blvd., Los Angeles 66, Calif.



Circle 245 on Inquiry Card

There's a HOWARD fractional h.p. gear motor



for every application!

Ratios from 3:1 to 2700:1

Whether you require a Universal, Induction or Shaded Pole Gear Motor or individual Gear Reduction Units, Howard can fill your mechanical and electrical requirements from a complete line of standard models that assures you of minimum cost and delay. One of the many Howard models is shown below. Check your specs first with Howard or write for our free complete catalog.

MODEL 3000—2 Pole Shaded Pole with Gear Unit

DIAMETER: $3\frac{7}{16}$"

LENGTH: $3\frac{5}{8}$" to $4\frac{1}{2}$"

MAX. CONT. TORQUE:* 1 RPM (at $1\frac{1}{2}$" stacking length) 45 in. lbs.

MAX. INTER. TORQUE*: 1 RPM (at $1\frac{1}{2}$" stacking length) 70 in. lbs.

BEARINGS: Porous bronze sleeve type with oil reservoir.

*With external fan. Torques at other speeds from 1 to 400 RPM also available.

POWERED BY **HOWARD**

HOWARD INDUSTRIES, INC.
1730 State St., Racine, Wisconsin

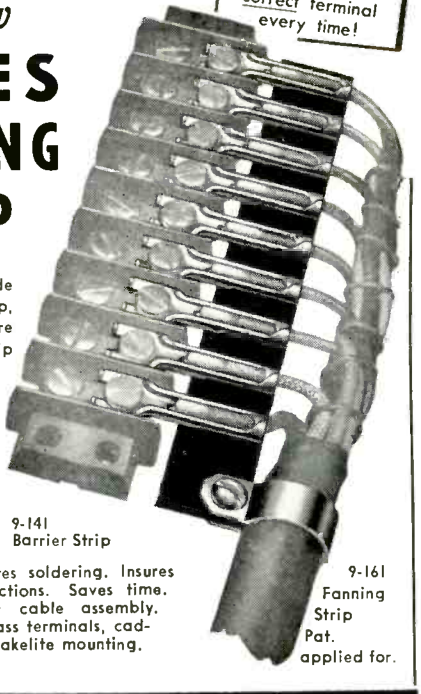
Divisions: Electric Motor Corp., Cyclohm Motor Corp., Racine Electric Prods., Loyd Scruggs Co.

Circle 90 on Inquiry Card

Here's BIG HELP IN TERMINAL WIRING!

The New JONES FANNING STRIP

The correct wire to correct terminal every time!



9-141 Barrier Strip

9-161 Fanning Strip Pat. applied for.

Connections are made through Fanning Strip, on bench or anywhere apart from barrier strip and quickly slipped into assembly.

Designed for use with Jones Barrier Terminal Strips Nos. 141 and 142, for 1 to 20 terminals.

Simplifies and facilitates soldering. Insures positive correct connections. Saves time. Ideal for harness or cable assembly. Strong construction: Brass terminals, cadmium plated. Heavy bakelite mounting.

Send for complete data on this new basic improvement!

Jones

HOWARD B. JONES DIVISION
CINCH MANUFACTURING COMPANY
CHICAGO 24, ILLINOIS
DIVISION OF UNITED-CARR FASTENER CORP.

Circle 91 on Inquiry Card

...IT GLOWS *when the* FUSE BLOWS!

NEW INDICATING 3AG FUSE POSTS

ACTUAL SIZE

EXAMINE THESE FEATURES

1. New patented knob design to assure high degree of illumination for instant blown fuse indication.
2. Positive finger grip for knob extraction.
3. Quick service bayonet lock.
4. Constant tension beryllium copper coil & leaf spring for positive contact & lower millivolt drop.
5. Optional—at extra cost—neoprene "O" ring to assure splash-proof feature.
6. New high degree vacuum neon lamp for greater brilliance & visibility.
7. Impact black phenolic material in accordance with MIL-M-14E type CFG.
8. One piece brass hot tin dipped non-turning bottom terminal.
9. Double flats on body to permit mounting versatility.

SPECIFICATIONS:

LITTELFUSE

PART #	VOLTAGE RANGE
344006	$2\frac{1}{2}$ - 7 volts
344012	7 - 16 volts
344024	16 - 32 volts
344125	90 - 125 volts
344250	200 - 250 volts

Maximum current rating 20 amps.

PHYSICAL CHARACTERISTICS—Overall length $2\frac{3}{8}$" with fuse inserted • Front of panel length $\frac{13}{16}$" • Back of panel length $1\frac{9}{16}$" • Panel area front $\frac{15}{16}$" dia. • Panel area back $\frac{15}{16}$" dia. • Mounting hole size (D hole) $\frac{5}{8}$" dia. flat at one side.

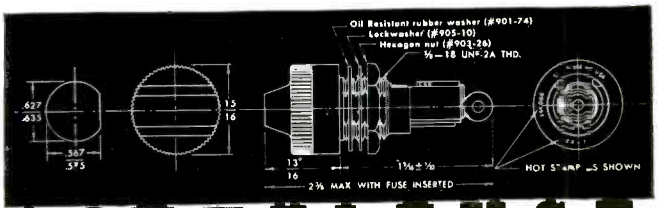
TERMINAL—Side—one piece, .025 brass—electro-tin plated • Bottom—one piece, lead free brass, hot tin dipped.

KNOB—High temperature styrene (amber with incandescent bulbs—$2\frac{1}{2}$ thru 32 volts—and clear with high degree vacuum neon bulbs—90 thru 250 volts) • Extractor Method—Bayonet, spring grip in cap.

HARDWARE—Hexagon nut—steel, zinc cronak or zinc iridite finish • Interlock lock washer—steel, cadmium plated • Oil resistant rubber washer.

MILITARY SPECIFICATIONS—MIL-M-14E type CFG. Fungus treatment available upon request per Jan-T-152 & Jan-C-173.

TORQUE—Unit will withstand 15 inch lbs. mounting torque.



LITTELFUSE

DES PLAINES, ILLINOIS

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NEW!
SENSITIVE RESEARCH
.01% ACCURATE
.005% STABLE

MODEL STV

D.C. VOLTAGE STANDARD

The Model STV is an extremely accurate and stable reference source for use with "null balance" devices such as potentiometers ond other infinite impedance comparators. It is at least equivalent in accuracy to the best unsaturated standard cells and is superior in almost all other respects to both saturated and unsaturated types.

While the Model STV is essentially a zero current drain source, it can be operated into any impedance without damage. It can be short circuited indefinitely without affecting accuracy or life expectancy and it will almost instantaneously regain its original open circuit voltage when the short is removed. Vibration from transportation, exposure to extremes of temperature, and operating position do not affect its accuracy.

Specifications — Type "A"

Input: 90-135 v.; 60 cps; 25 va.

Output: 1.0000 v. and 1.0185 v.

Accuracy: ± .01% of nominal listed output (certificate furnished to .001% of actual output).

Stability: ± .005% of actual output, for 100-125 v. input and 20° — 30°C.; .01% for 90-140 v. input and 10° — 40°C.

Temp. Range: 10°C — 40°C (operotes with reduced accuracy beyond these limits, but with its voltage exactly reproducible).

Operational Life: 25,000 hours minimum.

Size: 9⅜" x 7⅝" x 5". **Weight:** 10 lbs.

The Model STV is available for 19" rack panel mounting and in 3½" x 3" x 3" cans for OEM users (input must be regulated to 1%). Write for additionol information on all types and special versions.

Symbol of Quality

SENSITIVE RESEARCH INSTRUMENT CORPORATION
NEW ROCHELLE, N. Y.

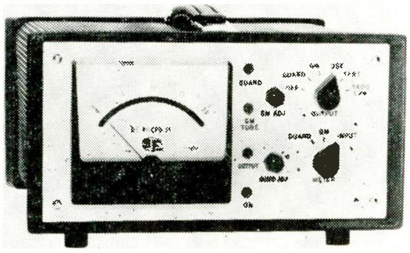
ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

← Circle 93 on Inquiry Card

New Products

PREAMPLIFIER

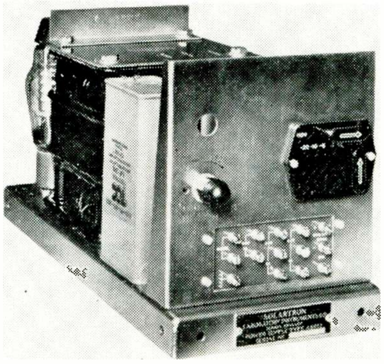
Transistorized Model 501 Anti-coincidence Preamplifier is designed for low-level Beta work. It is used with a geiger tube detector and cosmic ray umbrella type detector, such as the new Amperex 18515 or 18517 to reduce the background count from 22 counts/min. to approx. 1 or 2 counts/min. Voltage dividers provided for the independent adjustment of the high voltage for guard and detector. Input impedance is 0.5 megohm. Sensitivity is from 0.1 v. to 20 v. Resolving time is 400 μsec. It provides a 20 v. negative going pulse 20 μsec wide to the scaler. Smith-Florence, Inc., 4226-36 23rd Ave., West, Seattle, Wash.



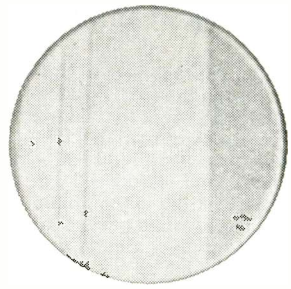
Circle 246 on Inquiry Card

POWER SUPPLIES

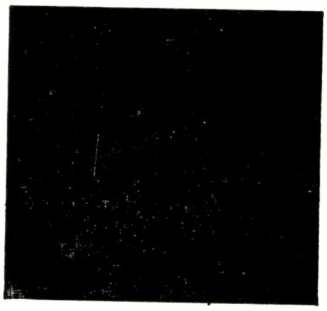
For continuous duty pulse loading applications, chokeless power supply sub-units can withstand pulsing from zero to full load without loss of control. Stability factor is better than 400 to 1. Range comprises three sub-units of 100 ma max. load (AS 951, 952, 953) and three of 200 ma (AS 955, 956, 957) output voltages covering from 100 to 400 v. Output voltage can be varied over ± 50 v. from nominal. Solartron Electronic Group Ltd., 45 Thames St., Kingston, Surrey, England.



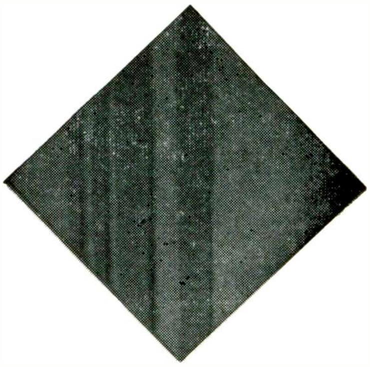
Circle 247 on Inquiry Card



TINSLEY DELIVERS



CORNING GLASS FILTERS



IN 3-5 DAYS

Wherever you are in the United States you can get standard thickness Corning Glass color filters in 3-5 days from Tinsley Laboratories. Fast delivery, too, on special sizes and thicknesses, custom ground and pitch-polished in our laboratories. You can depend upon Tinsley and on the Corning filters we finish and supply. They are particularly useful in colorimetric work and other applications in which specific regions of the radiant spectrum must be isolated. Send for a free copy of our price list.

TINSLEY
LABORATORIES, INC.

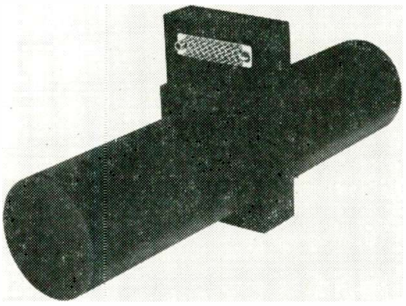
2526 Grove Street · Berkeley 4, California

Circle 94 on Inquiry Card

New Products

SERVO SYSTEM

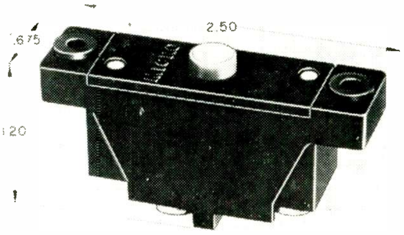
Multi-output electro-mechanical system to provide servo controlled attenuation of signal level for a specific input function, provides a network of as many as 7 gangs of servo driven potentiometers in one small integral package. Each individual potentiometer can be supplied with its own independent function so that simultaneous control, feedback and telemetry signal can be provided. Specs are: linearity, ±0.1%; resistances, 1000 to 100,000 ohms; resolution, as low as 0.03%; power rating, 1.5 w per element; temp. range —65 to +200°F. Bourns, Inc., P.O. Box 2112, Riverside, Calif.



Circle 248 on Inquiry Card

2-CIRCUIT SWITCHES

A series of 2-circuit precision switches, 3MN Series, for use on machine tool limit and control mechanisms. Median mechanical life exceeds 10 million operations at full overtravel. Three of the snap-action switches have a combined stacking width of 2.03 in. A minimum 0.080 in. overtravel provided. Contact arrangement is single-pole two-circuit double-break. Underwriter's laboratories listed for 15 a., 120, 240, 480 or 600 vac. Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.



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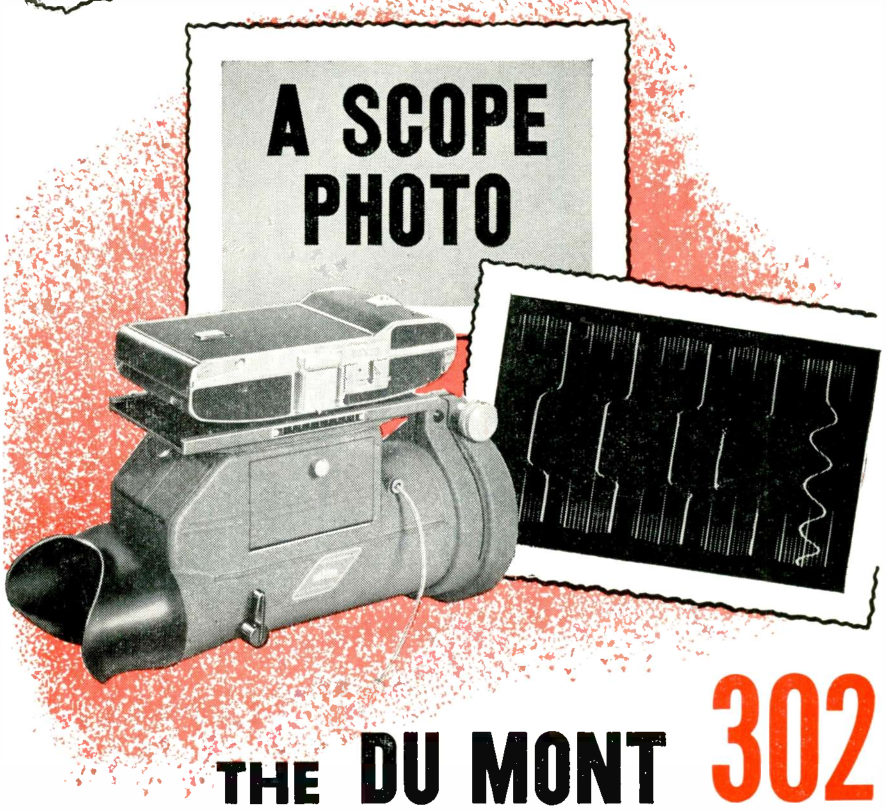

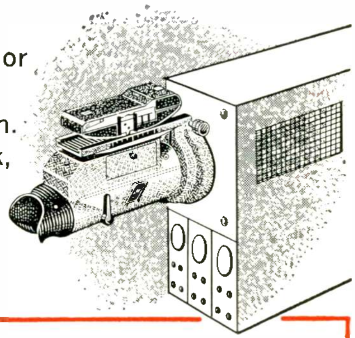

product of the pioneer

IN 60 SECONDS...

THE DU MONT 302

When used with Polaroid Land film materials you can have print-a-minute permanent records of your scope traces, or in two minutes — transparent records for immediate projection or reproduction. The Type 302, with its sliding detent back, permits multiple, separated exposures per frame for comparison studies or measurement. Provisions for identifying each frame are included — enabling life-long identification for engineering records. An interchangeable back is available for regular film emulsions.

Price: $350^00 f/2.8
$395^00 f/1.9

FEATURES
- "Print-a-minute permanent records or slides
- Multiple or single exposures per frame
- Viewing while recording without danger of fog
- Choice of lens
- Self-supporting structure
- Interchangeable back for regular film materials

DU MONT®

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precision electronics is our business

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INTERNATIONAL DIVISION • 515 MADISON AVENUE, NEW YORK 22, N. Y. • CABLES: ALBEEDU, NEW YORK

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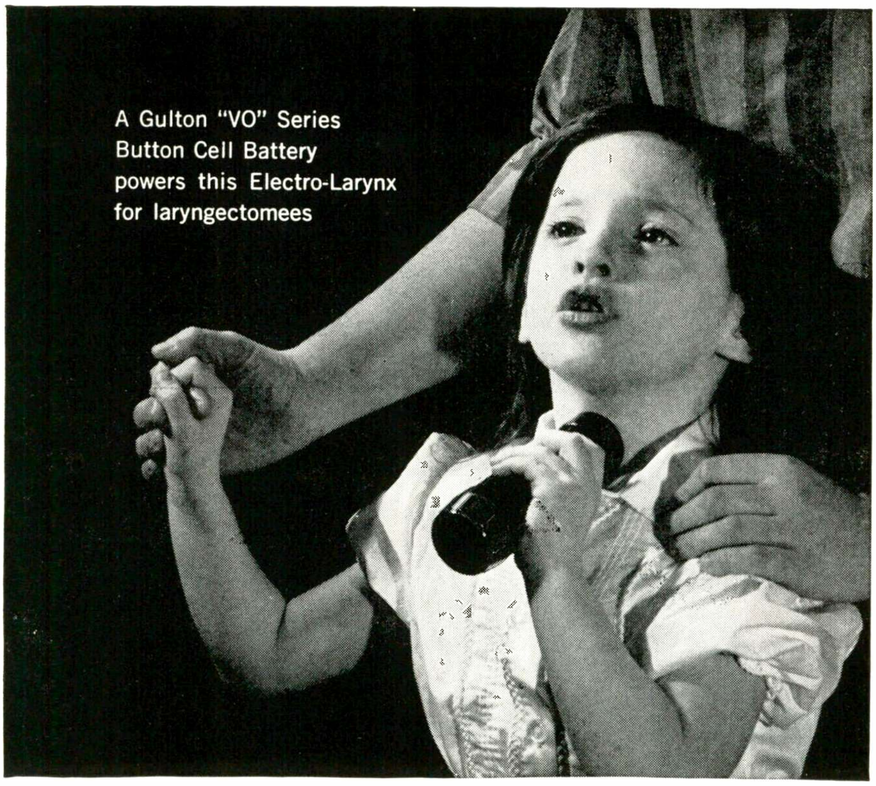


A Gulton "VO" Series
Button Cell Battery
powers this Electro-Larynx
for laryngectomees

Dependable...long-lived...rechargeable

This child holds a voice in her hand . . . the Kett Electro-Larynx. A push of a button sets a column of air vibrating in her throat, gives sound to words formed with mute lips.

The Electro-Larynx will prove a boon to thousands of people who cannot speak for one reason or another. To give it a reliable, long lasting, sealed rechargeable source of power, Kett Engineering Corp. chose a Gulton "VO" series sealed nickel cadmium button cell battery.

How Can You Use These Batteries?

Here is a partial list of the many ways imaginative engineers are employing Gulton button cell batteries: transistorized radios, prosthetic devices, missiles, flashlights, photoflash power packs—*wherever small size, large capacity, light weight, long life, no maintenance, complete reliability, and easy recharging are desired.*

Most Complete Line Available

"VO" cells are available in capacities of 100, 180, 250, 500 and 1750 mah; have a nominal 1.2 voltage; can be packaged in any combination to meet your voltage specs. Patented sintered plate construction provides exceptional cycling characteristics; highest capacity per unit size. Like more information? Write us for Bulletin No. VO-110.

Available from stock—
GLENNITE BATTERY DISTRIBUTORS
92-15 172nd Street, Jamaica, New York

GI®

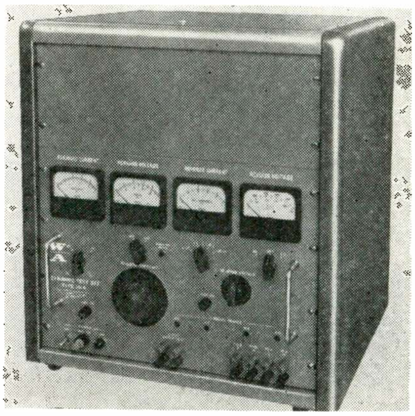
Gulton Industries, Inc.
Alkaline Battery Division, Metuchen, New Jersey

Circle 96 on Inquiry Card

New Products

RECTIFIER ANALYZER

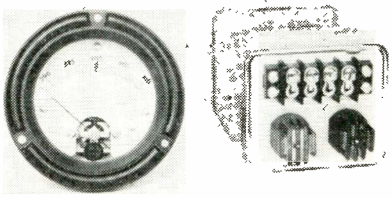
Dynamic rectifier test set, Model 141A, for incoming inspection, on-line testing and laboratory use. Forward current and reverse voltage controls are independently adjustable. Forward current range is 0-1, 10, 20 adc ave. Reverse voltage peak, 0-1000. It measures a forward drop range of 0-1/5 v. and a reverse current range of 0, 0.05, 0.5, 5, 50 ma ave. Provisions provided for monitoring all four parameters with an external oscilloscope. No auxiliary equipment needed. Wallson Associates, Inc., 912-914 Westfield Ave., Elizabeth, N. J.



Circle 250 on Inquiry Card

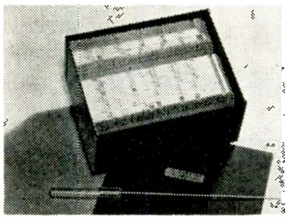
FREQUENCY METERS

Suppressed range frequency meters, Series 536, designed to fill the gap between simple field units and elaborate laboratory standards. Standard models are for readings from 48 to 62 cycles per second. Input is 105 to 135 vac of the frequency being measured; no auxiliary power required. Accuracy is the sum of 2.5% of the frequency range and 0.25% of the frequency being measured, over a temperature range of —65 to 30°F. Consolidated Controls Corporation, Bethel, Connecticut.



Circle 251 on Inquiry Card

TRANSISTOR INDEX



- Eleven parameters for sorting
- Simple, instantaneous transistor comparison
- Avoids frustrating data sheet searches
- Compact central file of all transistor data
- Transistor selection in less than three minutes
- Quarterly up-dating
- Pays for itself immediately

The TRANSISTOR INDEX, by utilizing keysort card sorting techniques, can in seconds sort out all transistors of a given characteristic.

The characteristics of each transistor together with other pertinent manufacturing data, are printed on individual cards, indexed and cross-referenced by means of holes and slots at the edge of the card.

By merely inserting the sorting needle into the hole corresponding to the desired characteristic and lifting the needle, a selection of ALL transistors bearing those characteristics is made.

THE ZECO INDEX contains transistor data from more than 20 manufacturers.

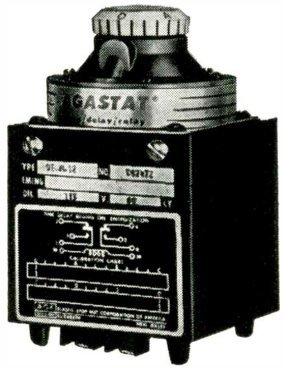
The TRANSISTOR INDEX is updated quarterly by a subscription service which provides additional cards for new transistors, and the serial numbers of obsolete transistors, which can be removed from the deck. Purchase of the INDEX also includes a keysort needle and storage box. Quarterly subscription service is renewed annually.

ZEUS ENGINEERING COMPANY
635 SOUTH KENMORE AVENUE
LOS ANGELES 5, CALIFORNIA

Zeco

Circle 97 on Inquiry Card

NEW AGASTAT®



HAS LONGER OPERATING LIFE

The Agastat time/delay/relay has been completely re-designed, inside and out, to make every moving part last longer and operate more reliably. Here are some other important advantages:

- Dial adjustment for ease and accuracy
- Five timing ranges, covering an overall range of from 0.08 seconds to 15 minutes
- Timed intervals remain the same through repeated readjustments
- Integral wiring diagram and calibration plate
- Measures only 4-9/16 x 2-9/16 x 2-5/8"
- All contacts are flexible contacts
- Contacts are larger for fast heat dissipation

Write for details and application engineering assistance to Dept. A32-132.

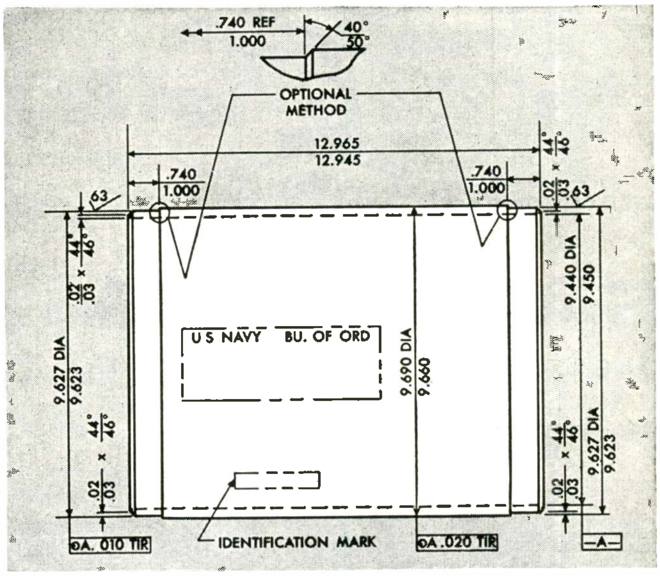
AGA DIVISION

Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth, New Jersey
Pioneers in Pneumatic Timing

Circle 98 on Inquiry Card

The Navy said

"CAN YOU"



In the drawing above, a reinforced plastic battery shell that we have made in quantity for the U.S. Navy Bureau of Ordnance. Tolerances were tight . . . such as ± .002" on this 10-1/4" dia. part, which had a wall thickness of only 3/32".

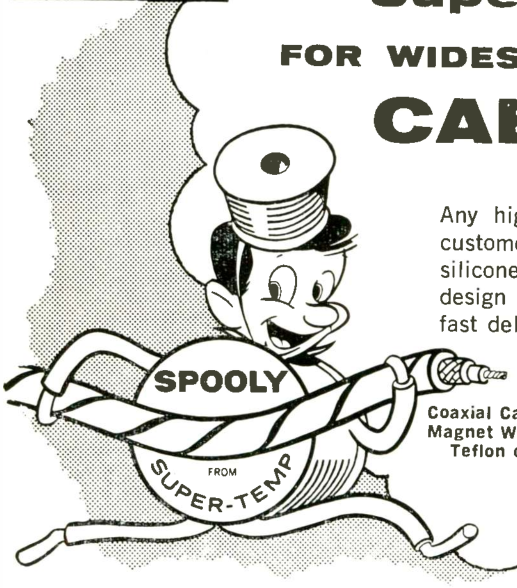
Production was successful, thanks to techniques we were already using for volume production of reinforced plastic pressure tanks.

The same techniques can solve *your* problems! Whether it's tanks or tubs or parts, call us or write. We'll tell you what's possible and whether it's practical.

structural fibers, inc.
FIFTH AVENUE • CHARDON, OHIO

REINFORCED PLASTIC PRODUCTS BY THREE PROCESSES:
- internal pressure molding
- matched die molding
- premix molding

Circle 99 on Inquiry Card



"SPOOLY" SAYS...

Super-Temp
FOR WIDEST VARIETY OF
CABLES

Any high temperature cable the customer wants . . . using Teflon*, silicone rubber, nylon or PVC. You design it or we'll help you. Same fast delivery.

Coaxial Cables, Miniature & Jumbo Cables
Magnet Wire, Airframe Wire, Hook-up Wire
Teflon or Silicone Rubber Insulations

*DUPONT'S TFE RESIN

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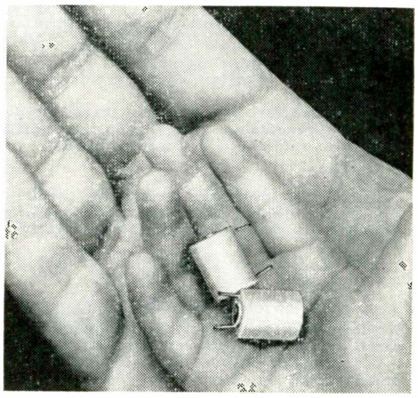
New Products

VARIABLE INDUCTOR

Line of miniature variable inductors with inductance ranges of 0.10 to 4700 microhenries. These tiny inductors, measuring 0.400 inches outside diameter and ½ inches in height are encapsulated in epoxy resin. They meet MIL-C-15305A, Grade 1 and Class B. The units have stable inductance at extreme temperature variations, and also high reliability along with the light weight and miniature size factors. Essex Electronics, Division of Nytronics, Inc., 550 Springfield Avenue, Berkeley Heights, New Jersey.



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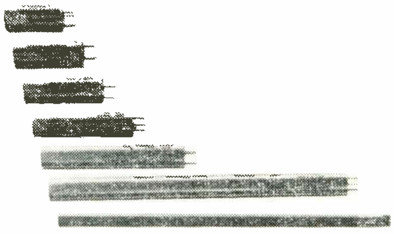
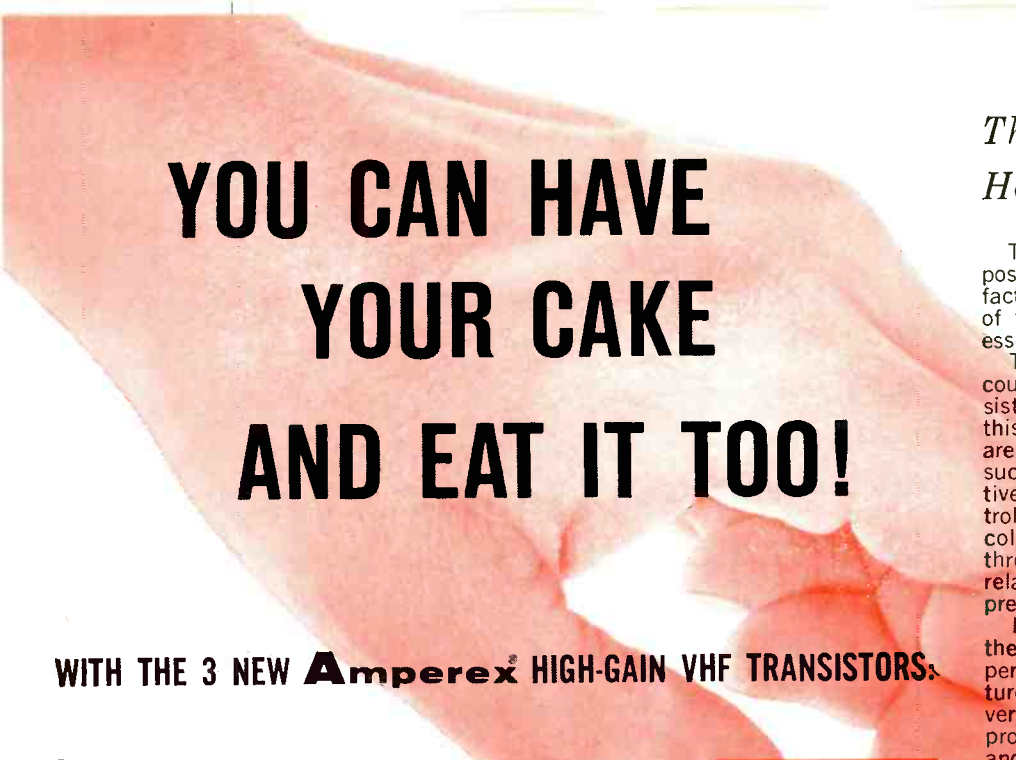
TRANSDUCERS

Line of high-temp. variable permeance transducers. Temp. range is −325°F to 1000°F. Boron-free materials used throughout. Phase change: 180° at null; zero shift: less than 0.003%/F.S./°F; thermal coefficient of sensitivity: less than 0.003%/F.S./°F; null voltage: less than 0.25% of total output; bore dia.: 0.125 nom.; slug dia.; 0.116 nom.; thermal neutron cross section: less than 14 barns; linearity: ±0.3 to ±0.75%; linear ranges: ±0.040 to ±1.00 in.; full scale sens: 0.2 v/v to 0.4 v/v. Technical Industries Corp., 389 N. Fair Oaks Ave., Pasadena, Calif.



Circle 253 on Inquiry Card

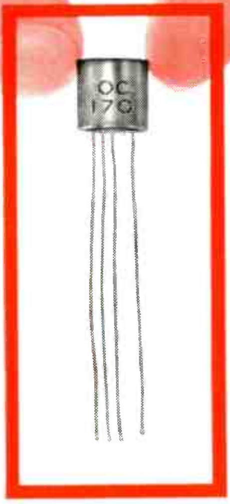


YOU CAN HAVE YOUR CAKE AND EAT IT TOO!

WITH THE 3 NEW **Amperex** HIGH-GAIN VHF TRANSISTORS:

Unrivaled for—**RELIABILITY,**
OPERATING STABILITY
and UNIFORMITY

And yet they cost no more, in many cases, than equivalent vacuum tubes and are available now in production quantities.



At last, you can realistically employ high frequency transistors for RF and IF amplifiers in production FM receivers; as mixers, oscillators and RF and IF amplifiers in mobile radio equipment, car radios and short wave receivers; and as broadband amplifiers in instrumentation and industrial applications.

Implemented and fully proven by Amperex, a unique manufacturing technique originating with Philips of the Netherlands now enables Amperex to provide you with production VHF transistors of unparalleled laboratory quality at truly reasonable prices.

The new Amperex "alloy-diffusion" P-N-P transistors combine the best qualities of both the alloy and the diffusion approaches to transistor construction. As a result of the special "self-jigging" techniques, a maximum degree of uniformity is achieved. Thus the necessity for "selection" is completely eliminated.

The Type OC170 is designed for use as a mixer oscillator in short wave receivers, as an IF amplifier in FM receivers, and as a broadband linear amplifier for instrumentation and industrial applications. The OC170 features a high cut-off frequency of 70 Mc and a low collector-to-base capacitance of 1.8 μμf.

The Type OC169 is designed for lower frequencies and gain.

The Type OC171 is designed for use as a local oscillator and preamplifier in FM receivers and has a cut-off frequency of 100 Mc.

		OC169	OC170	OC171
MAXIMUM RATINGS				
V_{CE}		20 V	20 V	20 V
I_C		10 mA	10 mA	5 mA
P_C at $T_{amb.} = 45°C$		50 mW	60 mW	60 mW
TYPICAL CHARACTERISTICS				
Cut-off frequency	$f_{\alpha b}$	70 Mc	70 Mc	100 Mc
Power gain	Pg at 0.45 Mc	35 db	35 db	—
	Pg at 10.7 Mc	20 db	20 db	—
	Pg at 100 Mc	—	—	10 db min.
Noise figure	NF at 0.45 Mc	—	3 db	—
	NF at 10.7 Mc	—	4 db	—
	NF at 100 Mc	—	—	11 db

The Breakthrough...
How It Was Accomplished!

This VHF transistor breakthrough was made possible by a new alloy-diffusion process, a manufacturing method that combines the best features of the currently used alloy and diffusion processes, without their drawbacks.

The limitation of the alloy process is encountered when attempting to manufacture transistors with an average cut-off above 20 Mc. In this process the collector and emitter elements are fused (or alloyed) to the base. For this to be successfully accomplished the base must be relatively thick and the thickness very accurately controlled in order that during the fusion process the collector and emitter elements do not flow through the base and short the transistor. This relatively thick base increases the transit time, precluding any usable response above 20 Mc.

In the diffusion process the base is formed on the collector by gaseous diffusion in a high temperature oven. Very thin bases can be manufactured by this method with low transit time and very high cut-off frequencies. In this process the problem lies in attaching the emitter junction and base lead.

In the AMPEREX "alloy-diffusion" process, alloying and diffusion take place simultaneously. The transistor is built up on a piece of P-type germanium. Two small pellets are placed on the germanium. Pellet B, the base pellet, contains only an N-type impurity. Pellet E, the emitter pellet, contains a P-type and an N-type impurity.

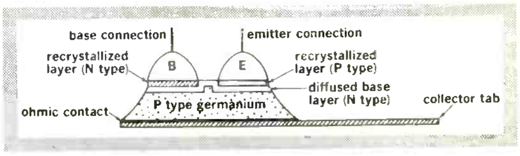
When this assembly is heated at a certain temperature, the germanium dissolves into the metal pellets until saturation is reached, and the pellet impurities diffuse into the solid germanium.

However, the P-type impurity in pellet E has such a low diffusion constant, that for practical purposes it does not penetrate into the germanium. The N-type impurity in pellets E and B has a much greater diffusion constant and readily penetrates into the solid germanium to form a diffused N-type layer underneath the pellets.

When the assembly is cooled down, a layer of germanium recrystallizes from the pellets as in the normal alloy technique. The recrystallized layer of pellet E contains many atoms of the P-type impurity and is, therefore, a P-type germanium layer. The germanium layer recrystallized from pellet B is, of course, the N-type because there are no other impurities in the pellet.

Connections are made to the germanium and the metal pellets and a P-N-P transistor is obtained. The original P-type germanium is the collector, pellet B the base, and pellet E the emitter.

This process makes it possible to mass produce transistors with a base layer of a few microns for very short transit time and high cut-off frequencies. The yield is also very high which enables AMPEREX to supply these transistors at low prices.



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Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, Long Island, New York
In Canada: Rogers Electronic Tubes & Components, 116 Vanderhoof Avenue, Toronto 17, Ontario

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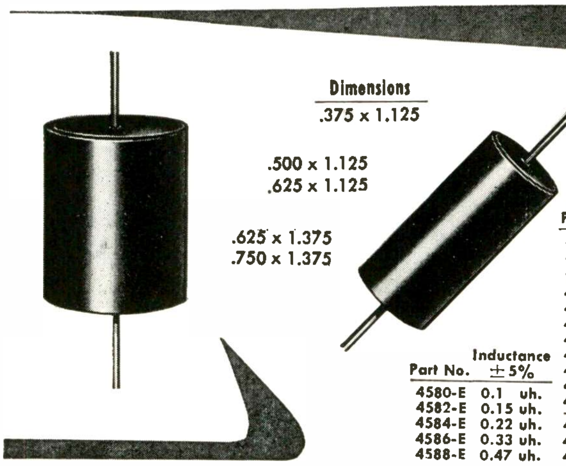
ENCAPSULATED
RADIO FREQUENCY CHOKES

The following series of R.F. chokes range in value from 0.1 uh to 50 mh. Basically identical to our standard series of axial lead R.F. chokes bearing the equivalent number, these coils are encapsulated in epoxy resin and conform to MIL-C-15305A.



Part No.	Inductance ±5%
4580-E	0.1 uh.
4582-E	0.15 uh.
4584-E	0.22 uh.
4586-E	0.33 uh.
4588-E	0.47 uh.

Part No.	Inductance ±5%
4590-E	0.68 uh.
4592-E	0.75 uh.
4594-E	0.82 uh.
4602-E	1.0 uh.
4604-E	1.5 uh.
4606-E	2.4 uh.
4608-E	3.9 uh.
4609-E	5.5 uh.
4610-E	6.2 uh.
4611-E	8.2 uh.
4612-E	10.0 uh.
4622-E	10.0 uh.
4624-E	15.0 uh.
4626-E	24.0 uh.

Part No	Inductance ± 5%
4628-E	39.0 uh.
4629-E	55.0 uh.
4630-E	62.0 uh.
4631-E	82.0 uh.
4632-E	100.0 uh.
4642-E	0.10 mh.
4644-E	0.15 mh.
4646-E	0.24 mh.
4648-E	0.39 mh.
4649-E	0.55 mh.
4650-E	0.62 mh.
4651-E	0.75 mh.
4652-E	1.0 mh.
4662-E	1.0 mh.
4664-E	1.5 mh.
4666-E	2.4 mh.
4668-E	3.9 mh.
4669-E	5.5 mh.
4670-E	6.2 mh.
4671-E	8.2 mh.
4672-E	10.0 mh.
6302-E	2.5 mh.
6304-E	5.0 mh.
6306-E	10.0 mh.
6308-E	25.0 mh.
6310-E	50.0 mh.

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It lists over 1300 chokes, filters, transformers and coils, available for immediate delivery. Includes 260 new coil items—many conforming to military specifications. Request Miller Catalog No. 60.

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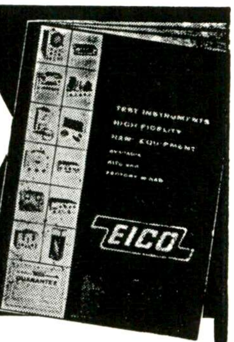

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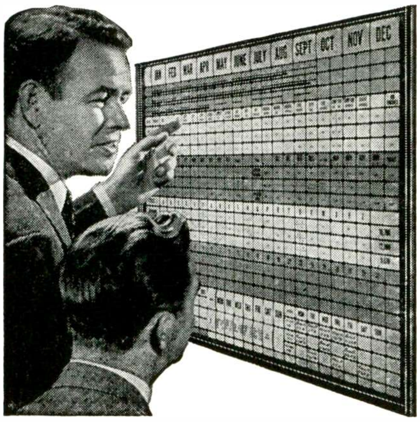

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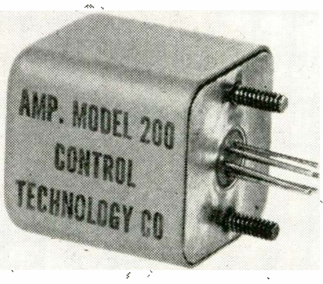
Circle 105 on Inquiry Card

New Products

AMPLIFIER

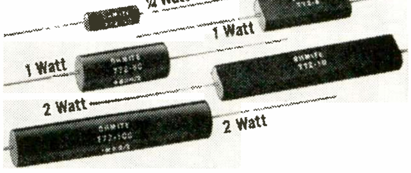
Transistorized amplifier, Model 200, is 1 x 1 x 1⅛ in. Will drive 2 w or 3.5 w servo motors from low level 400 CPS signals at an ambient temp. of up to 125°C. Max. gain is 2500 and may be adjusted by external resistor. Gain stability is 2 db over temp. range. Internal limiting prevents overdrive or phase shift for high input signals. Operates on 28 vdc. Low output impedance gives good servo response. Will operate under MIL E5272A environmentals. Control Technology Co., 1186 Broadway, New York 1, N. Y.



Circle 254 on Inquiry Card

METAL FILM RESISTORS

Expanded line of metal film precision resistors provides: a smaller size, ⅝ x 15/64 in. dia.—¼ w at 125°C; 2 w units in semi- and full-cylindrical shape affording a range to 2½ megohms; sizes to meet physical styles of MIL-R-10509C and MIL-R-19074B (Ships). The line consists of 8 different sizes and 3 styles—full-cylindrical, semi-cylindrical, and rectangular. The semi-cylindrical or flat-sided type offers the max. economies in space, and the rectangular type has radial leads convenient for assembly into printed circuits. Ohmite Mfg. Co., 3655 W. Howard St., Skokie, Ill.



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EPR SPECIAL PRODUCTS CORPORATION

MAGNASCOPE

EPR's *LARGE SCREEN* OSCILLOSCOPE

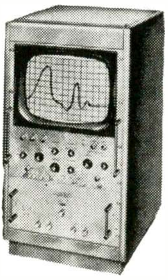
FEATURING A 17-INCH CATHODE RAY TUBE!

The Magnascope performs the various oscilloscope functions with the highest degree of resolution and accuracy — Excellent for computer readout observation and production testing.

10 MV/inch sensitivity — Highly stabilized input amplifiers for drift-free operation — Accurately calibrated controls for an overall 2% accuracy — 1% linearity — Accurately stabilized voltage regulators — Frequency response, DC to 500 KC — Resolution, 40 lines per inch deflection.

RUGGED & HANDSOME!

The Magnascope is enclosed in a sturdy steel cabinet of modern, wrap-around construction with an attractive, two-tone grey finish of baked enamel.



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675 Barbey Street, Brooklyn 7, N. Y. Telephone: HYacinth 5-0133

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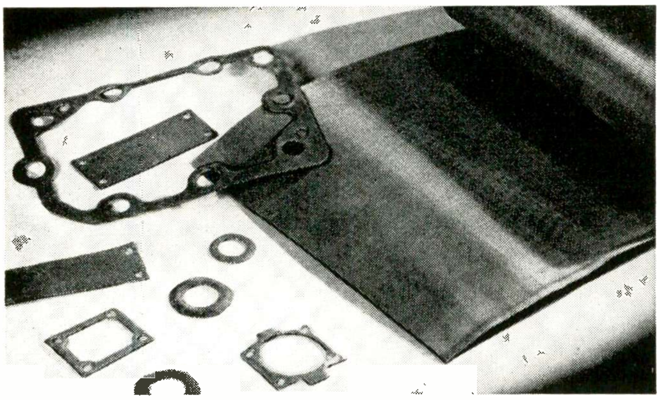

CONDUCTIVE GASKETING

. . . Seals yet conducts high frequency currents

Highly recommended for wave guide gasketing and for shielding between magnetos and their bases, in ignition harnesses and quick disconnect plugs. COHRlastic Conductive Gasketing types 8016 and 8020 are 30 and 24 mesh aluminum alloy wire cloth impregnated with Neoprene to a thickness of .016" and .020". Meets wire and rubber specs — AMS 4182-A and AMS 3222C. For high temperature applications, COHRlastic Conductive Gasketing types 8516 and 8520, impregnated with silicone rubber are used. COHRlastic Conductive Gasketing provides a dependable and economical material which conforms easily to irregular surfaces, is impervious to fluids and maintains radio frequency integrity. Available in 8" widths in lengths up to 50 yards or as cut gaskets to Ordnance or Commercial prints.

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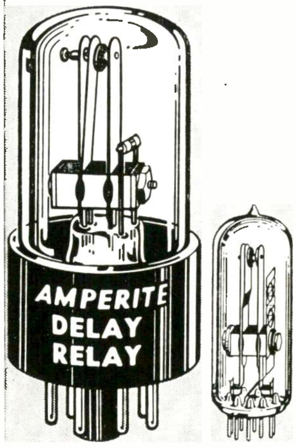
AMPERITE

THERMOSTATIC DELAY RELAYS



2 to 180 Seconds

Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.

Hermetically sealed. Not affected by altitude, moisture, or climate changes.

SPST only—normally open or closed.

Compensated for ambient temperature changes from —55° to +70° C. Heaters consume approximately 2 W. and may be operated continuously. The units are **rugged, explosion-proof, long-lived,** and—**inexpensive!**

TYPES: Standard Radio Octal, and 9-Pin Miniature . . **List Price, $4.00.** Standard Delays

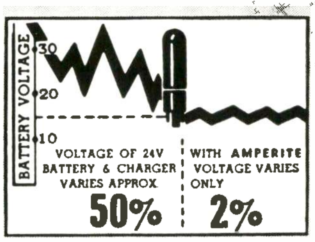
Also — **Amperite Differential Relays:** Used for automatic overload, under-voltage or under-current protection.

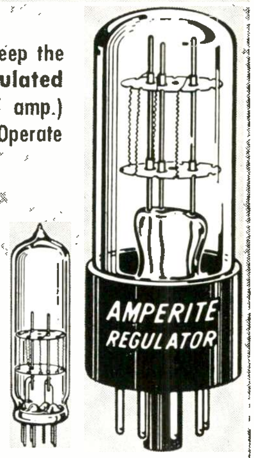
PROBLEM? Send for Bulletin No. TR-81

AMPERITE

BALLAST REGULATORS

Amperite Regulators are designed to keep the current in a circuit **automatically regulated** at a definite value (for example, 0.5 amp.) . . . For currents of 60 ma. to 5 amps. Operate on A.C., D.C., or Pulsating Current.





Hermetically sealed, they are not affected by changes in altitude, ambient temperature (—55° to +90° C.), or humidity . . . Rugged, light, compact, most inexpensive . . . . **List Price, $3.00.**

Write for 4-page Technical Bulletin No. AB-51

AMPERITE

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E.M.I.
MULTIPLIER PHOTOTUBES

For scintillation counters, spectrophotometry, flying spot scanning. The range of phototubes made by E.M.I. is one of the largest in the world. It includes end-window types of 1″ to 15″ diameter, with S10, S11, S13 and S20 cathodes, with 10 to 14 dynodes of venetian blind type or of box and grid or focused construction. Tubes for C^{14} and H^3 Scintillation counting, also very low dark-current types, are an E.M.I. speciality. Tubes can also be produced to special order.

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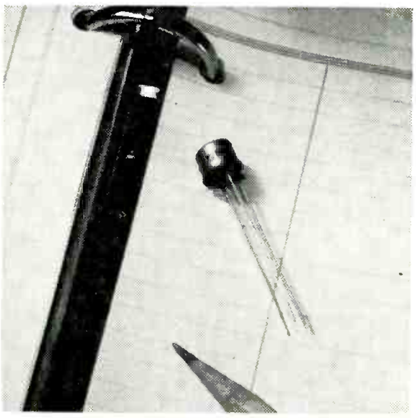
Circle 109 on Inquiry Card

New Products

15 MC SILICON TRANSISTOR

High frequency npn silicon transistors have a min alpha cutoff frequency rating of 15 MC and are JEDEC type-designated 2N1276 to 2N1279. Ac beta (2N1276) ranges from a min. of 9 to a max. of 22; (2N1277) from 18 to 44; (2N1278) from 37 to 90, (2N1279) from 76 to 333 with a design center at 101. Typical 1000-cycle power gain ratings are 37, 39, 44, and 45 db. Typical output capacity, C_{ob}, rating is 2 $\mu\mu$f with the max. ratings at 5 $\mu\mu$f. Collector to base voltage rating is 40 v. Temp. range is from −65 to +200°C. Case dimensions conform to JEDEC outline TO-5. Lead configuration conforms to JEDEC triangular base E-3-44. General Electric Co., Semiconductor Products Dept., Charles Bldg., Liverpool, N. Y.



Circle 177 on Inquiry Card

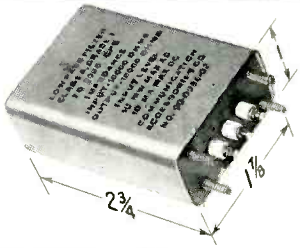
MICROWAVE TUBES

Microwave tubes, the types QKK-837 and QKK838 are mechanically tuned velocity variation oscillators designed for operation in the 67,000 to 73,000 megacycle range with a minimum output of 10 milliwatts. The r-f output is through waveguide sealed by a mica window. The output flange mates with a standard UG385/U cover-flange. Raytheon Company, Waltham 54, Mass.

Circle 178 on Inquiry Card

LOW PASS FILTERS

Developed for standard applications. Built to MIL-T-27A specifications. Requests for special applications invited.



UNIVERSAL 90-0036 SERIES

All units have a loss of less than 3 db at cutoff frequency, and attenuation of greater than 45 db at 1.5 times the cutoff frequency.

Max. AC Operating Level: 10 Milliwatts
Max. DC Operating Voltage: 200 VDC (10 Ma.)

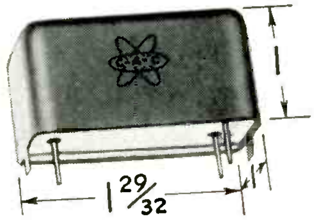
Voltage Breakdown:
500 VRMS, 60 CPS.

Insulation Resistance:
10,000 Megohms

Case: Hermetically sealed, 6-32 studs

Temperature:−40° to +85°C for a pass band tolerance of ± 1 db

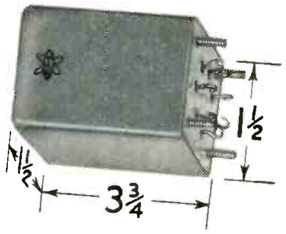
STANDARD VALUES			
Part No.	Z (ohms)	3db Point (cps)	45db Point (cps)
90-0036-00	600	3000	4500
-01	5000	3000	4500
-02	10000	3000	4500
-03	600	6000	9000
-04	5000	6000	9000
-05	10000	6000	9000
-06	600	10000	15000
-07	5000	10000	15000
-08	10000	10000	15000
-09	600	15000	22500
-10	5000	15000	22500
-11	10000	15000	22500



90-0229 SERIES FOR ETCHED CIRCUITRY

Designed specifically for printed circuit applications. Units have a loss of less than 1.5 db at 3500 CPS and an attenuation of 40 db at 4500 CPS.
AC Operating Level:
.5 Volts
DC Operating Voltage: 0
Voltage Breakdown:
300 VDC
Case: Hermetically sealed
Temperature: −40°C to +85°C for a pass band tolerance of ± 1 db

STANDARD VALUES	
Part No.	Z (ohms)
90-0229-00	50000
90-0229-01	20000



90-0145-00 AUDIO OUTPUT LOW PASS FILTER

Designed to operate from tube plate, directly to a 600 ohm line. Unit has a loss of less than .5 db at 3500 CPS and an attenuation of 40 db at 5700 CPS.
Input Impedance: 10,000 ohms
Output Impedance: 600 ohms
Operating Level: 10 DBM
Voltage Breakdown: 500 VDC
DC Input Current: 10 Ma.
Case: Hermetically sealed
Temperature: −40°C to +85°C for a pass band tolerance of ± 1 db

WRITE FOR COMPLETE CATALOG

301

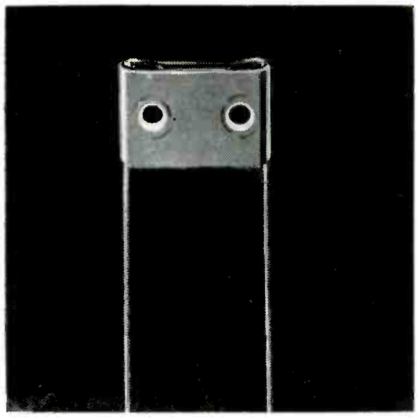
COMMUNICATION ACCESSORIES COMPANY
A Subsidiary of Collins Radio Co.
LEE'S SUMMIT, MISSOURI

Circle 110 on Inquiry Card

New Products

PHOTOCELL

Made of indium antimonide, the Mullard ORPIO, has sensitivity in the infra-red radiation range to 7.5 microns at room temp. Actual spectral response range is from the visible to 8.0μ, peak response 6.0 to 6.5μ. Sensitivity measured with 2μW radiation on sensitive area and 50ma dc applied to cell. With this, signal to noise ratio at 6μ is more than 72 and noise equivalent power at 6μ is 4 x 10^{-9}w. Cell is low impedance in the order of 75 ohms. The max. dc value is 100ma and the max. case temp. 70°C. International Electronics Corp., 81 Spring St., New York 12, N. Y.

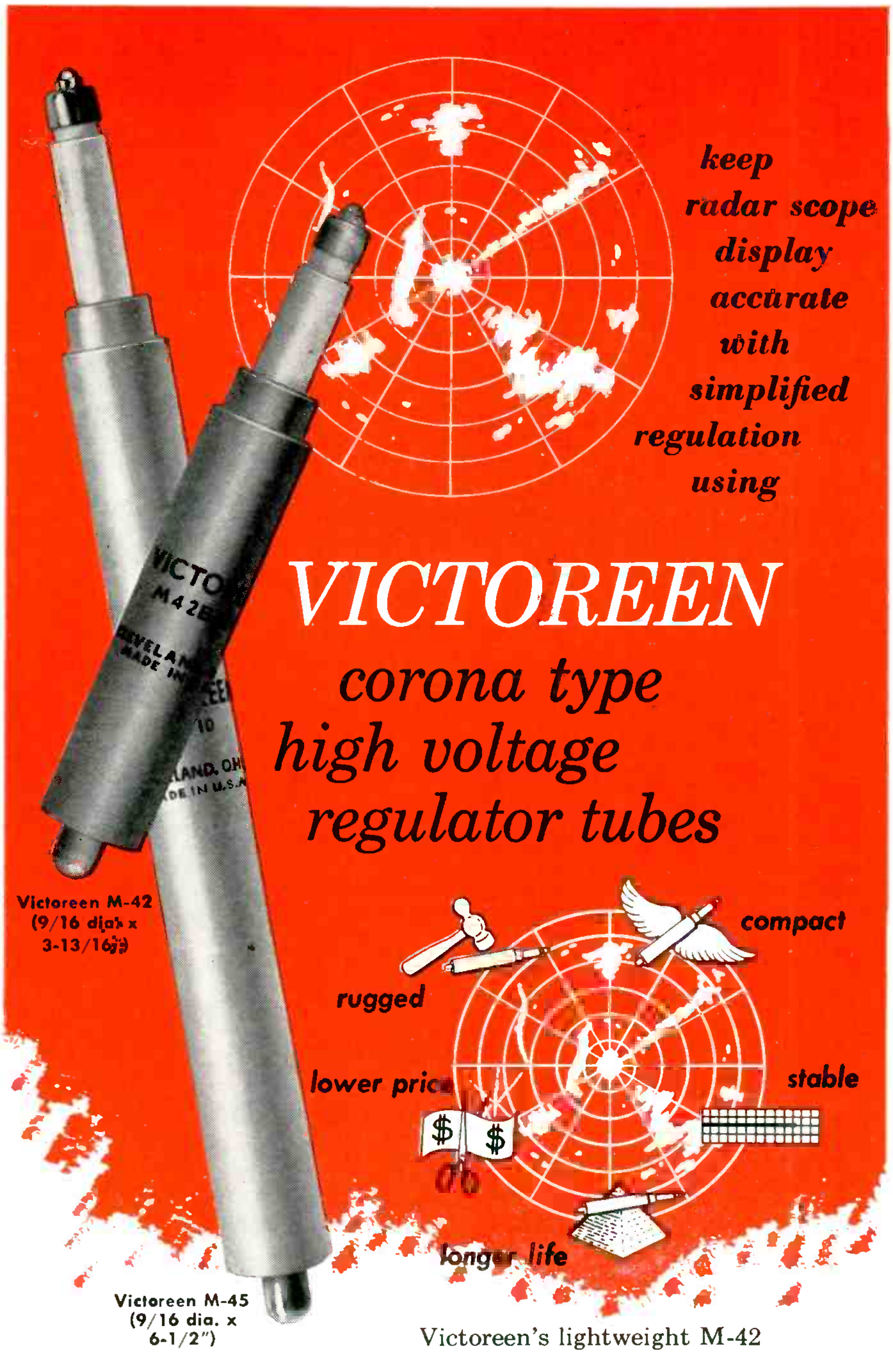


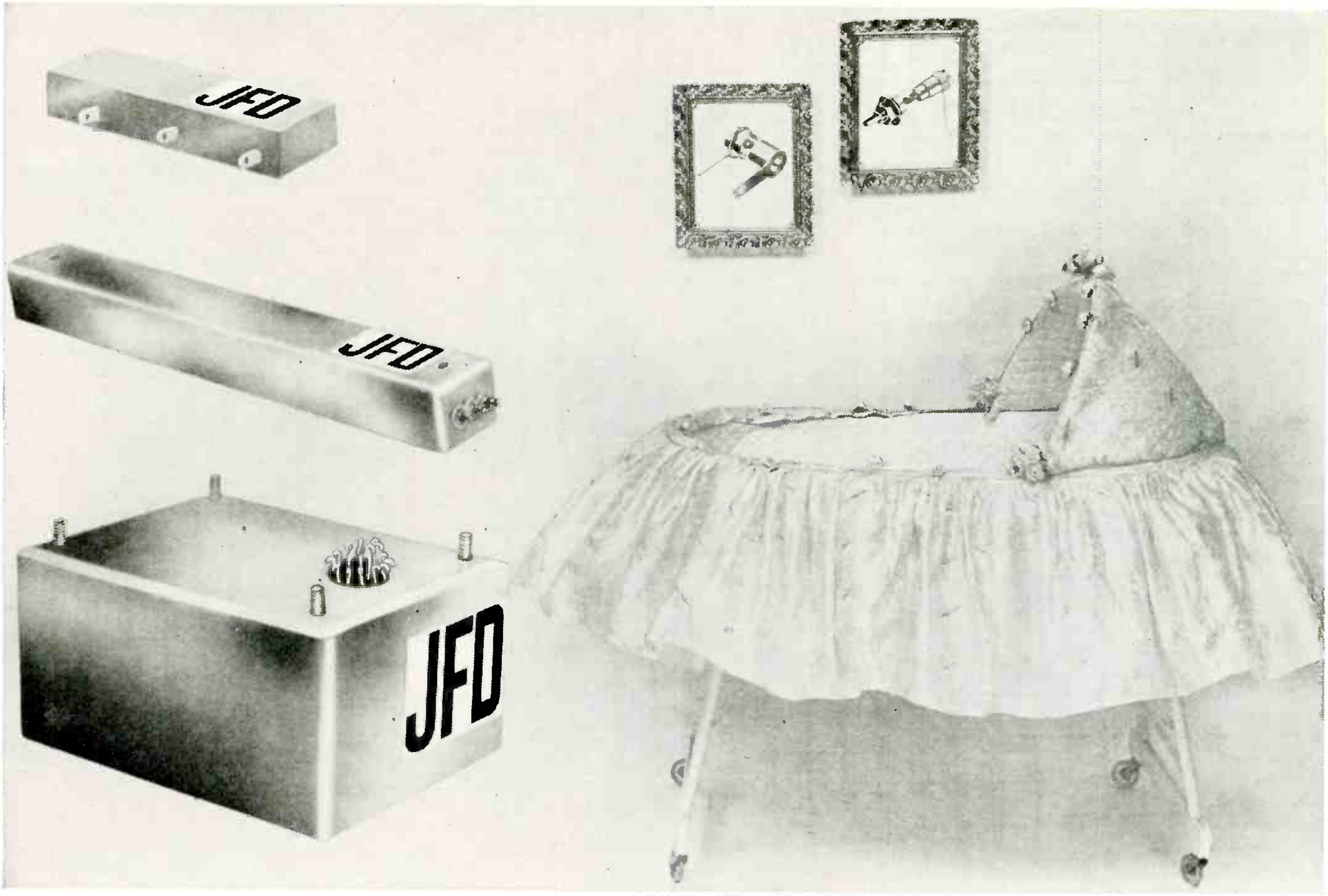
Circle 256 on Inquiry Card

QUARTZ CRYSTAL

Sub-miniature quartz crystal, Type KC-43A in sub-miniature HC-18U military-type holders. Frequency range is 4 MC through 150 MC. Frequency shift is less than ±0.0025% over a temperature range of −55°C to +105°C. Physical dimensions: pin diameter, 0.017; pin spacing, 0.192; body height; 0.530; body width, 0.402; body thickness, 0.150. On the plug-in unit, pin diameter is 0.040. Keystone Electronics Company, 65 Seventh Avenue, Newark 4, N. J.

Circle 257 on Inquiry Card





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Meet the newest addition to the growing family of JFD precision electronic components.

Designed with compactness, ruggedness and reliability in mind, new JFD lumped constant Delay Lines upgrade your prototype or production project.

Compare the advantages of the standard JFD lumped constant delay lines:

- High delay-to-rise time ratio with minimum signal attenuation.
- Tolerance of ±5% max. on delay and characteristic impedance.
- Temperature range of –55° C to +125° C.
- Delay time thermal stability of 50 parts per million per degree centigrade.
- Up to 25 Mc bandwidth.
- Virtually linear phase shift.
- Hermetically sealed metal cases for maximum resistance to shock, vibration and humidity.
- Meet all applicable MIL specs.

Typical Standard Delay Line Characteristics

Delay Time 5 µ sec.		10 µ sec.		25 µ sec.	
Rise Time	Size	Rise Time	Size	Rise Time	Size
1.0	1 1/8x1 1/8x2 1/4	2.0	1 1/2x1 1/2x3	5.0	1 7/16x1 7/16x2 7/8
.5	1 5/16x1 5/16x2 5/8	1.0	1 5/8x1 5/8x3 1/4	2.5	1 3/4x1 3/4x3 1/2
.3	1 3/8x1 3/8x2 3/4	.6	1 3/4x1 3/4x3 1/2	1.5	2 7/16x2 7/16x4 7/8
.15	2 1/4x2 1/4x4 1/2	.3	2 1/4x2 1/4x4 1/2	.75	2 3/4x2 3/4x5 1/2

Range of characteristic impedance: 50 ohms to 2000 ohms ±5%.
Attenuation: Less than 1db per. µ sec. up to 3 µ sec. delay; 6db max. up to 50 µ sec. delay.
Temperature stability: 50 parts per million per degree C from –55° to +125° C.

Whether your application calls for standard or custom-built lumped constant or distributed constant delay lines, our engineering staff will be glad to review your needs and submit recommendations. Closer tolerance delays and impedances are available, in forms, sizes and terminal designs to match your needs. Write for Bulletin No. 213A.

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Circle 112 on Inquiry Card

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Look at these *exclusive* features...

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- *built-in* Automatic Gain Control
- *built-in front panel* switching for grid or anode modulation
- *built-in* digital readout for delay line supply
- *built-in* dual output jacks for parallel tube operation or external metering

PLUS automatic sequential application of filament, grid and collector, delay line, and anode voltages... each with its own *front panel adjustments.*

Naturally, there is automatic safety overload protection in the anode, delay line, and collector current circuits. The best news (of course) is that the PRD 813 BWO/TWT Power Supply is available FROM STOCK.

For the full story on the PRD 813, contact your nearest PRD representative or write:

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Western Sales Office:
2639 So. La Cienega Blvd., Los Angeles 34, Calif.
UPton 0-1940

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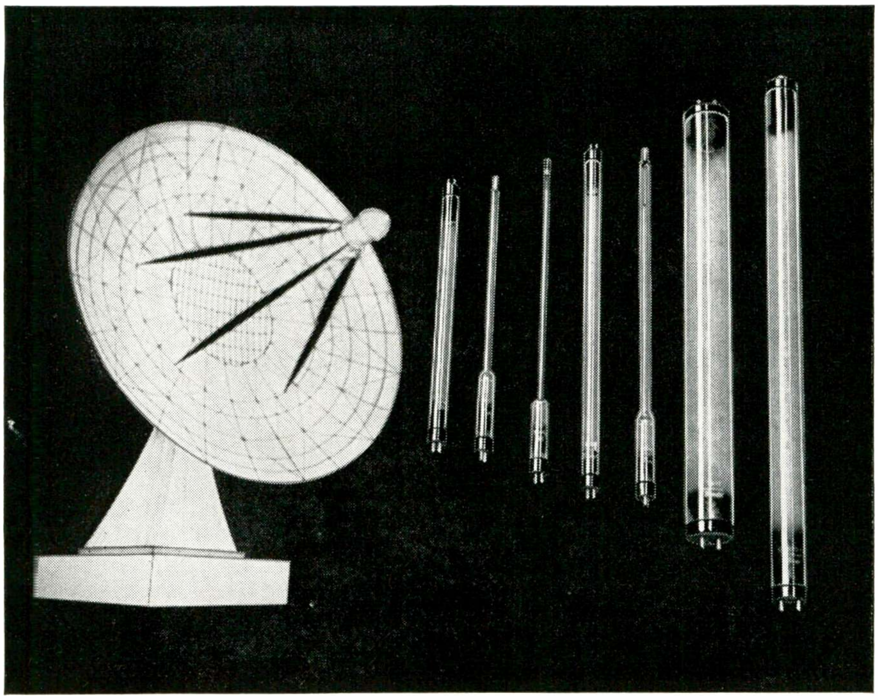


Tech Data

for Engineers

Terminal Strips

Four-page brochure from Tektronix, Inc., P.O. Box 831, Portland 7, Oregon, contains tech. data on ceramic terminal strips. Tabular data and dimensional drawings are included.

Circle 258 on Inquiry Card

Waveguide Data

Wall chart from Narda Microwave Corp., 118-160 Herricks Rd., Mineola, L.I., N.Y., lists standard Waveguide data in tabular form. Included are Frequency (TE_{10} Mode), Waveguide size, Narda and EIA Type designation, theoretical attenuation, waveguide wave length, and theoretical C W power rating.

Circle 259 on Inquiry Card

Dials—Drives

Bulletin 59-6, 8 pages, 2 colors, describes and gives specs of an assortment of dials, rim and planetary drives, and vernier mechanisms. National Radio Co., 37 Washington St., Melrose 76, Mass.

Circle 260 on Inquiry Card

Pressure Pickup

The 4-380A potentiometer pressure pickup for missile use is described in bulletin 1604 from the Transducer Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif. The pickup is designed to operate in rugged environments. A general description, design features, and specifications are included.

Circle 261 on Inquiry Card

Voltmeter

Illustrated bulletin features the SIE Model R-2 voltmeter and its applications—such as measuring the regulation of power supplies, the resolution of potentiometers, and the linearity of amplifiers. Southwestern Industrial Electronics Co., div. of Dresser Industries, Inc., 10201 Westheimer, P. O. Box 22187, Houston 27, Tex.

Circle 262 on Inquiry Card

Diode Encapsulation

A process by Epoxy Products, Inc., 137 Coit St., Irvington, N. J., makes possible the use of economical mass production techniques in the encapsulation of diodes. The E-Pak system consists of an epoxy molded case and a yellow E-Form pellet with a step configuration that provides easy positioning of the diode. The diode is inserted into the assembled pellet and case. With the application of heat, the pellet melts and seals the unit. No expensive fixturing is required.

Circle 263 on Inquiry Card

FREQUENCY STANDARDS

PRECISION FORK UNIT
TYPE 50

Size 1" dia. x 3¾" H. Wght., 4 oz.*

Frequencies: 240 to 1000 cycles

Accuracies:—
Type 50 (±.02% at —65° to 85°C)
Type R50 (±.002% at 15° to 35°C)

Double triode and 5 pigtail parts required

Input, Tube heater voltage and B voltage

Output, approx. 5V into 200,000 ohms

*3⅛" high
400 - 1000 cy.

FREQUENCY STANDARD
TYPE 50L

Size 3¾" x 4½" x 5½" High
Weight, 2 lbs.

Frequencies: 50, 60, 75 or 100 cycles

Accuracies:—
Type 50L (±.02% at —65° to 85°C)
Type R50L (±.002% at 15° to 35°C)

Output, 3V into 200,000 ohms

Input, 150 to 300V, B (6V at .6 amps.)

PRECISION FORK UNIT
TYPE 2003

Size 1½" dia. x 4½" H. Wght. 8 oz.*

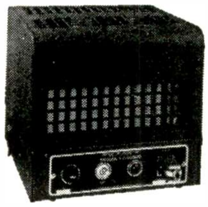
Frequencies: 200 to 4000 cycles

Accuracies:—
Type 2003 (±.02% at —65° to 85°C)
Type R2003 (±.002% at 15° to 35°C)
Type W2003 (±.005% at —65° to 85°C)

Double triode and 5 pigtail parts required

Input and output same as Type 50, above

*3½" high
400 to 500 cy.
optional



FREQUENCY STANDARD
TYPE 2005

Size, 8" x 8" x 7¼" High
Weight, 14 lbs.

Frequencies: 50 to 400 cycles
(Specify)

Accuracy: ±.001% from 20° to 30°C

Output, 10 Watts at 115 Volts

Input, 115V. (50 to 400 cycles)

FREQUENCY STANDARD
TYPE 2007-6

NEW

TRANSISTORIZED, Silicon Type

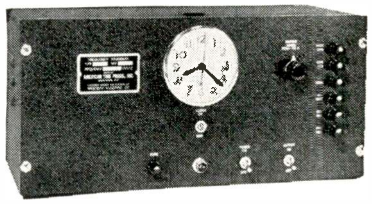
Size 1½" dia. x 3½" H. Wght. 7 ozs.

Frequencies: 400 — 500 or 1000 cycles

Accuracies:
2007-6 (± .02% at —50° to +85°C)
R2007-6 (±.002% at +15° to +35°C)
W2007-6 (±.005% at —65° to +125°C)

Input: 10 to 30 Volts, D. C., at 6 ma.

Output: Multitap, 75 to 100,000 ohms



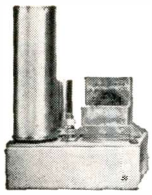
FREQUENCY STANDARD
TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.

Output: 115V
60 cycles, 10 Watt

Accuracy:
±.001% from 20° to 30°C

Input, 115V (50 to 400 cycles)



FREQUENCY STANDARD
TYPE 2001-2

Size 3¾" x 4½" x 6" H., Wght. 26 oz.

Frequencies: 200 to 3000 cycles

Accuracy: ±.001% at 20° to 30°C

Output: 5V. at 250,000 ohms

Input: Heater voltage, 6.3 - 12 - 28

B voltage, 100 to 300 V., at 5 to 10 ma.

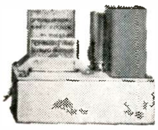
FREQUENCY STANDARD
TYPE 2111C

Size, with cover
10" x 17" x 9" H.
Panel model
10" x 19" x 8¾" H.
Weight, 25 lbs.

Frequencies: 50 to 1000 cycles

Accuracy: (±.002% at 15° to 35°C)

Output: 115V, 75W. Input: 115V, 50 to 75 cycles.



ACCESSORY UNITS
for TYPE 2001-2

L—For low frequencies
multi-vibrator type, 40-200 cy.
D—For low frequencies
counter type, 40-200 cy.
H—For high freqs, up to 20 KC.
M—Power Amplifier, 2W output.
P—Power supply.

This organization makes frequency standards within a range of 30 to 30,000 cycles. They are used extensively by aviation, industry, government departments, armed forces—where maximum accuracy and durability are required.

WHEN REQUESTING INFORMATION
PLEASE SPECIFY TYPE NUMBER

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Watch Master
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NEW KAY Rada-Sweep® 300

FUNDAMENTAL SWEEPING OSCILLATOR TO ALIGN RADAR IF's
Between 1 and 350 mc Center

- Single Unit Sweeping Oscillator with Twelve Wide Bands at Customer Specified Center Frequencies
- 30 Crystal Marks Set to Your Specification
- Single Switch Provides Sweep and Markers Simultaneously
- Highly Stable; Low Harmonic Content; No Spurious Signals

Catalog No. 386-A

SPECIFICATIONS

Frequency Range: Any 12 fixed center frequencies set to customer specifications between 1 mc and 350 mc. Twelve switched bands; fundamental frequency; all-electronic sweep.
Sweep Width: 70% of center frequencies selected between 1 and 100 mc; 60 to 70 mc for frequencies between 100 and 350 mc.
Sweep Rate: Variable around 60 cps. Locks to line frequency.
RF Output: 0.5 V rms into nom. 70 or 50 ohms, higher for lower frequency units. Output held constant to within ±0.5 db over widest sweep by AGC circuit.
Zero Reference: A true zero-base line is produced on oscilloscope during retrace time.
Attenuators: Switched 20, 20, 10, 6 and 3 db plus continuously variable 6 db.
Markers: Up to 30 crystal-controlled positive-pulse markers at customer-specified frequencies. Accurate to ±0.05%. Up to three markers per band (more at lower frequencies) are available; no individual switches on markets.
Marker Amplitude: Continuously variable, zero to 10 V peak.
Sweep Output: Regular sawtooth synchronized with sweeping oscillator.
Power Supply: Input approx. 150 watts, 177 V (±10%) 50-60 cps B+ electronically regulated.
Dimensions: 8¾" x 19" rack panel, 13" deep. Supplied with cabinet.
Weight: 34 lbs. approx.
Price: $850.00 f.o.b. factory plus $17.00 per crystal marker.

Write for New Kay Catalog

KAY ELECTRIC COMPANY
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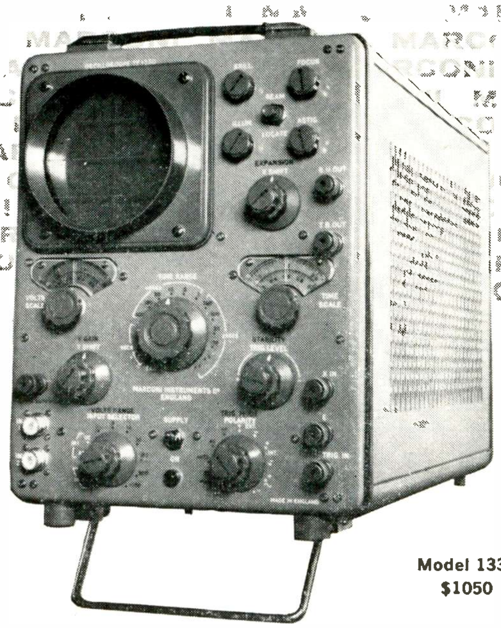

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DC–15Mc (—3dB)
.025μsec Risetime
.25μsec delay
50mV/cm to 50V/cm

X AMPLIFIER
DC to 2 Mc (—3dB)
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Automatic Triggering and
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X and Y gain continuously variable and continuously calibrated to 2%

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INSTRUMENTS

111 CEDAR LANE • ENGLEWOOD, NEW JERSEY
Circle 117 on Inquiry Card

Tech Data

for Engineers

Synchro Test Equipment

A 36-page, 1960 catalog from Theta Instrument Corp., 520 Victor St., Saddle Brook, N.J., describes a line of equipment which measures the electrical characteristics of control synchros, torque synchros, and computing resolvers, Theory of operation, operating procedure and specs are included.

Circle 264 on Inquiry Card

Choppers

Synchronous modulator - demodulator functions are performed in single DPDT choppers. Bulletin C-43 from Airpax Electronics, Inc., Cambridge Div., Cambridge, Md., describes Types 600 and 800 DPDT choppers for 400 and 60 CPS operation and illustrates typical circuit applications, internal construction, dimensions and terminal connections.

Circle 265 on Inquiry Card

Variable Transformers

Bulletin 151 from Ohmite Mfg. Co., 3654 Howard St., Skokie, Ill., describes a supplementary line of cased variable transformers for portable use or for fixed-mounting. Overvoltage type to 7.5a and no-overvoltage types to 10a are included.

Circle 266 on Inquiry Card

Magnetic Shielding

Data Sheet 150 from Magnetic Shield Div., Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill., describes the problems extremely low level magnetic fields have on backward wave tubes and how these problems can be eliminated by low leakage Co-Netic Netic magnetic shields.

Circle 267 on Inquiry Card

Linear Amplifier

Illustrated brochure, Form 3014-9C, details uses for the Model 851 DD-2 non-overload linear amplifier. Performance, spec data, and available optional accessory equipment are included. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 268 on Inquiry Card

Motors—Controls

Catalog No. EE-100, 36 pages, illustrates the facilities and products of the EEMCO Div. of Electronic Specialty Co., 4612 W. Jefferson Blvd., Los Angeles, Calif. Products covered include ac and dc motors, linear and rotary actuators, gear boxes, turbine controls and electromechanical systems.

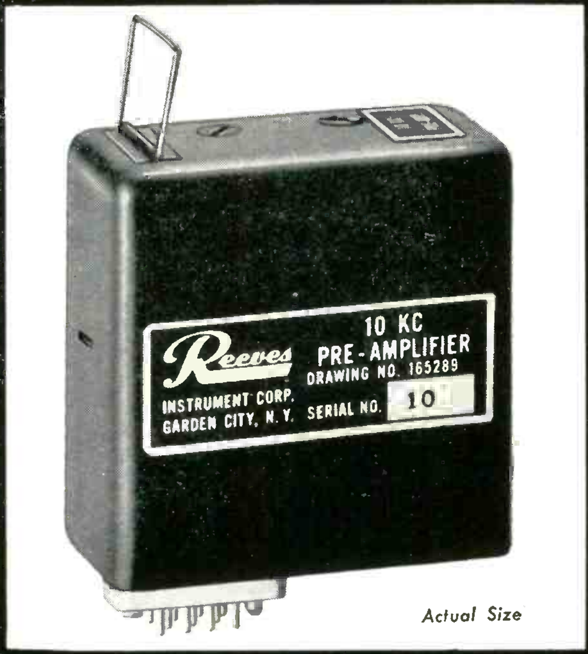
Circle 269 on Inquiry Card

Reeves INSTRUMENT CORPORATION

Subminiature Computers

MODULAR DESIGN

- COMPUTER AMPLIFIERS
- COMPUTER CONTROL SYSTEMS



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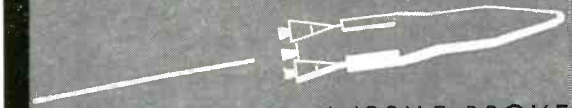

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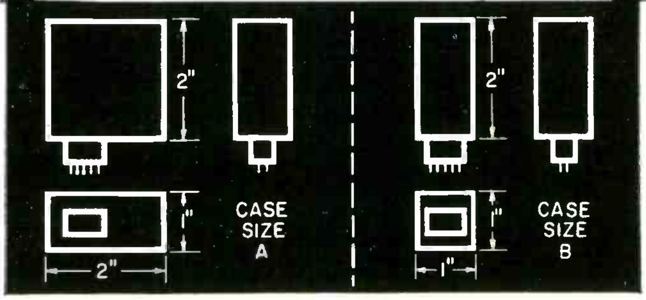
FULLY DESIGNED AND DEVELOPED TO MEET APPLICABLE MILITARY SPECIFICATIONS



AVAILABLE TYPES

AMPLIFIER	Case Size	AMPLIFIER	Case Size
Resolver Drive Amplifier	B	A-C Amplifier	A
A-C Summing Amplifier	A	D-C Amplifier	A
A-C Isolation Amplifier	A	Pulse Amplifier	A
AGC Amplifier	A	ADC Drive Amplifier	B
Relay Amplifier	A	Pulse Power Amplifier	A
Servo Preamplifier	A	Accumulator Amplifier	A
Servo Power Amplifier	A	Electronic Differential	A

Diode Synchro Signal Selector

DESIGN FEATURES

- Completely encapsulated for continued reliability under extreme environmental conditions
- Plug-in modular design for rapid assembly and ease of maintenance
- Fully transistorized—Minimum Weight and Volume
- Cadmium-plated steel casings for electrical shielding
- Meet MIL specifications: MIL-E-8189 and MIL-E-5400, Classes I and II

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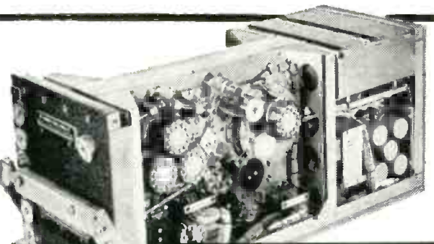

12RV59

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Circle 118 on Inquiry Card

Antenna Calculations

(Continued from page 98)

intensity versus frequency for both the folded-unipole, and for the stub antenna are plotted. Several values of X_n corresponding to different amounts of down-lead tuning are indicated for the folded-unipole. Also the driving current is noted. As can be seen, operation with $X_n = \frac{1+P}{P} X_a$, (600 ohms) produces a significant improvement in radiated field intensity as reflected in the lower driving point current required to give comparable field intensities. Disadvantages in operating under this condition are:

(1) The change in driving-point impedance (reactance component) as observed in Fig. 9 changes about 35% when the frequency is varied from 430 to 470 KC. This would complicate system design and may not give adequate BW for particular applications.

(2) Operation under this condition would not give the required radiated bandwidth ($Q_R \neq Q_{D.P.}$).

(3) The driving-point impedance Z'_{mg} is sizeable, requiring a high drive voltage to produce the necessary antenna current.

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The Editor
ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Phila. 39, Pa.

Conclusions

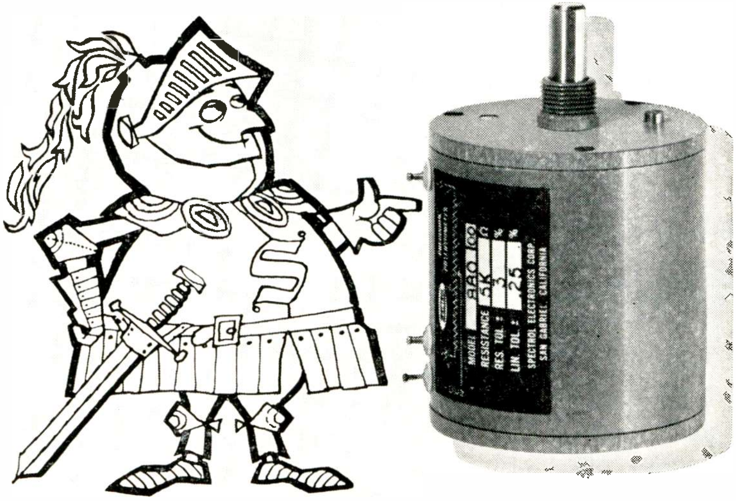
As a result of this analysis, the following conclusions were reached:

(1) Operation of the folded unipole can be fully specified by using the generalized equivalent circuit (Fig. 3).

(2) The folded-unipole exhibits characteristics, which make it suitable for uses requiring a low antenna driving-point impedance. Two conditions with regard to downlead tuning were shown to exist satisfying this requirement. One condition $X_n = 0$, showed poor efficiency, the other condition $X_n > [1 + P^*/P] X_a$, yielded a reasonable value of efficiency.

(3) The folded-unipole can be operated to yield radiated field intensities somewhat greater than the stub antenna for a given driving current. This results when $X_n = [1 + P^*/P] X_a$, but as cited in the previous section several major disadvantages result for this mode of operation.

(4) While some advantage may be realized by using the folded-unipole configuration with re-



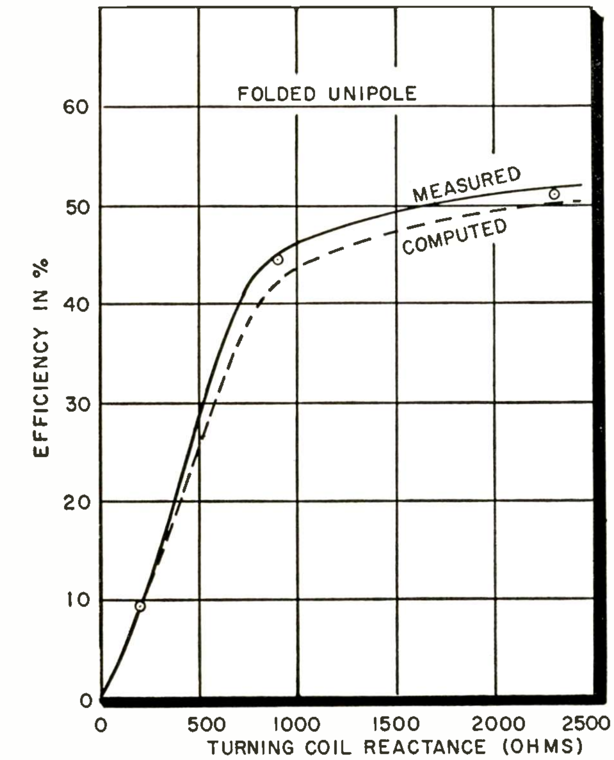


Fig. 7: Radiation efficiency (ant. only) vs. tuning coil reactance

gard to driving-point Q and radiated field intensity, care must be exercised to assure adequate radiated bandwidth since, in general $Q_R \neq Q_{D.P.}$

(*Continued on page* 174)

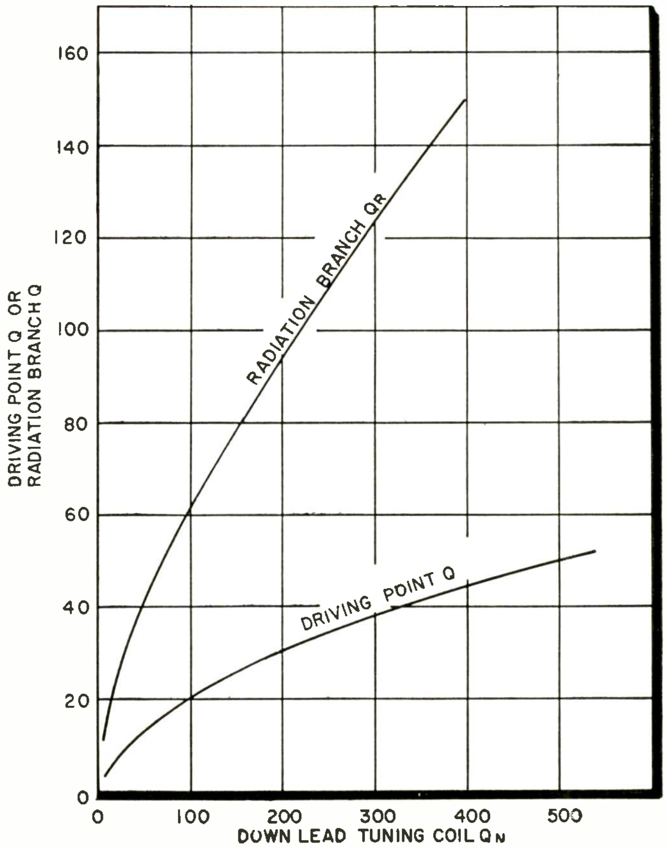


Fig. 8: Plots of radiation branch Q and driving point Q are shown as a function of the tuning coil Q

The Metal Pots

Spectrol offers four 3-turn and four 10-turn models. All feature anodized aluminum cases with 3/16-inch thick walls. These 8 precision wire-wound pots absorb no moisture—dissipate heat fast and stay dimensionally stable. They operate from −55°C to +125°C and withstand relative humidity of 95%.

You can choose diameters of 7/8, 1, 1-5/16 and 1-13/16 inches in both 3 and 10-turn models. Resistance ranges to 1,000,000 ohms with standard linearity tolerances of ±0.25% (0.020% on special order). Like Sir Spectrol, the new multi-turns will take a respectable jolt. They function to 20g vibration from 55 to 2.000 cps and withstand 30g shocks.

Please write for literature, or consult the yellow pages of your phone book for your Spectrol engineering sales representative.

SPECIFICATIONS

MODEL	540	530	580	560	780	790	880	840
No. of coil turns	10	3	10	3	10	3	10	3
Diameter (inches max.)	⅞	⅞	1	1	1 5/16	1 5/16	1 13/16	1 13/16
Standard resistance range in ohms (±3%)	25-125K	10-36K	25-150K	10-40K	30-300K	10-90K	50-400K	20-120K
Special resistance to	250K	75K	250K	75K	750K	240K	1 meg	330K

SPECIAL POTS

Spectrol can design and deliver the pot you need when you need it. Recent custom designs include pots for airborne computers, pots designed to be immersed in fuel, pots for high temperature application, pots with non-linear functions, and many others. Let us know your requirements.

STANDARD POTS

Popular single and multi-turn models and turns counting multi-dials are stocked in 30 electronics supply houses in the U. S. and Canada. Ten resistance ranges from 100 ohms to 200 k ohms with standard linearity tolerances of ±0.3% are available.

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1704 SOUTH DEL MAR AVENUE • SAN GABRIEL, CALIFORNIA

Antenna Calculations

(*Continued from page* 173)

Acknowledgments

The author wishes to express his appreciation to the Low-Frequency Navigation staff for their help in collecting the data.

Field Test data presented was obtained while performing work on Contract DA 36-039 SC-78020.

References

1. J. Leonhard, R.D. Mattuck and A. J. Poté; "Folded Unipole Antennas," *IRE Transactions Antenna and Propagation,* July 1955, pp 111-116.
2. R. Guertler: "Impedance Transformation in Folded Dipoles," *Proc IRE,* Vol. 38, Sept 1950, pp 1042-1047.

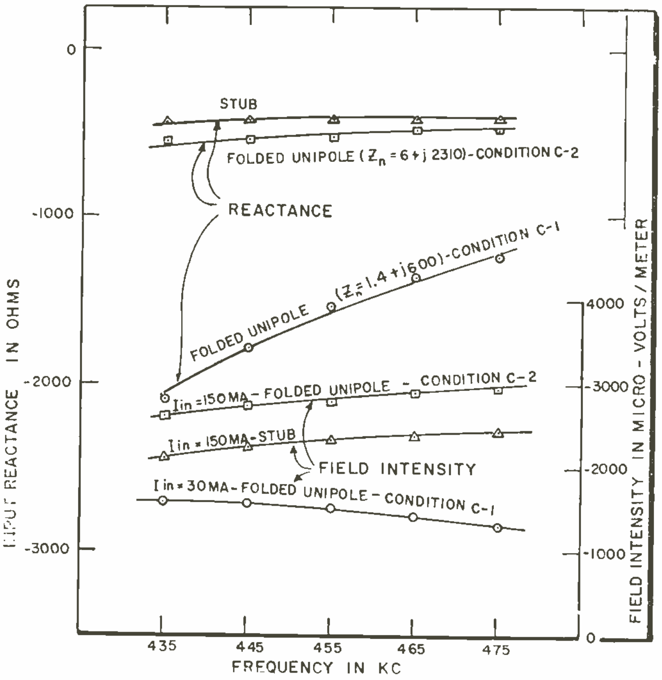

Fig. 9 (right): Input reactance and field intensity vs. frequency

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Sinclair Reports on Hungarian Microwave

Dr. Donald B. Sinclair, Vice-President and Chief Engineer, General Radio Co., West Concord, Mass., returned to Boston on **November 18th.** He had just attended a symposium on microwave communications in Hungary.

One of four outsiders, and the only American, present at the meeting, Dr. Sinclair summarized his experiences at a press conference just before acting as Chairman of the International session of NEREM. Dr. Sinclair, who last year attended the Russian version of the National IRE Show at Poppov, received his invitation to the Hungarian meeting directly. While in Hungary he was permitted to visit some of the electronic plants in and around Budapest. His observations of their manufacturing techniques and technology appeared more newsworthy than the papers which he heard at the symposium. One comment, however, on the symposium is in order. A Hungarian microwave relay system, 24 channels, PPM, was described which though competent, did not compare with those in use in the U. S.

Though the Hungarians objected to his plant tours, they finally conceded, and, in fact, readily answered most of his questions.

One of the first things noticed in the Hungarian plants was the tooling. Much of it is Russian — and better than United States' equipment. A large portion of the manpower in each plant is devoted to tooling — on the order of 70 out of every 1000 employees.

Some components, especially electrolytic capacitors, are imported. In this country it appears that research and development work is done by the Institute. When completed the project is then turned over to an independent manufacturer.

All Hungarian technology is self sufficient. If a manufacturer cannot immediately find a component he desires, he will proceed to manufacture it himself. Dr. Sinclair

queried his hosts on the pay of the production workers. In his opinion, based on the present exchange rate, they are paid much lower than workers in this country. The Hungarian monetary unit is the fared. It is equal to 4.33 cents. In the plant where the AT403 television receiver, a 90° tube without etched circuits set, is made, girls on the assembly line are paid 5 to 6 fareds per hour. Those in the test section received 7 to 12 fareds per hour. They all worked an 8 hr. day, 5 day week. There are two assembly lines in operation and they can produce 100 sets per day. The director of the plant stated that they were trying to improve conditions but had nothing to say on the pay rates.

Etched circuits are used, but their soldering technique is quite different from that used in the United States. Solder is applied only where wanted; that is, the dip solder method is not used. It was suggested that they might be trying to save solder.

Standardization seems to be very minor throughout the manufacturing facilities of Hungary. The attitude of the plant workers and director toward the West appeared bland. Dr. Sinclair further observed that digital techniques up to 10 mc were evidenced. Oscilloscopes could handle up to 10 mc. No multi-trace scopes were seen.

Industrial distribution of the equipment is probably handled through the Ministry. The Ministry controls both the institute and the factory in the particular field.

The Hungarian engineer does not appear to be as well off as his counterpart in Russia.

Many of the people contacted in Hungary could speak English. In the schools of that country the Russian language is compulsory. The students are allowed to select their other language — and this is usually English.

There are powers at work in Hungary trying to establish that country as an instrument center. They want IRE cooperation. An embargo which we placed on goods to Hungary caused that country to become a dandy instrument country.

In his hotel room in Budapest, Dr. Sinclair had a TV receiver and telephone. The TV reception was only fair. But, Dr. Sinclair could not determine whether the receiver or the transmitter was at fault. It must be remembered that TV is only 2 years old in this central European country.

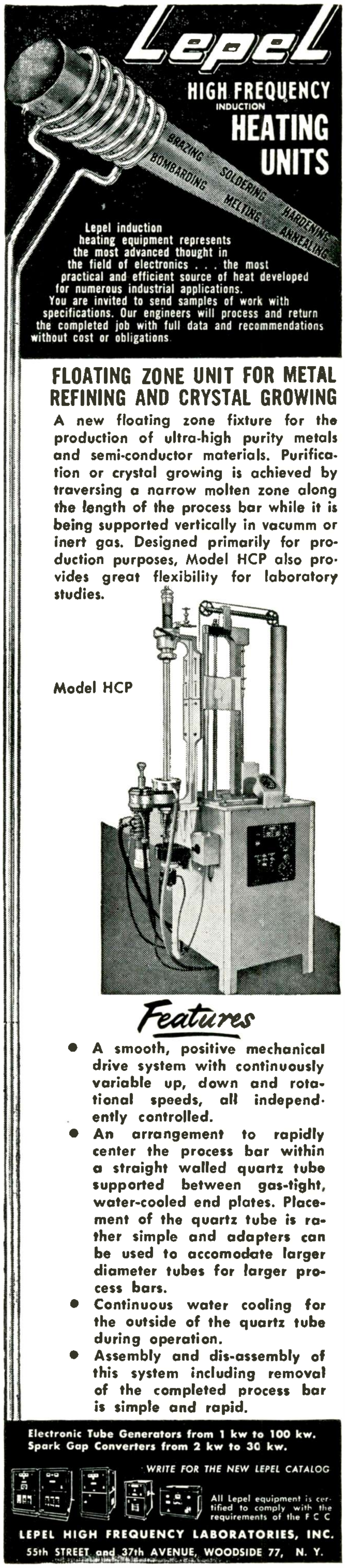
Getting back to education, three types of scholarships are available in Hungary. First is the state educational scholarship which is usually provided by the average student and is accompanied with a grant of 400 fareds per month; the second is a society and industrial scholarship and is for those with a higher intelligence and provides 400 fareds per month above that of the state education but the student must agree to work 3 to 5 years with the sponsoring organization. The third type of scholarship is a special or government. This is usually granted to military and political students.

Dr. Donald B. Sinclair, VP and Chief Engineer of General Radio Co., recently attended a communications symposium in Hungary. He was permitted to visit several manufacturing plants during his stay. His observations are summarized in these columns.

The Hungarians make their own ferrites and appear to do very good work. They have also made silicon and germanium crystals with good noise figures.

The instruments manufactured in Hungary are better than that which would be supplied to a service man but could not be considered in the precision class.

Another comment on education —Universities award two types of degrees: One is a diploma engineer (dipl-ing) and the other is a doctor engineer (dr-ing). The academy grants an award of Doctor of Science. This degree is modeled after the Russian Doctor, which incidentally, is quite difficult to obtain. A man must actually prove himself for several years in industry before he can obtain a Doctor of Science degree in either Hungary or Russia. He normally can never be younger than 35 or 36 years of age.



Ferroelectric Converter

(Continued from page 77)

do not have to use battery power as is the case in the circuit described above. One way of eliminating the need of battery power is to use a storage battery in series with the load, Fig. 3. A storage battery charges the converter capacitor over a charging diode. After heating, the stepped-up voltage is fed through a discharge diode, a load, and the storage battery. Thus, the electrical charge is returned to the battery. The load itself could be a storage battery which would act as a buffer.

Another way of eliminating battery power is shown in Fig. 4. Battery 7 serves only to initially charge or "prime" a multitude of converter capacitors (9, 10, and 11) and to overcome leakage in these capacitors. A high value charging resistor 8 or a diode is used in series with the battery to prevent the discharge of output currents through the battery. Converter capacitors 9, 10, and 11 are temperature cycled in such a fashion that they are at different points of the cycle at a given moment. Assuming capacitor 9 at temperature T_b and capacitor 10 at T_c, a discharge of 9 over diode 12, load 13 and a charging of capacitor 10 will take place. In the next step, capacitor 10 will discharge and charge 9 and/or 11. In this fashion, the total charge is recirculated between the capacitors, resulting in a d-c current through load 13.

High-Voltage Generators

Ferroelectric energy converters inherently have higher output voltages than other known converters. These output voltages can be in excess of 1000 v.

Extremely high voltages can be obtained by cascading several stages of converter capacitors so that the output voltage of a preceding stage may be used to charge the following capacitor, Fig. 5. Four converter capacitors, 20-23 are attached to a rotating cylindrical or spherical body, 24, which forms a common outside electrode. It is assumed that the cylinder is heated at the top to a temperature T_b and cooled by a heat sink or by radiation to a temperature T_c. The optimum output voltage, V_n, of a converter with n capacitor stages is given by

$$V_n = V_c\left(\frac{K_c}{K_b}\right)^n, \text{ where } V_c$$

is the voltage of battery 27. In the example shown, $n = 4$, so that the output voltage becomes

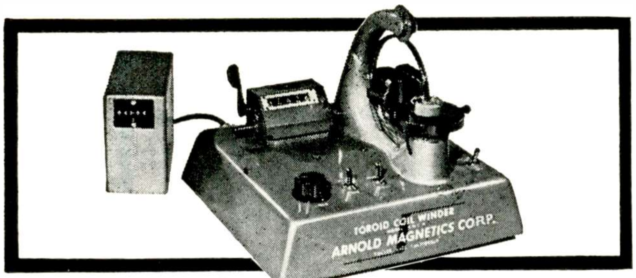
$$V_c\left(\frac{K_c}{K_b}\right)^4.$$

The electrical charge is fed back into capacitor 20 and recirculated. Battery 27, consequently, supplies only the initial charge and leakage losses as in the case of Fig. 4.

A device as shown in Fig. 5 lends itself particularly well for satellites or space vehicles which can easily be made to spin and use solar energy. The high voltage can be used as energy source for ion propulsion or other purposes.

A-C Generators

Since the new ferroelectric energy converter requires temperature cycling of ferroelectric capacitors, it is ideally suited for the generation of alternating currents. The principle of an a-c generator is shown in Fig. 6. It shows a section through a rotating cylindrical or spherical body such as a spinning satellite. Two large ferroelectric converter capacitors are arranged on opposite sides of the satellite so that one is heated by incoming solar radiation while the other is cooled through radiation. The outside electrodes of both capacitors are on common ground. The inside electrodes are connected through a load. The capacitors are charged initially by a battery and resistor. This electrical charge is driven back and forth through the load as both capacitors are heated and cooled alternately. The battery has only to supply the leakage currents which can also be obtained from a rectified output. It should be noted that the electrical energy dissipated in the load is derived from the temperature cycling of the ferroelectric capacitors, and not from the rotational energy of the body as in conventional electromagnetic generators.



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sets up quickly . . . easy to operate . . .
takes wide range of wire sizes

SPECIFICATIONS:

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- Max. finished toroid O.D.: 4.0 in.
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- Wire range: AWG 44 to AWG 26
- Dual, self-checking turns counting system
- Loading (wire length) counter
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PRODUCTION USE

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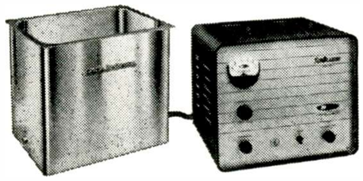

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Submersible Transducers

Model NT-604 — Hermetically sealed heli-arc welded stainless steel case. Radiating face: 27 sq. in. Effective plane of radiation: 40 to 50 sq. in. (approx. 10" x 5"). Effective cavitation of volumes: up to 1200 cu. in. at 24" tank height (5 gal.) and 2400 cu. in. at 48" tank height (10 gal.). Swagelok tube fitting on side or end for internal tank wiring.

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Now you can say goodbye to expensive chemicals, solvents, and degreasing equipment . . . reclaim valuable floor space . . . eliminate high installation costs . . . just by installing a Narda Series 1500 SonBlaster. At the same time, you'll get better, faster cleaning, and you'll need fewer people to do the job!

Get the tremendous activity of the new 300-watt Narda SonBlaster, with the largest transducerized tank ever made, at the lowest price in the industry! Choose from transducerized tanks or submersible transducers for use in any arrangement in any shape tank you desire. Up to 4 submersible transducers can be easily operated from the same generator at one time; load selector switch provided — an exclusive Narda feature.

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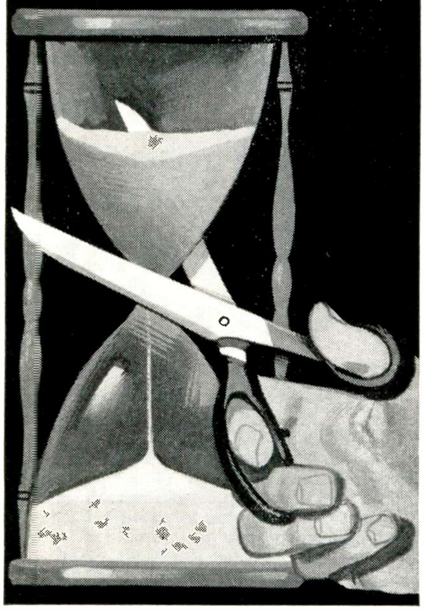


Industry News

C. P. Pesek, Minnesota Mining & Mfg. Co., Vice-President for Engineering and Staff Manufacturing, has been elected to the 3M Board of Directors and to the Executive Committee.

Radiation Inc., has announced the appointment of **William C. Holmes** as Vice-President and Manager of the Space Communications Div. of Mountain View, Calif.

Myron G. Domsitz has joined Weinschel Engineering as Executive Vice-President.

Appointment of **Irving P. Magasiny** as Director of Engineering by Schaevitz Engineering has been announced.

I. P. Magasiny

T. Ciochetti

Tom Ciochetti has been appointed to the position of Sales Manager of Dallons Semiconductors, a div. of Dallons Laboratories, Inc.

Robert F. Halligan has been named Executive Vice-President and General Manager of The Hallicrafters Co.

Edward J. Danneberg has been elected to the newly created position of Vice-President for Personnel of Tung-Sol Electric Inc.

Calvin K. Townsend and **Dr. John V. N. Granger**, have joined the Board of Directors of WESCON (Western Electronic Show and Convention). Mr. Townsend has been named by the Western Electronic Manufacturers Assoc. and Dr. Granger was chosen by the San Francisco Section of the Institute of Radio Engineers.

Robert L. Adams has been named General Manager of the recently formed Mallory Electronics Div., P. R. Mallory & Co., Inc.

Sydney Simon has been appointed Vice-President and Engineering Head of U. S. Transistor Corp.

T. R. Anderson has been elected a Director of Magnetic Controls Co.

Richard A. Campbell is now Vice-President in Charge of Operations of Pacific Semiconductors, Inc.

The election of **Frederick F. Robinson** as Director of Collins Radio Co. has been announced.

Dr. Harold Schutz has been appointed Director of the Westinghouse Astronautics Institute, a study and development center at the company's Air Arm Div. in Baltimore.

Walter H. Venghaus has joined The Narda Ultrasonics Corp. as Vice-President and Manager of Manufacturing.

Fred L. Katzmann has been promoted to Manager of Circuit Design for the Instrument Engineering Dept. of Allen B. DuMont Laboratories, Inc.

Election of **Peter H. Stanton** as Chairman of the Board and Chief Executive Officer of American Avionics, Inc. has been announced.

P. H. Stanton

A. D. Kurtz

Dr. Anthony D. Kurtz has been appointed General Manager and Executive Vice-President of Kulite Semiconductor Products, Inc.

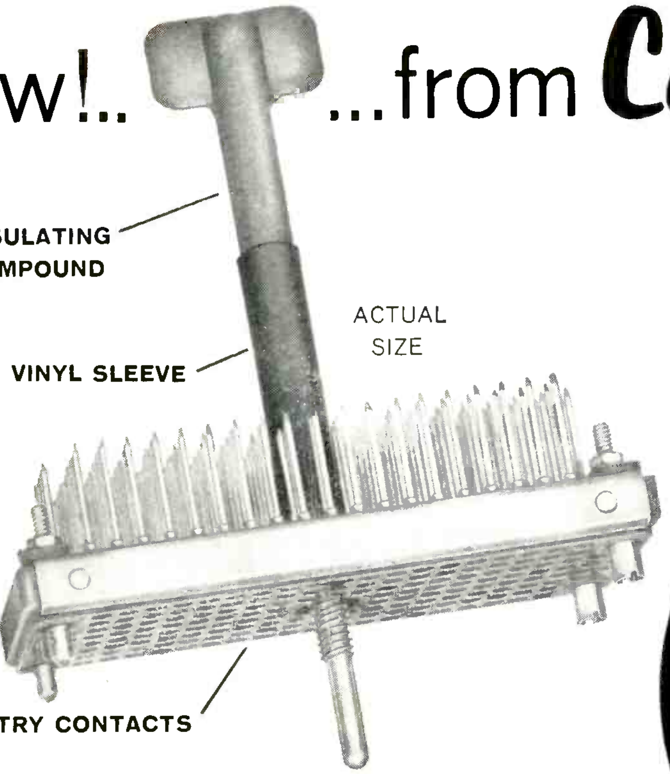
The election of **James McCormack,** Major Gen. USAF (Ret.), Vice-President of Massachusetts Institute of Technology, as a Director of the Perkin-Elmer Corp. has been announced.

Robert L. Rod has been elected President of the Long Island Electronic Manufacturers Council. Other officers named include **John J. Demsey**, Vice-President; **Dr. Robert E. Corby**, Secretary and **Anthony Marra,** Treasurer.

John F. Carr has been elected a Vice-President of General Time Corp.

Winfield Shiras, formerly with Westinghouse Electric Corp., has been named Vice-President and General Manager of Telex, Inc.

new!.. ...from Continental Connector



152 CONTACT

CENTER SCREWLOCK CONNECTOR WITH PROVEN RELIABILITY

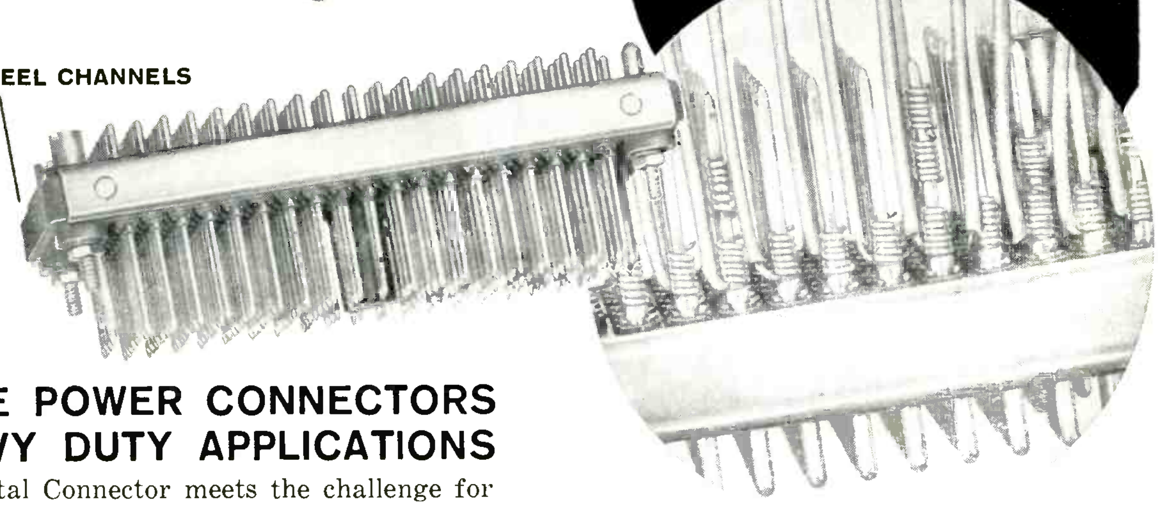


ILLUSTRATION SHOWS WIRE WRAP TERMINALS WITH ONE, TWO AND THREE WIRE CONNECTIONS

MINIATURE POWER CONNECTORS FOR HEAVY DUTY APPLICATIONS

Again Continental Connector meets the challenge for reliability and high precision in critical electronic equipment with these new center screwlock plug and socket connectors. They are designed for heavy duty applications requiring high dielectric and mechanical strength, partially achieved by the use of a body material molded from glass filled Diallyl Phthalate (MIL-M-19833, Type GDI-30, green). The double lead thread action center screwlock and stainless steel channels are extra features that contribute to the rugged construction and performance-proven reliability.

CLOSED ENTRY CONTACTS provide increased reliability and maintain a low millivolt drop under constant and uniform insertion pressure. Positive polarization is assured with reversed male and female guide pins and guide sockets. In addition to the wire wrap termination illustrated, solderless taper pin or solder cup terminals can also be supplied.

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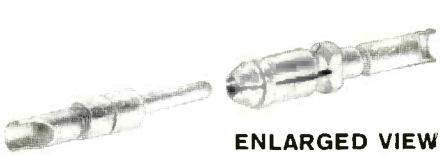

ENLARGED VIEW CLOSED ENTRY CONTACT

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Industry News

Royal Industries, Inc. has announced the appointment of **J. R. Johnson,** former Sr. Vice-President of Standard Coil Products, as Executive Vice-President.

The election of **Sydney W. Cable** to the Board of Directors as Secretary of Camloc Fastener Corp. and his appointment as its General Counsel have been announced.

W. Hubert Beal has been elected President and Chief Executive Officer of the W. L. Maxson Corp. **William L. Maxson, Jr.,** has been elected Vice-President.

The Board of Directors of Hofman Laboratories, Inc., has appointed **Gordon A. Carlson** to the position of Executive Vice-President.

G. A. Carlson

I. F. Richardson

Iden F. Richardson has been appointed Manager of Hughes Products Group, the Commercial Div. of Hughes Aircraft Co.

Wellesley Dodds, Manager of Varian Associates' Traveling Wave Tube and Backward Wave Oscillator Development Dept., has been made Vice-President of Engineering and Member of the Board of Directors for Bomac Laboratories, Inc.

Westinghouse Electric Corp. has appointed **Joseph L. Dickey** Manager of the Air Arm Div.'s Bomarc Missile Seeker Project.

Joe S. Kirk has been appointed Sales Manager for National Electronics, Inc.

Dr. George C. Sponsler III has been appointed a Sr. Scientist at Hoffman Electronics Corp.'s Science Center in Santa Barbara, Calif.

Gordon A. Mauchel has been appointed Sales Engineer for Hamner Electronics Co., Inc.

Col. Murray A. Little, SigC, Dept. of the Army, has been named Director of the Armed Services Electro-Standards Agency (ASESA) Ft. Monmouth, N. J.

David E. Andrews has been appointed Vice President of the Teletronic Security Systems Div. Tel-Autograph Corp.

John J. Dempsey and **Mr. William T. Smither,** have been elected Vice Presidents of Servomechanisms, Inc.

Dixon Fiske is now Sales Product Manager at the Eemco Div., Electronic Specialty Co. He served in a similar capacity at the Electro-Mechanical Div., American Electronics, Inc.

Willard A. Hughes has been appointed General Manager of the Microwave Div. of Kearfott Co.

W. A. Hughes

W. K. Squires

Appointment of **William K. Squires** as operations Research Manager for the Lockheed Electronics and Avionics Div. (LEAD) has been announced.

Dr. Robert E. Samuelson has been appointed Assistant General Manager for Research and Development at Motorola's Western Military Electronics Center in Phoenix.

Henry J. Hamm has been appointed General Sales Manager at Tamar Electronics, Inc., and Pres-To-Line Corporation of America.

David Youngquist has been appointed to the position of Vice President, Director of Sales and Engineering at The Potter Co.

Adolph Vecek Jr. has been appointed Director of Manufacturing at The Martin Company's Baltimore Div. He succeeds **Vernon R. Rawlings,** General Manager of Martin's newly created Activation Div.

My name is Paul M. Platzman,

I pioneered the ultrasonic industry. Two well known ultrasonic companies were founded by me. Now, I have created a new organization, Ultrasonic Industries, Inc., based on a revolutionary approach to mass producing and selling ultrasonic equipment. No middleman's profit in this factory — direct-to-you deal.

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The DiSONtegrator Features:

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The DiSONtegrator works FAST

In SECONDS you can disintegrate soils on: radioactive lab apparatus; glassware; medical instruments; test tubes, syringes, hypodermic needles; dental instruments, drills, burrs, false teeth, bridges; fossils and fossil foraminifera; electronic components, semi-conductors, crystals, switches, precision potentiometers; optical parts, lenses, plastic contact lenses, eyeglasses; timing mechanisms; small gear trains; miniature printed circuit boards; and hundreds of other items.

In seconds you can remove:

rust, oxides, shop dirt, dust, lint, preservatives, finger prints, machning chips, extrusion lubricants, paraffin, wax, paint, varnish, lacquer, plastic residue, resists silicones, greases cooked food residue, blood, plaster of paris, lapping compounds, carbon, radioactive particles, polishing compounds, shale, diatomite, volcanic tuffs, clay and sand, graphite, starches, cutting oils, heat treat scale, color stains, foundry sand, abrasives, quenching oil, salts, pitch, asphalt, tar, inks, adhesives, jewelers rouge, tripoli, resin flux, acid flux, many others.

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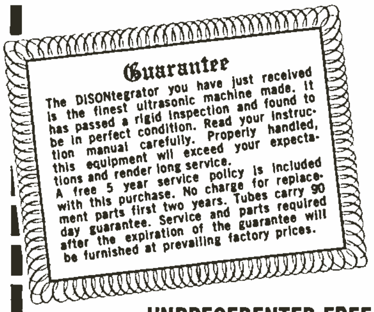

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A free 5 year service policy is included with this purchase. No charge for replacement parts first two years. Tubes carry 90 day guarantee. Service and parts required after the expiration of the guarantee will be furnished at prevailing factory prices.

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SPECIFICATIONS

GENERATOR INPUT: 117 V, 60 cycle — **GENERATOR OUTPUT:** 40 W, 90 KC
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Tank (overall): 5″ L x 5″ W x 8″ H
Tank (inside): 4½″ L x 4½″ W x 5″ D
Tank (capacity): 0.4 gal.

FOR THE FIRST TIME — you have a choice of 6 beautiful decorator colors to harmonize with your office or laboratory decor: **Ivory, Wheat yellow, Turquoise, Desert sand, Pale green** and **Soft gray.** Please specify color when ordering.

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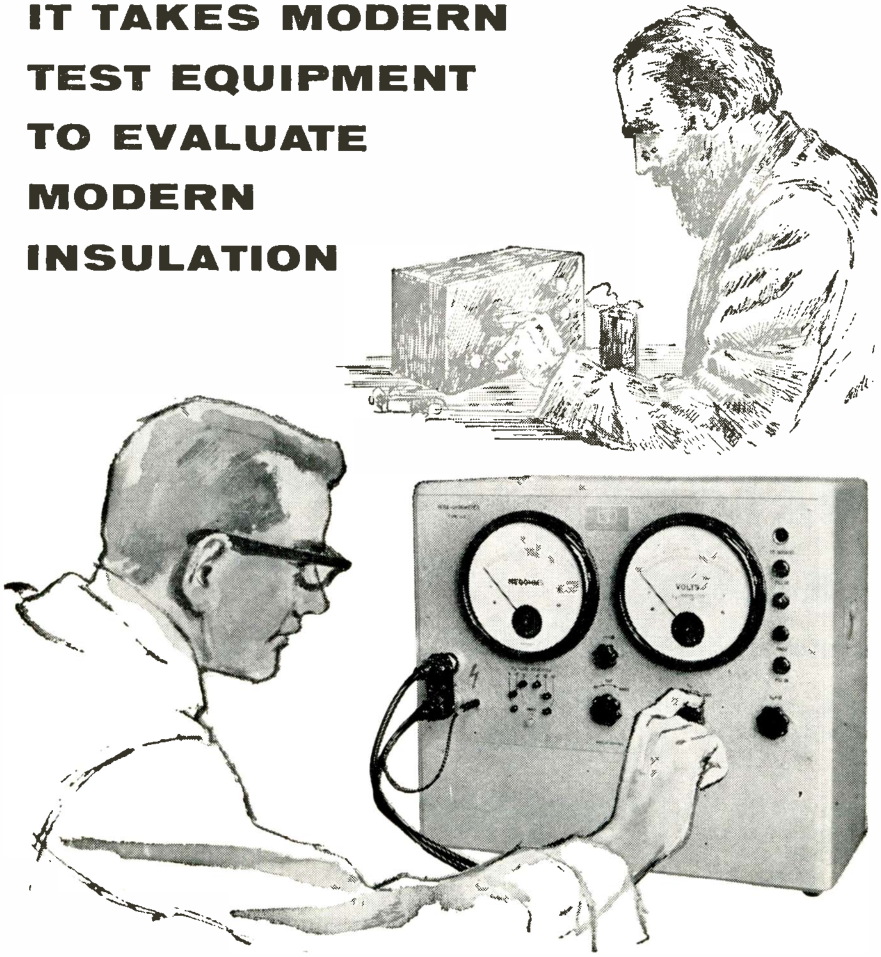
IT TAKES MODERN TEST EQUIPMENT TO EVALUATE MODERN INSULATION



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- Leakage resistance of capacitors
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- Surface resistance of printed circuits
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- Two large 7" meter scales for easy simultaneous reading of voltage and resistance
- Charge button for measuring capacitors

Write, wire, or 'phone for complete technical information.

Measuring today's special insulating materials, in the laboratory or on the line, calls for an advanced ohmmeter with far wider range and accuracy than provided by the relatively simple equipment considered satisfactory only a few years ago. Now, the ITT Type FT-H4 Tera-Ohmmeter* permits measurements of insulation resistances up to 5,000 tera-ohms, at voltages up to 1,000 volts, with ease, accuracy, and extreme stability.

In addition, the ITT Tera-Ohmmeter indicates instantaneous changes in insulation resistance. This is a particularly important advantage, not available in instruments based on the bridge or galvanometer method of measurement. Since insulation resistance is generally not a fixed value, but varies readily as a function of time, temperature, humidity, voltage, pressure, etc., the slope of the resistance/time characteristic is often more interesting to the observer than the final value obtained.

The fast response, high accuracy, extreme stability, and easy readability of the ITT Type FT-H4 Tera-Ohmmeter make it a practical necessity for production and research testing.

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News of Reps

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Manufacturer of Teflon insulated ribbon cable is seeking representation in the Chicago area and in the Florida-Georgia-Alabama area. For information: write to W. L. Gore Associates, 487 Paper Mill Rd., Newark, Delaware.

Neely Enterprises, West Coast rep firm has added three staff engineers to their staff. They are: James E. McGoldrick, Thomas M. Tinkle, and William R. Klauer.

Sales reps for the Electron Research Corp. have been established. The new reps are: **Allan Crawford Assoc.**, Willowdale, Ont., in all Canadian Provinces, except British Columbia; **E. G. Homes & Assoc.**, Atlanta, Ga., covering Alabama, Georgia, North and South Carolina, and Florida; **N. R. Schultz Co.**, Seattle, Wash., covering Oregon, Washington, and Idaho; **Technical Instruments Inc.**, Reading, Mass., covering Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and Maine and **Instruments for Measurements**, Sunnyvale, Calif. covering California.

Sierra Electronic Corp. has appointed **Lee Mark Assoc., Inc.**, as sales rep in Kansas, Missouri and Southern Illinois.

New sales reps have been appointed by Acton Laboratories, Inc., a subsidiary of Technology Instrument Corp. They are: **Saffro & Assoc.**, Chicago, Ill. in Kansas, Missouri, and Southern Illinois; and **White & Co.**, Palo Alto, Calif., in Northern California and Nevada.

Three new sales reps have been named by Servo Corp. of America. **The Jay Co.**, Arlington, Va., will cover Maryland, District of Columbia, Virginia, and Delaware; **Holdsworth & Co.**, Lansdowne, Pa., is assigned Eastern Pennsylvania and Southern New Jersey and **Perry Nathan**, Pittsburgh will cover Western Pennsylvania and Northern West Virginia.

Ault Associates, Menlo Park, Calif., has been named rep for the Components Div., Telemeter Magnetics, Inc. in California and Nevada.

Anderson and Associates, has been named rep for the Systems and Special Products Div. of Telex, Inc.

Roy Attaway Co. is now rep for Arthur C. Ruge Associates, Inc., in seven Southern States.

News of Reps

Sperry Semiconductor, Div. Sperry Rand Corp., has appointed **Martin P. Andrews, Inc.**, sales rep for New York State, with the exception of Metropolitan New York, Long Island, Westchester and Putnam Counties and **Holliday-Hathaway Co., Inc.**, as sales rep for the Middle and South Atlantic states, including the New York City area.

Six new reps have been appointed by Babcock Relays, Inc. They are: **Stan Clothier Co.**, Minneapolis, Minn.; **Jas. J. Backer Co.**, Seattle, Wash.; **G & H Sales Co.**, Cincinnati, Ohio; **Kay Sales Co.**, Kansas City, Mo.; **Packard Assoc.**, Dallas, Tex. and **Reed-Tollefson Corp.**, Rochester, N. Y.

Communication Accessories Co., announced the appointment of **Northport Engineering, Inc.** as rep in Minnesota, North Dakota, South Dakota and Wisconsin north of and not including the Counties of Crawford, Richland, Sauk, Juneau, Wood, Marathon, Shawano, Brown and Kewaunee.

Community Engineering Corp., announces the following sales reps: **William R. Lehmann Co.**, Orlando, Fla., covering Florida, Alabama, and Georgia; **Philip Nesbitt Co.**, Bethesda, Md., covering Maryland, Delaware, Virginia, Washington, D. C., lower New Jersey and Eastern Pennsylvania.

The **R. L. Holliday Co.** is now sales reps for Tracerlab Industrial Products Div. in the Pittsburgh, Buffalo and Cleveland areas.

Sunbeam Equipment Corp. has appointed **Gerald B. Duff and Co.**, Union, N. J., as rep.

North Atlantic Industries Inc., has appointed **Stanley Enterprises**, Seattle, Wash., as rep in its northwest sales territory.

Triad Transformer Corp., has appointed a manufacturer's rep for upper New York State. He is **Bob Nelson**, Mt. Vernon, N. Y.

Ferrodynamics Corp. has appointed the following reps: **Robert Smith Co.**, Brookline, Mass., the New England States **Stan Clothier Co., Inc.**, Minneapolis, Minn., North Dakota, South Dakota, Minnesota and Western Wisconsin; **Winfield Electronic Sales**, North Miami, Fla., Florida; and **Hal F. Corry Co.**, Dallas, Tex., in Texas, Oklahoma, Arkansas and Louisiana.

Circle 132 on Inquiry Card

This busy metropolitan area is the termination of over 1000 miles of microwave systems, providing reliable communications across town and country for the Western Union Telegraph Company. ANDREW's experience in research, development and manufacturing is the reason why the dependable performance of an ANDREW PS8-37, eight-foot Parabolic antenna was selected for this installation.

All ANDREW parabolic antennas conform to the newly proposed RETMA-FCC standards governing radiation patterns and side lobes, and they are *guaranteed* to give specified pattern and VSWR in your microwave system.

From a selection of over thirty stocked parabolic antennas, you can choose the type and size that will give optimum system performance with absolute mechanical and electrical reliability.

Microwave engineers have found ANDREW a valuable partner in planning their communication systems. A parabolic antenna computer for calculating system performance is available to you upon request. Write today for information and expert advice relative to your microwave antenna system requirements.

Circle 100 on Inquiry Card

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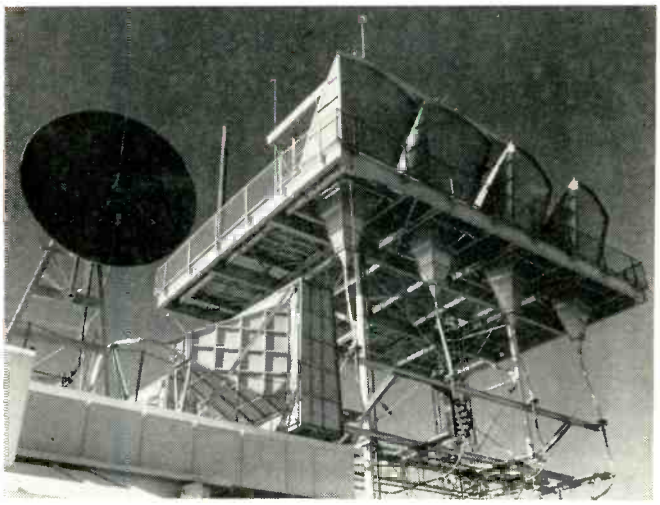
Tele-Tech's ELECTRONIC OPERATIONS

The Systems Engineering Section of ELECTRONIC INDUSTRIES • JANUARY 1960

SYSTEMS—WISE . . .

▶ **The U. S. Navy is now operating underwater TV equipment in deep water surveys. Designated AN/SXQ(XN-2), the system, built for the Navy's Bureau of Ships, has been recently employed in successful ocean bottom surveys at depths of more than 600 ft. This is the first time that a continuous, remotely controlled visual survey has been achieved at such depths.**

SCIENTIFIC DATA TRANSMISSION



New high speed method of transmitting scientific and business data by microwave is now being used by North American Aviation, Inc. Dish at left on Oat Mountain receives microwave signals from Rocketdyne, 9 miles away, then beams them to Los Angeles 30 miles away.

▶ The Association of Maximum Service Telecasters and Iowa State University announced jointly that the Engineering Experiment Station of Iowa State University of Ames, Iowa, will undertake two important engineering projects. One project is a further study of UHF wave propagation. The other project is designed to determine the extent and severity of interference to television broadcast service which results from the operation of television broadcast stations on adjacent channels.

▶ **NAB has selected Clair R. McCollough of Lancaster, Pa., a veteran broadcaster and industry leader, to receive its 1960 Distinguished Service Award. Mr. McCollough is president and general manager of the Steinman Stations which operates WGAL-AM-FM-TV, Lancaster, Pa., and WDEL-AM-FM, Wilmington, Del.; WKBO, Harrisburg, Pa.; WORK, York, Pa.; WEST-AM-FM, Easton, Pa., and WRAK-AM-FM, Williamsport, Pa.**

▶ An ultra sensitive television camera is being built by Dage Television. The transistorized TV camera will accompany an extremely sensitive tube Westinghouse will produce for delivery to the Electronic Technology Laboratory at Wright-Patterson AFB. Called the "intensifier image orthicon" the new tube combines in the same glass envelope the features of an image orthicon—to date the most sensitive television camera tube—with an "image intensifier" or "light amplifier."

▶ Harold E. Fellows, NAB president, appointed a 12-man task force of top broadcasting executives and staff experts to deal with ethical and legal issues facing radio and television.

▶ **Western Union recently opened transcontinental Public Facsimile ("Wirefax") service for the use of the general public and other users. The inauguration of the service now makes it possible for customers in New York, Washington, D.C., Chicago, Los Angeles and San Francisco to give material to the telegraph company for same-day transmission and delivery in exact facsimile of the material offered.**

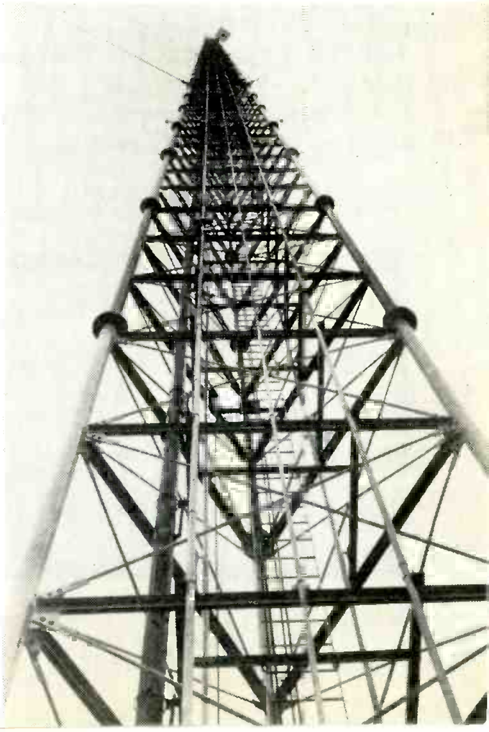
▶ CCTV for widespread display of flight arrival and departure information has been installed in the passenger terminal of United Air Lines at Chicago's O'Hare Field. The lobby and corridors of the passenger terminal occupy more than 40,000 sq. ft. of floor space. Thirteen TV monitor sets are located at strategic points throughout the area so that travelers are always within convenient viewing range.

▶ **The U. S. Information Agency notes that, as of September 30, there were 985 TV transmitting stations of all types (originating stations, relay stations, experimental stations, etc.) and 28,047,700 TV sets in operation abroad. The current figure compares with 639 on September 30, 1958.**

▶ Eventually there will be a nationwide educational television network on which a single outstanding teacher will be able to instruct as many as 100,000 students at the same time predicts Brig. Gen. David Sarnoff, Chairman of RCA. Through educational TV "it may be possible for those who—for one reason or another—cannot enter college, to earn a college degree in their own homes."

WORLD'S HIGHEST

The entire run of 6⅛ in. coaxial transmission line (left) for the world's tallest structure was manufactured and field tested by Dielectric Products Eng'g. Co., Inc., Raymond, Me. This 1619-ft. antenna tower is located at the WGAN - TV transmitter site in Raymond, Me.



The success of hi-fi reflects appreciation of quality sound.
Is it not now the time to return to the public
the quality TV picture they enjoyed ten years ago?
This thirty-cent circuit could do it.

The Case For DC Restoration

By ROBERT J. NISSEN
Chief Engineer, KQED
Bay Area Educational Television Assoc.
525 Fourth St., San Francisco 7, Calif.

ABOUT 10 years ago, a small TV receiver manufacturer captured a sizeable share of the market by building a "stripped" set to sell for a very low price. He resorted to every possible shortcut. Entire sections of the set were denuded and redesigned to save pennies. As a by-product of this redesign, new and valuable circuitry was eventually developed by other manufacturers.

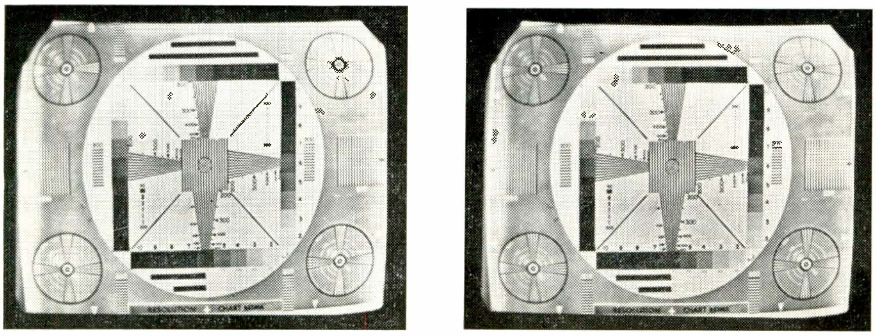
One of the circuits bodily ejected was the DC restorer. Reputable manufacturers claimed they were then forced to eliminate the DC restorer to "compete." A great deal of rationalization was indulged in—to justify its elimination. As more and more set builders dropped the restorer, it soon lost its identification (to the manufacturer at least) as an "essential" device. In the last few years it has all but been forgotten by the manufacturers.

Economy Measure

The DC restorer, originally deleted as an economy move, is now left out because of ignorance of its true value by the manufacturers. In fact, DC restoration and its effects are generally not well understood by many design and broadcast engineers.

What happens when the DC restorer is eliminated from a monochrome receiver? The main effect can best be described as follows: *The brightness values of the grey scale on the picture tube will vary in proportion to the area of the various shades in the original picture.* The term "grey scale" used here refers to the total range of light values from white to black in any picture. When it is understood that proper grey scale rendition, above all other factors, contributes most to the quality of a TV picture, the importance of the DC restorer can be appreciated.

Fig. 1: Balanced area picture (a, left) with and (b, right) without the DC restoration circuit. There is no difference between the fidelity of the two grey scale reproductions because of the balanced nature of the grey scale components in the pattern.



The two pictures in Fig. 1 are taken from the face of the same monitor. In Fig. 1a, the DC restorer was operating; in Fig. 1 b, it was disabled. Notice that there is no difference between the fidelity of the two grey scale reproductions. This is because of the balanced nature of the grey scale components in the test pattern. More about this balance later.

Comparison

The pictures in Figs. 2a and 2b were both made with the DC restorer "on." The large areas of black are reproduced essentially as they were in the original scene in the studio. The whites and middle values are also reproduced as accurately as can be expected of the TV system—plus photography—plus the magazine printing process.

Figs. 2c and 2d, are all too typi-

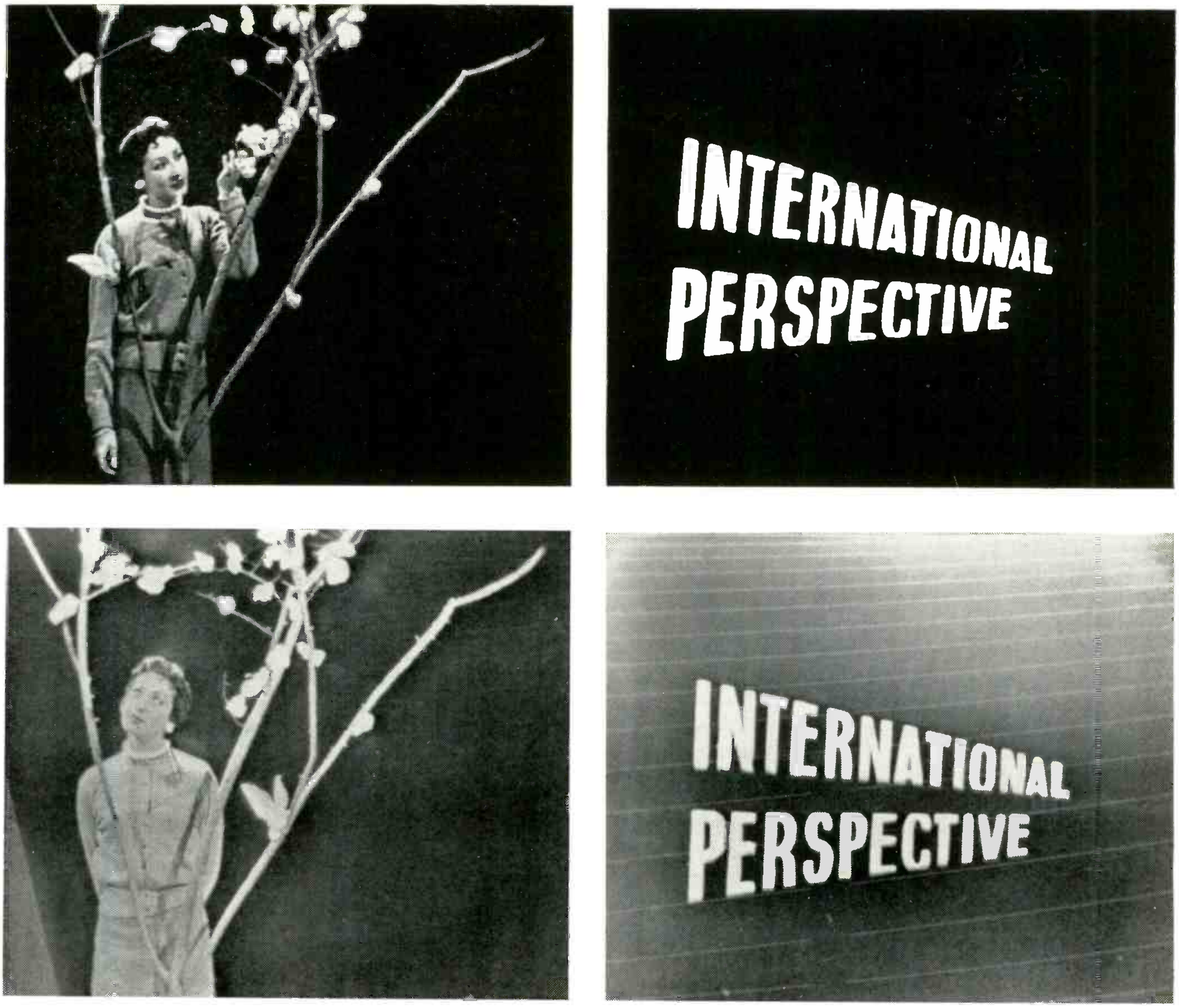


Fig. 2: The upper photos (a & b) show typical unbalanced areas with the DC restorer "on"; the lower photos show similar scenes without the DC restorer, and represent the type of picture obtained on the present day, or modern receiver.

cal of the result of the absence of DC restoration in the "modern" receiver. The "blacks" are reproduced as a dirty grey, and usually noisy, background. The middle greys are lightened in value. In addition, highlight saturation almost invariably distorts the picture. This white saturation is particularly destructive of picture quality as it tends to wash out skin tones and facial detail. A person's face often becomes a white blob against a grey background. Hardly a true or even pleasing reproduction of the original.

Bear in mind that the only change between the two sets of pictures was the removal of the DC restoration circuit. Identical photographic exposure and processing was used. The retrace lines shown, usually blacked out with special circuitry in the home set, indicate how bright unrestored "black" can be. It's apparent that the grey scale fidelity of the unrestored monitor is far from desirable.

What causes this fickleness of grey scale reproduction? For the answer we must examine what happens to the video signal after it has been demodulated in the receiver.

In the average set, the demodulated video signal is amplified by one or two video stages before being applied to the picture tube. For economic and other valid reasons the video stages are usually AC coupled to each other or to the picture tube with a blocking capacitor, Fig. 3. The purpose of this capacitor is to prevent the DC plate voltage of the amplifier from disturbing the bias voltage relationships of the following stage or picture tube. And this it does. But at the same time it also blocks the necessary DC components in the video information.

Nature of DC Components

Let's examine the nature of these DC components. Fig. 4 shows a composite signal of two lines of black information and two lines of white information. Note that the sync pulses and blanking levels are maintained in the same amplitude relationship with each other, independent of the nature of the video information. This rigid relationship originates in the broadcast studio and is maintained through

DC Restoration *(Continued)*

the video demodulator of the receiving set.

But after the video signal has passed through an AC coupled amplifier, this relationship will be destroyed. In fact, the low frequency components (DC) will be missing. This may be explained by the law of the AC axis: *An AC signal with a DC component which passes through a capacitor will be distributed above and below the zero voltage axis so that the areas between the curve and the axis above and below are equal.* (Fig. 5.) In other words, if the areas under the curve of both negative and positive excursions of the waveform are equal, they "cancel" each other over a period of time. This is to say that there is no DC component in the signal.

See what happens to our carefully maintained relations between sync, blanking, and video information when the signal passes through a capacitor. Fig. 6 shows the AC axis law operating on the same black and white information signals shown in Fig. 4. Both the black and the white information signals have distributed themselves above and below the AC axis in proportion to the areas under the curve; the DC component is missing. Note that the two blanking levels no longer have the same amplitude relationship with each other. Instead the black level floats around willy nilly, dependent on the nature of the picture information.

Tonal Values

Consider what havoc this creates with tonal values. We may adjust the "brightness" control to cause the picture tube to go black at the proper blanking level during the black information lines. Then when the white information lines are received, the "white" information will be reproduced as a dark grey.

A REPRINT
of this article can be obtained by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

Conversely, we may adjust the "brightness" control to cause the picture tube to go black at the proper blanking level during the white information lines. Then when the black information lines are received the "black" information will show as a light grey.

Thus under these two conditions the original blacks and whites at the studio are reproduced at the receiving picture tube as greys and greys.

As previously noted, white saturation usually accompanies the destruction of contrast and a true grey scale, when the DC component is not present. Shown in Fig. 7 are the two extreme cases of video information, namely, a small white area on black background and a small black area on white background. As you can see, the signal without a DC component requires almost one and one half times the peak to peak amplitude capability in the amplifying equipment, compared to that required for the signal with the DC component. Consequently, for the same degree of amplitude linearity, a more expensive amplifying system is required when the DC component is missing. In the average home receiver the problem is usually simply and sadly ignored. The combination of the lack of DC component plus inadequate amplitude linearity results in pasty light greys and saturated whites. As R. G. Neuhauser of RCA puts it, "—a mood shot, such as a romantic moonlight walk, looks like an overexposed picture taken by an amateur with a box camera on a cloudy day."[1]

When the DC component is not sent to the picture tube, the brightness control is usually set to provide a pleasing picture of an "average" video signal like the test pattern of Fig. 1. This test pattern has a reasonable balance of areas of the blacks, whites, and intermediate tones of grey. Any succeeding picture with similarly balanced areas will be reproduced with tonal fidelity regardless of the absence of the DC component. We may rightly conclude then, that the DC component is of no value when a balanced distribution of the areas of whites, greys, and blacks, is held constant in all of the pictures transmitted.

Limitations

Unfortunately, normal picture information has greatly varying balances of grey scale information. And the requirement of balanced areas of blacks and whites imposes an impossible task upon the broadcaster. The result is that the quality of reproduction must suffer at the home receiver. Many broadcast engineers are aware of the limitations placed upon their video information by the lack of the DC component in the home set. In fact, a great deal of ingenuity is daily being exercised in the studios to alleviate this defect in the receiver.

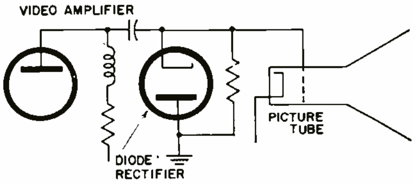


Fig. 3: Video amplifier AC coupled to the picture tube. This circuit represents present day practice—no DC restoration.

Extreme care must be used in lighting, set design, scripting, and staging to provide a balanced grey scale for the camera. The AC axis, i.e., the average value of the video, must not vary, if a true picture rendition is to be received in the home. Often this is in direct contradiction to the artistic effect desired.

The conscientious broadcast engineer who is aware of these limitations must rule out night scenes with large areas of black, spotlight effects with small areas of white, small area titles on black backgrounds, "limbo" shots, etc. The standard film technique of the dramatic "fade to black" loses its

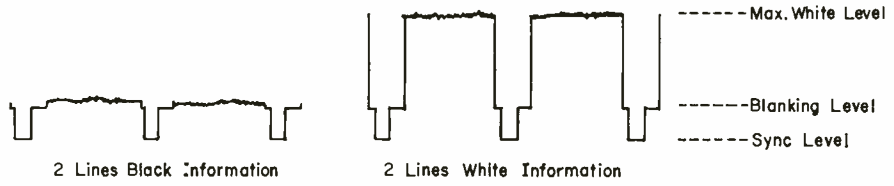


Fig. 4: White and black video information with the DC component present.

impact as the screen turns to a murky white. Obviously an effective astronomy show is impossible.

The wide capabilities of lighting and staging techniques otherwise available to the television medium must be severely restricted. Many artistic effects simply cannot be permitted. The engineer knows that if they are allowed to be broadcast, the picture on the home set will be an entirely different one from that on his control room monitors, which have DC restoration. The intended effect will probably fail miserably at home. Contrast suffers, blacks become greys, light greys become saturated whites. None of the shades of grey maintains a constant relationship with the same shades at the studio.

Seriousness of Problem

Fig. 8 will give an empirical example of the seriousness of the problem. The graph shows the actual light output in foot lamberts on the face of a typical picture tube. Measurements were made with varying percentages of white and black picture areas under restored and unrestored conditions. A logarithmic scale is used for the light output since the eye responds to brightness in an approximate logarithmic manner. Observe what happened to the contrast ratios between "white" and "black" areas in the unrestored condition. Note that the contrast ratio between the 100% black and 100% white is only 2 to 1 while under restored conditions it is 200 to 1!

How can the DC component be preserved? Two basic approaches are available to the design engineer. The first is to utilize a DC coupled video amplifying system to control the picture tube. There is no loss of the DC component to deal with, and true grey scale reproduction will be controlled by the broadcast station. This system was used in many sets in the earlier days of television. It lost its popularity because of the problems associated with any multistage DC coupled amplifier, namely, power supply complications and the difficulties of maintaining stable bias relations with varying circuit parameters.

The second approach is DC restoration, or re-insertion. Note that if we could simply bring all the peaks of the sync, or blanking, pulses in Fig. 6 to the same amplitude level, regardless of the picture content, the signal would again be identical to that of Fig. 4. In other words, the DC component would be "restored" to its original level.

A completely impractical method of DC restoration would be to have the viewer adjust the brightness control to compensate for every shift of the black level. Not only would this be quite tiring on the wrist, but because of the line to line changes at the rate of 15,750 times a second, it would be most difficult. Nonetheless, it is important to recognize this process as a form of DC restoration.

Peak Rectifier

Fig. 9 shows a more practical device; a peak rectifier DC restorer. The diode will conduct during only the negative peaks of the incoming signal, the sync pulses. Since the diode acts as a low impedance to ground during each sync pulse, it forces the grid to ground potential during each sync pulse interval. Thus all the sync pulse tips are returned to the same voltage reference, ground potential.

Since the sync pulse has a constant amplitude relationship with the blanking pulse, the diode also returns the blanking pulse to a fixed level above ground. Referring again to Fig. 4, we see that this effectively restores the DC component.

Shown in Fig. 10 is a simplified version of another type of DC restorer, a keyed clamp. A pulse applied during horizontal blanking to the transformer primary appears as equal and opposite pulses on the secondary. During the pulsing time the diodes conduct, the pulses cancel each other, with the result that the picture tube grid is returned—or "clamped"—to the potential of the center tap of the transformer secondary, which is grounded. Once again we drive the grid of the picture tube to ground potential during each horizontal blanking period and thus restore the DC component lost through the action of the coupling capacitor.

The keyed clamp restorer has two basic advantages over the peak rectifier restorer: faster, more accurate restorer action—the peak rectifier relies upon a fairly long time constant value to operate—and better immunity to impulse noises. Since the peak rectifier can conduct at any time, large negative noise pulses in the video information may upset the restoring action. The keyed clamp, however, is inactive for over 92% of the time—the time between horizontal sync pulses. Therefore, noise pulses occurring during this time have no effect on the restoring action.

Why is it, if there is such clear-

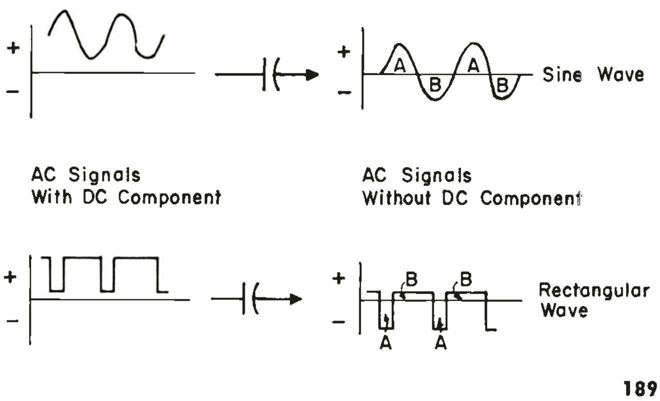
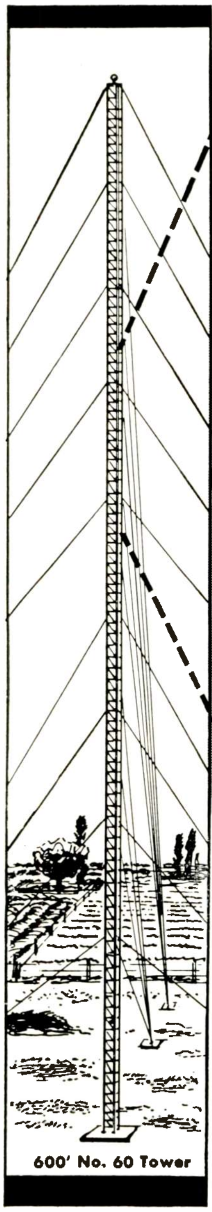
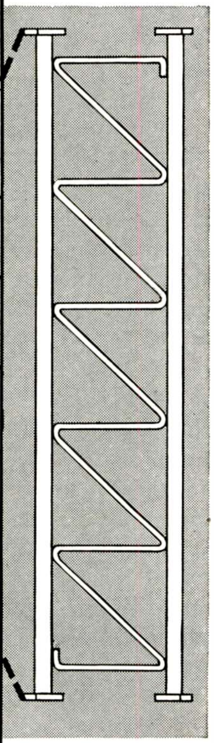


Fig. 5: The effect on waveforms when the DC component is removed by interstage coupling capacitors. Area A equals area B.





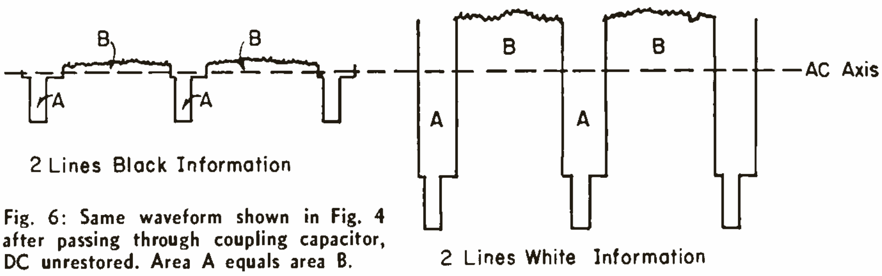


Fig. 6: Same waveform shown in Fig. 4 after passing through coupling capacitor, DC unrestored. Area A equals area B.

DC Restoration

(Continued)

cut evidence of the superiority of a set with DC restoration, that of 5,300,000 monochrome home receivers manufactured in 1958, nearly 98% failed to incorporate this circuitry? I have just completed a questionnaire survey of all the major TV receiver manufacturers in the United States. They were asked, among other things, to give reasons for their policies on DC restoration.

Manufacturers' Objections

Frankly, I was surprised at the high percentage of answers which by their very nature indicated a real ignorance of the effects of the lack of DC restoration. There was, however, a smaller group of answers that presented seemingly valid arguments for the unrestored set. Let us examine three of these arguments presented by one manufacturer.

Added cost is at the top of his list. The manufacturer admits that DC restoration would add only 25 or 30 cents. This amount, incidentally, is about the average cost estimate from the other manufacturers. Though this may seem trivial to the reader, and indeed to the author, the large set builder doesn't see it in this light. In fact, the chief engineer of one of the major companies reported that he had recently been to two staff meetings to determine whether to eliminate a 7 cent high voltage fuse! The inference was, of course, what chance would he have advocating spending 25 cents for a "questionable" addition. The sales manager of this same company, however, saw it differently when it was suggested to him that he would have a powerful selling point in "true blacks and whites" if restoration were included. As of this writing the brand referred to, still does not incorporate DC restoration.

The second argument advanced against DC restoration is its susceptibility to noise. A large negative noise pulse may tend to be more noticeable in the picture since it may momentarily shift the operating point of the picture tube. Years ago the impulse noise problem of the DC restorer may have

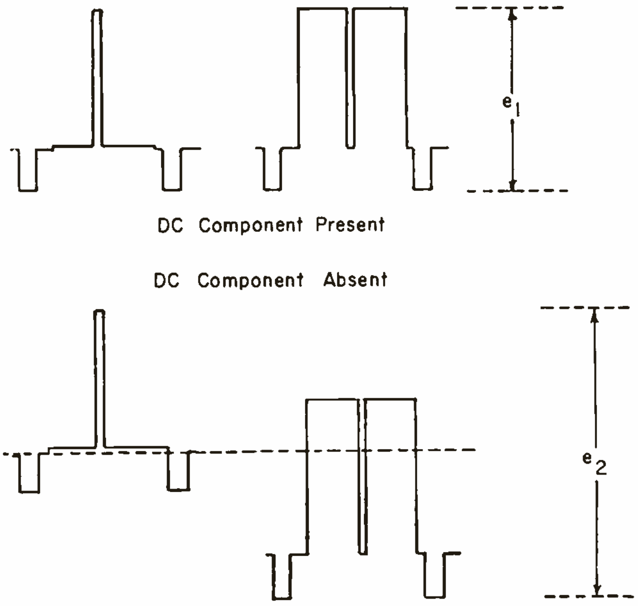


Fig. 7: Graphic illustration of the difference of dynamic range required for DC restored vs. unrestored systems. Peak-to-peak range required is e_1 for restored system; e_2 for unrestored.

offered a legitimate point against its use in the home receiver. But today, with the development of high-gain low-noise converter stages, improved antennas, better automatic gain control circuitry, and high power transmitters, the argument has little validity.

Of course, nothing, except additional expenses, prohibits the use of the superior keyed clamp form of DC restorer. As explained earlier, not only is its restoration ability more accurate but its noise immunity is very high.

Receiver design engineers have proved their skills in the last decade by stripping receiver circuitry at every conceivable point, making do with under-rated components, devising compactness which is against all common sense, while still achieving a fairly usable picture. It's difficult to believe that this resourcefulness could not be channeled toward the task of adding a simple noise-free inexpensive method of DC restoration.

The third argument offered against the use of DC restoration is that broadcasters do not maintain proper black level control. The complaint is that the viewer with a restored receiver finds objectionable shifts in black level when he is changing channels, or when cameras are being switched during a program.

Black Level Information

The objection has just enough truth in it to confuse the issue. In the early years of television, much of the broadcast equipment was incapable of generating and maintaining proper black level information in the picture. Even though modern equipment is now fully capable of the job there are still some stations which do not maintain adequate control of their transmitted levels. The problem has been frequently explored by broadcast engineers. The solution is twofold: (1) A higher appreciation by operating personnel of the importance of absolute level control, and (2) the use of equipment which will automatically maintain proper levels. The latter solution is being incorporated at a rapidly increasing number of stations.

But the person who complains about non-perfect levels from the broadcast station fails to observe that when perfect levels are transmitted, the unrestored receiver has constantly changing grey scale values. And these values change from shot to shot, camera to camera, station to station — very much the effect that the manufacturer says is his objection to the restored set. Thus the unrestored receiver makes a shambles of the correct levels and values sent out from the transmitter. No case can possibly be made that the unrestored receiver maintains proper grey scale levels. A case can be made that an unrestored receiver so distorts black level changes that improper operation at the broadcast station might be less noticeable. One might just as well suggest spraying a fine fog coating over the picture tube so that the difference between a good and bad picture is less noticeable.

The argument against the restored receiver on the basis of unstable broadcast levels has both valid and invalid aspects. Valid, because the problem does exist in some broadcast operations. Invalid, because despite non-perfect black level control, the average quality is far superior on a DC restored receiver. One has only to spend a short time in a television station control room, observing both restored and un-re-

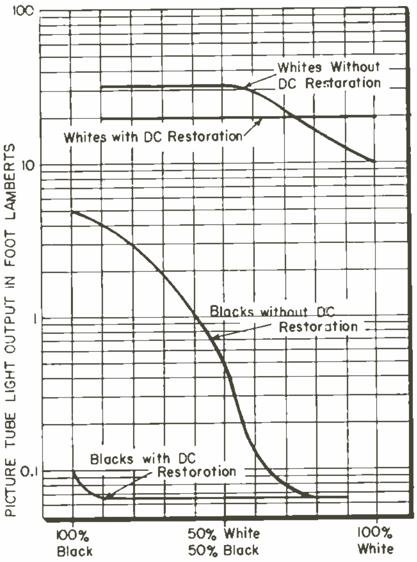


Fig. 8: Actual light output from the face of a picture tube under both restored and unrestored conditions. White and black input signals held constant. Percentage of white and black areas in picture indicated along the abscissa.

(Continued on page 193)

WASHINGTON News Letter

UHF FREQUENCY STUDY—In his budget message to Congress early this month (January), President Eisenhower was slated to present a proposed $2.5 million fund in the FCC appropriations for a special frequency usage technical study of ultra high frequency TV operations. This fund would be in addition to the regular FCC budget for all activities for the fiscal year which starts July 1, 1960. This frequency usage study should have far-reaching implications for all radio services, since it would clear away the number one roadblock with the present UHF television spectrum space to more effective frequency allocations, particularly in the non-broadcast radio services.

INDEPENDENT RESEARCH—The actual research activities in the UHF television operations frequency study are to be carried out by an independent consulting engineering firm. This consultant organization is expected to utilize the services of independent laboratories such as those of universities. With its limited staff personnel already burdened with the regular grist of assignments, the FCC is not slated to furnish its technical experts for this research activity except for liaison officials.

NEW MEDICAL SERVICE—Establishment of a new "medical emergency radio service" for use by physicians, hospitals and emergency ambulance services has been made by the FCC. The new service was created in response to a number of petitions which had been pending.

CONTINUED BIG OUTLAY—The funds allotments for communications and electronics procurement for the three armed services for the next fiscal year will not be made public until the President's budget message is submitted to Congress. However, highly authoritative Department of Defense sources indicated to ELECTRONIC INDUSTRIES' Washington news bureau that the c-e expenditures during the coming fiscal period will be as large, and possibly even more than the outlay for communications-electronics equipment, systems and devices during the current fiscal year which ends June 30. It was asserted that the communications-electronics portion of the new appropriations program of July 1, 1960 to June 30, 1961, will be a most substantial share of the $41 billion national defense funds program.

POTENT OPPOSITION — The FCC has received potent opposition to its microwave policy decision in which it looked toward virtually unrestricted licensing of private systems from the National Association of Railroad & Utilities Commissioners. The NARUC has the view that the FCC should take into consideration the availability of common carrier (telephone and telegraph) facilities in licensing microwave systems. Of course, the Bell System and Western Union Telegraph Co. have already announced a policy that right-of-way organizations—aviation, railroads, pipelines and electric and gas utilities—and public safety radio systems such as police and fire departments can establish their own microwave facilities.

ADVERSE EFFECTS—The NARUC emphasized to the FCC that an unrestricted licensing of private point-to-point microwave systems would produce adverse economic effects to the telephone and telegraph companies, which serve the general public. The Association declared that "the state regulatory commissions have an obligation to protect from adverse economic effects the users of communications common carrier service subject to their regulations."

National Press Building
Washington 4

ROLAND C. DAVIES

FAA PROPOSES NEW RULES—The Federal Aviation Agency has proposed a new ruling covering airborne radio and radar equipment voluntarily installed by the nation's airlines.

FAA officials explained that many airlines have recently installed new specialized radar and radio devices to supplement the navigation and communications facilities required by Civil Air Regulations.

FAA points out that such new equipment—though not required—may have a significant effect on the safe operation of the flight. The proposed rule-making, therefore, would require that all these devices meet Agency performance standards, and be approved.

MANUAL STANDARDIZATION — A plan by the Aerospace Industries Association aimed at standardizing the manuals used for the operation and maintenance of weapon systems, and which offers substantial economies, has been approved by the Department of Defense.

The official AIA publication says, "The Air Force alone spends $250,000,000 a year for technical manuals."

The Service Publications Committee of AIA, which is composed of technical manual specialists from eighty-three companies and divisions of the aerospace industry, devised the plan of establishing a Technical Manual Standardization Committee in the Department of Defense. This group will work through task forces assigned to specific problem areas—cataloging, maintenance, operations, overhaul and repair. Military and industry specialists would serve on the task forces.

stored monitors, to determine whether he would give away the obvious advantages of DC restoration for the dubious "advantages" of the unrestored set. No one, to my knowledge, who has made this test, despite improper broadcast level control, prefers the unrestored picture.

Misinformation

Aside from these three plausible objections to DC restoration—cost, noise susceptibility, unstable broadcast levels—there is the outright rejection by one manufacturer who claimed that "laboratory and field tests indicate DC restoration is of little or no value." I simply cannot help but believe that anyone who makes such a statement has neither seen nor conducted either laboratory or field tests. It betrays a pure and simple ignorance of the effects of DC restoration.

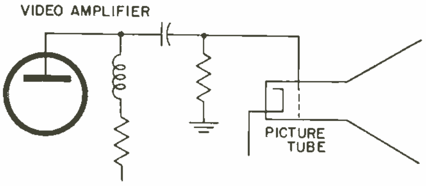


Fig. 9: A peak rectifier DC restorer ckt.

The sources of such misinformation are not too difficult to find. For one thing, sets have been selling quite well for a number of years without DC restoration. Virtually no complaints have been forthcoming from the consumer. The public—not having available facilities for an A-B check of restored versus unrestored sets—is generally not aware of how it is being cheated on quality. For another, the manufacturer himself may be honestly misinformed.

As far as I have been able to determine, not one major receiver manufacturer uses a standard broadcast image orthicon camera in an actual studio environment to test the final ability of his set to reproduce the studio picture. Instead, a signal generator, monoscope, or slide camera is used for a test signal. Since most of these signal sources have an inherently balanced grey scale, the advantage of DC restoration is not evident. Even the use of air signals from regular broadcast stations has limitations in design testing, since a well balanced grey scale picture from the station will show up equally well on a restored or unrestored receiver.

Layman's Test

Broadcast engineers have often been accused of being overly critical of picture quality. I, therefore, decided two years ago to start tests with layman viewers who had never heard the words "DC restoration." Two identical monitors were viewed simultaneously by each person. To eliminate resolution as a possible factor, the frequency response of both monitors was degraded to that approximating the average home receiver. One monitor was equipped with DC restoration, the other was unrestored. Picture material running the gamut from balanced grey scale subjects to filmed night scenes were shown on both monitors. The only instruction to the viewer was to indicate which monitor had the "best quality" pictures.

I feel there is no reason to continue the tests, since of the 265 persons tested, 265 indicated preference for the picture on the monitor with DC restoration.

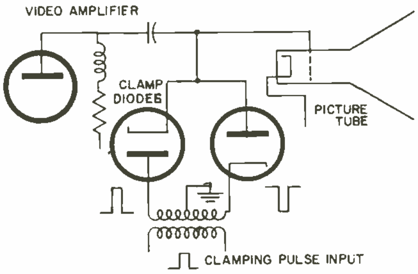
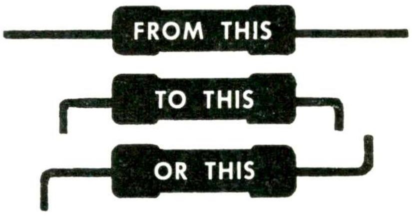


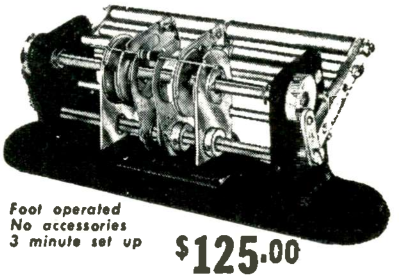
Fig. 10: A keyed clamp DC restorer circuit.

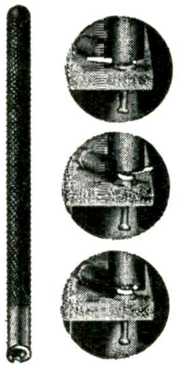
Receiver manufacturers tend to underrate the desire of the viewing public for quality. The public has adequately shown that it appreciates high fidelity in sound reproduction. It can certainly be proved that they appreciate high fidelity in television picture reproduction. Is it too much to hope for that the manufacturers will restore their own original respect for quality?

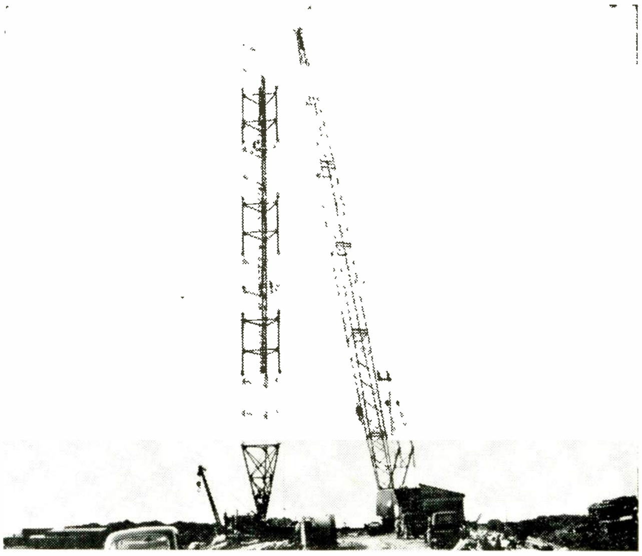
References

1. R. G. Neuhauser, "Black Level—The Lost Ingredient in Television Picture Fidelity," *Journal of the SMPTE*, Oct. '57







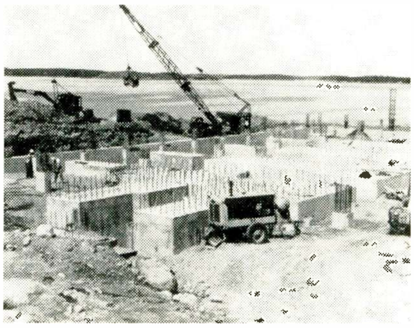


Erection of towers. The gin pole suspended in center of the tower is used at heights above 200 ft. to raise tower material for erection.

USN Building New Radio Center For Atomic Fleet

THE World's most powerful radio station is taking shape on a rockbound Maine peninsula, extending eastward into the Atlantic Ocean.

This huge, $67 million USN facility is under construction at Cutler, Me.

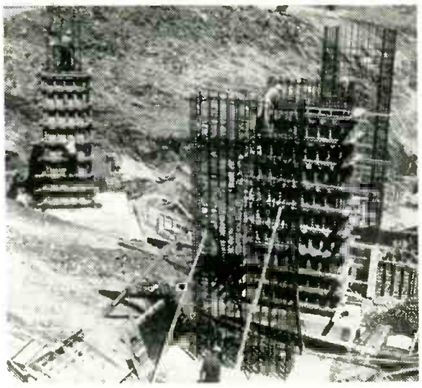


Power plant foundations. Five large blocks run at right angles to the length of the building. The two small blocks (left, foreground) are foundations for small generators.

Its power and range will permit the sending of messages to surface warships and to submarines lying in the depths of the North Atlantic and Arctic Oceans. Thus the station will be a keystone in the Navy's plans for quick retaliation against an aggressor.

Twenty-six giant steel towers, ranging in height from 800 to 980 ft., will support the station's vast antenna network. They are being erected on a 2800 acre clearing carved out of the forest-clad peninsula on the edge of Machias Bay.

Thousands of tons of structural steel, wire rope, other steel products and intricate electronic equipment from many sections of the country will go into this giant radio installation. Bethlehem Steel Co. is one of the companies making a substantial contribution to the project's success through its products, facilities and technical know-how.



Tower foundation. Deep excavation was made through very soft grey marine clay to reach bed rock.

Some 1600 tons of steel will go into the 36 antenna counterweights.

From Bethlehem's Williamsport, Pa., plant 987 tons of wire rope, plus 82 tons of fittings, will be shipped to the project's site for use in conjunction with the counterweights in raising or lowering the big antennas.

The antenna system is being built in two arrays. Each array will have a center tower 980 ft. tall; an inner ring of six towers 875 ft. high and an outer ring of six towers 800 ft. high.

The two antenna arrays that link these towers will resemble two large six pointed stars or the supports for mammoth canopies. Each will be broad enough to cover 11 buildings the size of the Pentagon in Washington, D.C.

A total of 2200 miles of copper wire will be laid underground below the antenna arrays for an extensive ground system.

A central transmission building has been built between the two antenna arrays. Its power plant will be capable of turning up 11-million watts for station demands and for VLF transmission.

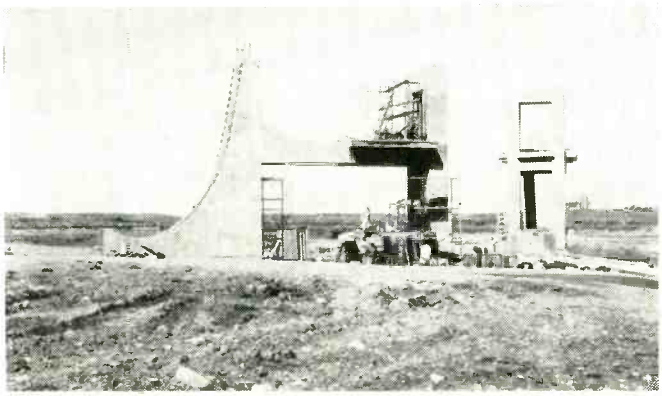
The latter can use up to 2 megawatts.

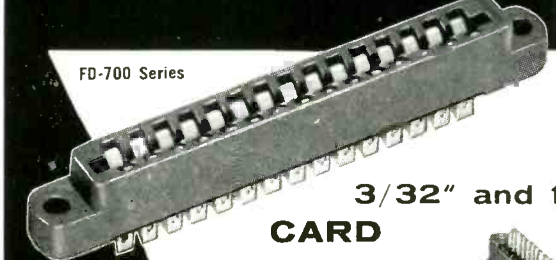
The completed station will include a fuel pier on Machias Bay and a petroleum depot. An administrative center will be located three miles back of the shore. Around it, in buildings still to be constructed, the station's service personnel will be housed.

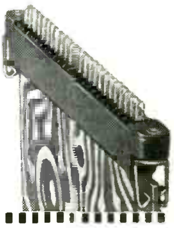
The remote Cutler peninsula was chosen by the Navy for its big radio station after a number of potential sites had been carefully surveyed. It alone met the requirements of being an easternmost point, a northernmost point and a point surrounded on three sides by water.

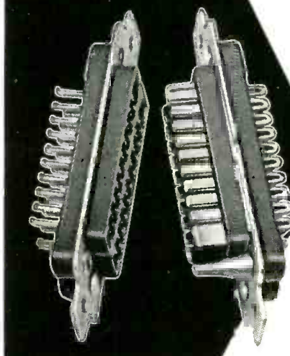
The construction schedule calls for the station to be ready for full operation in late 1961 or early 1962.

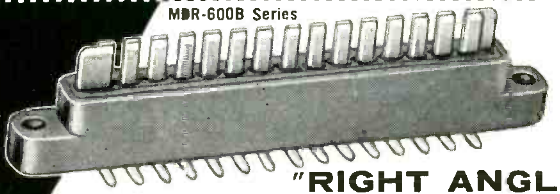
Counterweight carriage structures at tower, seen from inner anchor.









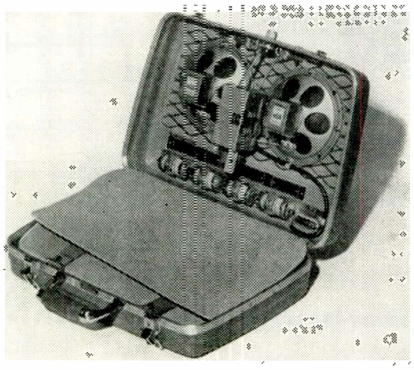


Portable, 5-transistor amplifier is useful for moderately large audiences. Complete unit consists of amplifier, 2 loudspeakers, batteries and mike, contained in an attache case.

Transistor P-A Amplifier

By G. FRANKLIN MONTGOMERY, and FRANK R. BRETEMPS
National Bureau of Standards,
Washington 25, D. C.

Complete p-a amplifier, with speakers, mounts in conventional attache case



Unit is powered by 4-size-D batteries that provide operation for over 20 hrs.

Microphone and cord are stored in case

THIS portable voice amplifier, useful for delivering talks to a moderately large audience, is a single unit, powered by four size-D flashlight cells. It develops approximately 0.75 watt in a pair of cone loudspeakers.

All parts and accessories are contained in a 5 x 12 x 18-in. attache case.

Fig. 1 shows the two 6-inch loudspeakers located on one wall of the case with the volume control and two input jacks fixed to the top.

The transistor amplifier, assembled in a small utility box, is mounted between the loudspeakers in Fig. 2, with the batteries beneath.

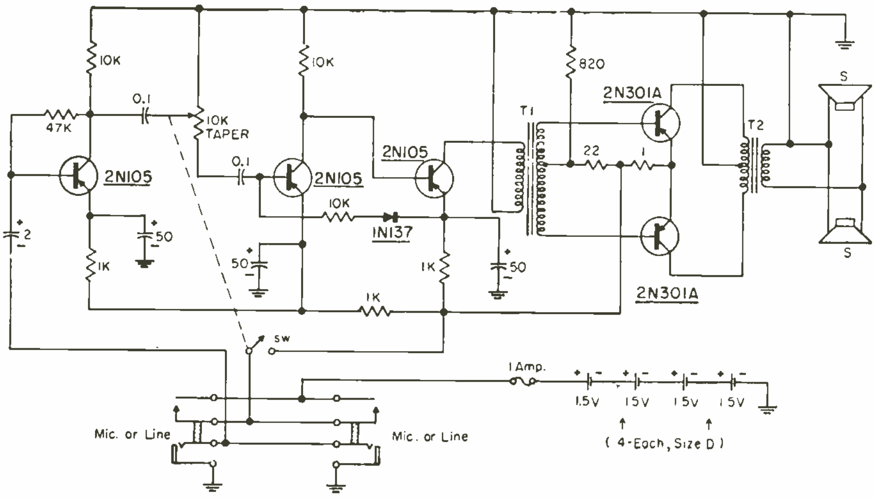
The microphone cradle is attached to the opposite wall (Fig. 3).

The amplifier circuit, shown in Fig. 4, uses a pair of 2N301A transistors in class AB. These transistors are operated much below maximum rated dissipation and collector current (the peak current is about 0.5 ampere) and in a range of collector current where the current amplification is nearly linear. Consequently, the impedance of the driver need not be as low as that required for linear amplification at maximum power. Three stages using 2N105 transistors provide sufficient gain in power from a 200-ohm dynamic microphone to drive the output stage.

Two input jacks permit using two microphones simultaneously. Alternatively, with one microphone, a separate cable can be used to connect the inputs of additional amplifiers in parallel with the first.

With normal talking, the average battery current is about 0.1 ampere, so that size-D dry cells should last for twenty hours or more. There is no battery drain unless the volume-control switch is on and at least one input jack is occupied. A fuse protects the batteries and output transistors from damage due to improper battery insertion.

Amplifier circuit. Output 2N301A's are operated Class AB, much below max. ratings



Notes:

All Resistors in Ohms, ½ Watt.
All Capacitors in Microfarads, >6 Volts.
T_1—Argonne AR-109, 10K to 2K C. T.
T_2—Argonne AR-503, 48Ω C.T. to 3.2Ω.
S—Utah PA6F, 8 Ohms.
Microphone—Turner 58A Dynamic, 200 Ohms.

CUES for Broadcasters

Preparing Slide Projector While Showing Movie Film

RAYMOND M. JURADO
WMSL-TV, Decatur, Ala.

During a film showing it is extremely difficult to edit slides that have been inserted into the projector. The light from the slide projector had to be blocked off from the multiplexer. And then it is almost impossible to read slides when checking sequence. It is also possible that one may be accidentally placed in wrong or may not be level.

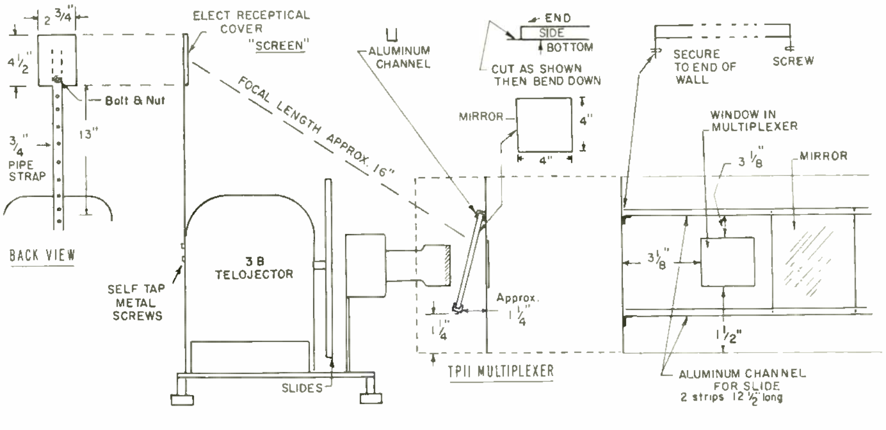
It became apparent that something should be done to rectify this situation. With a little effort I was able to solve the problem with a few parts, all "junk box" origin.

The accompanying sketch shows a side-view of the telojector with the pipe strap mounted and the receptacle cover used as a "viewing screen." In front of the window in the multiplexer, the aluminum channeling allows the "Switcher" to slide the mirror in front of the projector lens so that the image will be projected on the small screen.

In the initial setup of the mirror it is advisable to first install the pipe strap and small screen. Secondly, position the channeling and tilt the mirror until the reflected image will be centered on the screen. Then fasten the channeling. Focusing can be very easily adjusted simply by a slight deflection of the strap one way or the other.

Aluminum channeling was obtained from a discarded grille of a late model auto.

The projected image will be readable and will be seen as it would appear on the Monitor Console.



MATERIALS NEEDED

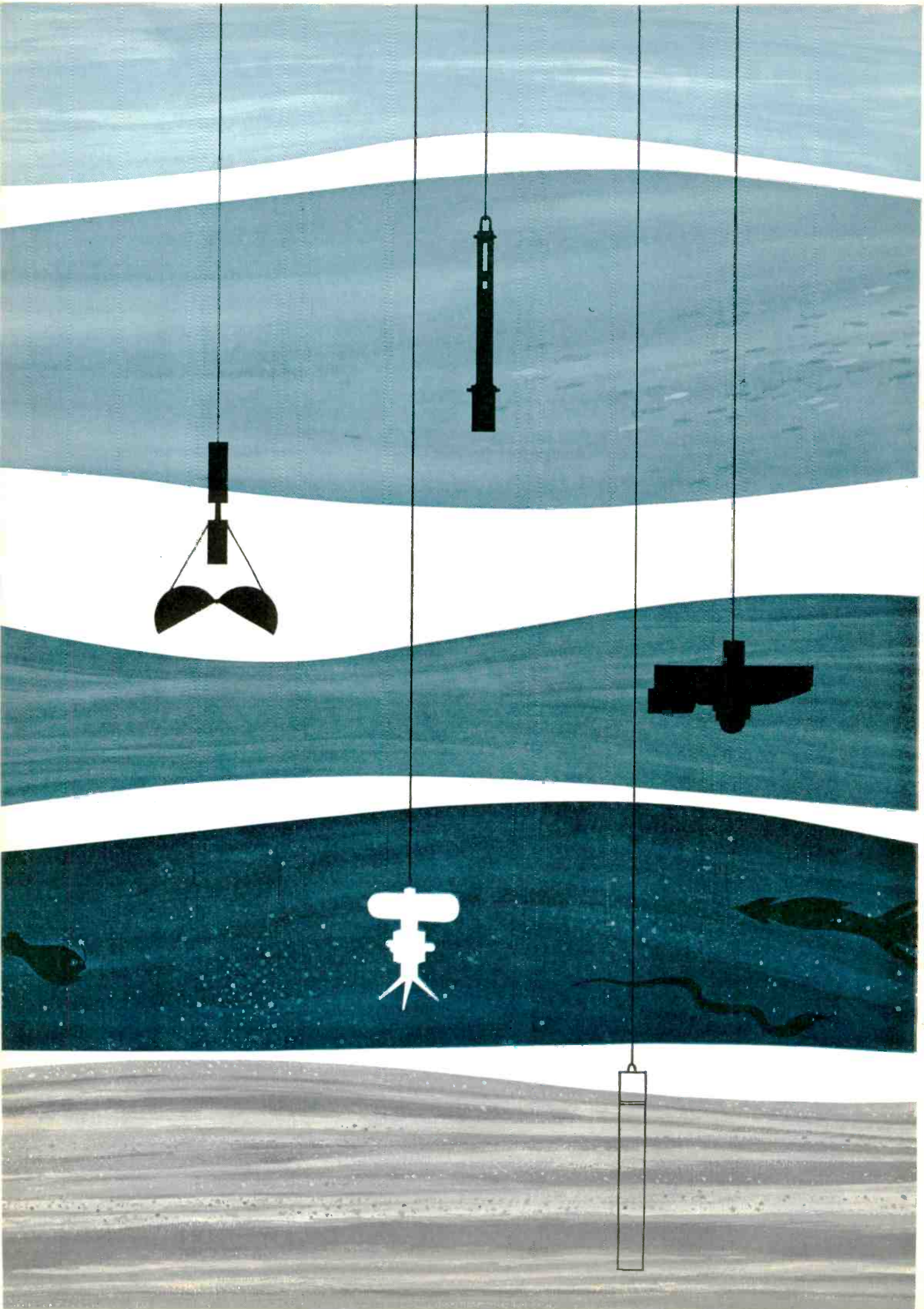
1 - $2\frac{3}{4}$" X $4\frac{1}{2}$" BASE RECEPTICAL COVER
1 - LENGTH PIPE STRAP 3/4" X 13"
2 - LENGTHS ALUMINUM CHANNEL $12\frac{1}{2}$" LONG
1 - MIRROR 4" x 4"

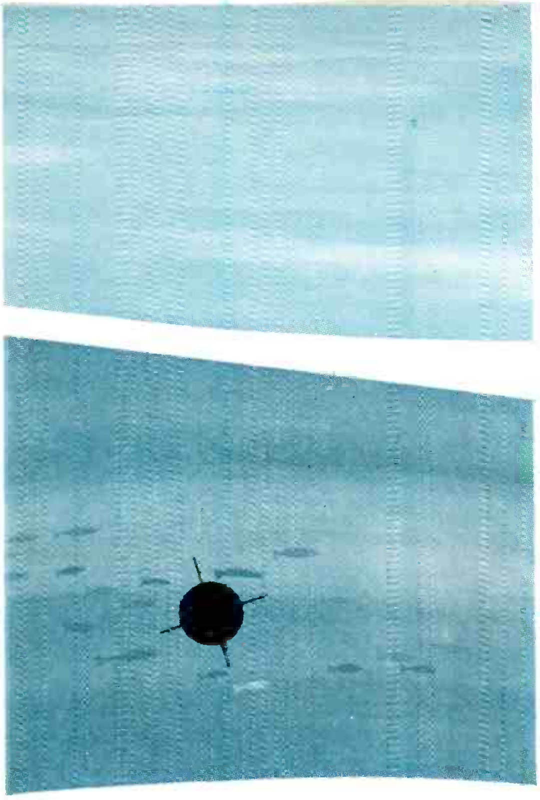
Equipment used are the RCA 3B Telojector, TP11 Multiplexer and 2-TP 16F Projectors. Note: drawings are not drawn to scale.

G-E To Market Citizen's AM Radio

General Electric's Communication Products Dept. of Lynchburg, Va., and E. F. Johnson Co. of Waseca, Minn., joined forces in a national marketing effort for the Class D Citizens Radio field.

The agreement calls for G-E to place its nationwide sales, installation and service forces in the forefront of an intensive campaign launching Johnson's new "Viking Messenger" product. G-E has elected to distribute Johnson's Class D Citizens Band product rather than re-enter AM production at this time. It was pointed out that Class D Citizens Band required strictly AM equipment and G-E has not produced AM communication sets for several years.

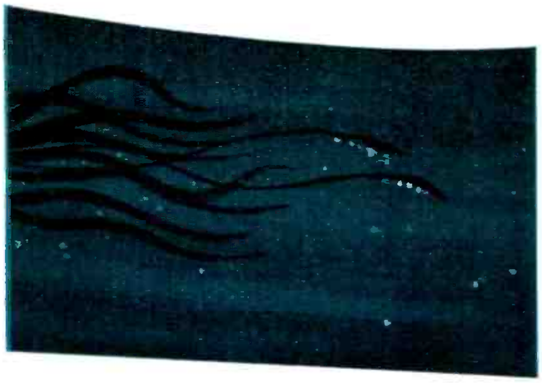


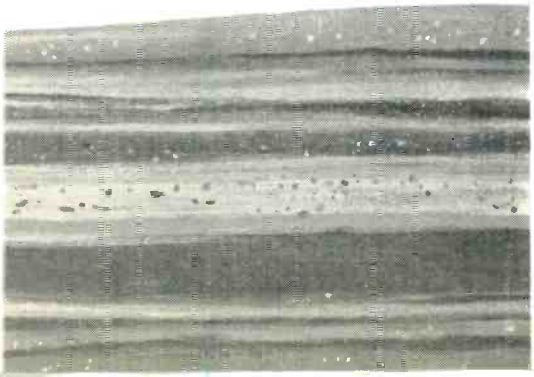


Lockheed's interest in the virtually unknown 360,000,000 cubic miles of this planet's oceans, stems naturally out of its underwater environmental development work with the Navy's POLARIS Fleet Ballistic Missile.

Proposed studies in the increasingly important field of oceanography include: oceanographic research vessels; measuring instruments; data collection systems; underwater communication and navigation; and basic research regarding natural phenomena and military aspects of the deep sea.

EXPLORING THE WORLD OF WATER





Division Diversification— Oceanography is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology — from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetodynamics; man in space; materials and processes; applied mathematics; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space communications; space medicine; space navigation; and space physics.

Engineers and Scientists — Such programs reach far into the future and deal with unknown and stimulating environments. It is a rewarding future with a company that has an outstanding record of progress and achievement. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. A-48, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship required.

Lockheed

MISSILES AND SPACE DIVISION

Systems Manager for the Navy POLARIS FBM;
the Air Force AGENA Satellite in the DISCOVERER Program;
MIDAS and SAMOS; Air Force X-7; and Army KINGFISHER

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
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Circle 503 on "Opportunities" Inquiry Card

The Importance of International Standards*

By HARVEY WILLIAMS
President, Philco International Corporation.

IN the last thirty years, the electronic industries have grown into a position of outstanding prominence in the economy of the United States. It is not so much the size of the industry which is significant, despite its annual sales of over $10 billions; nor is it the size of the industry's exports which last year approached $450 million; nor is it the fact that the electronic industries are looked upon as one of the great growth opportunities of the United States despite the stature which it has already attained domestically and internationally.

Growing Electronic Market

The truly significant fact is the substantial degree to which developments and devices of the electronic industries will permeate more and more into our American scientific development, our industrial activities and our domestic way of life.

The use of electron devices in aircraft, missiles and satellites are spectacular examples of this. The general public is only dimly aware of the rapidity of change for which electron devices are responsible in communications. Here is a huge area of business activity in which it is safe to forecast revolutionary design developments, around electron devices, during the next decade.

More prosaic are the growing variety of electronic controls being applied to machinery, processes and procedures—even to counting railway cars.

In the home itself, tubes and semiconductor devices do more and more for the household. Television alone is a multi-million dollar postwar industry which has brought new horizons of knowledge and entertainment to, perhaps, 85% of our American families in the short space of a dozen years. We have seen domestic radio sets become independent of the household power supply because transistors make practical lightweight battery-operated portables of long life and low cost. We shall see more electronic controls in various types of household appliances. The typical home of 1970 will contain electronic devices for increased economy or comfort which are still unknown today.

This breadth and depth of what electron devices can accomplish and will make possible, is the truly significant feature of the electronic industries. It is this breadth and depth of application of electron devices to our present industrial and domestic lives which introduces the growth and volume factors into the size and prospects of the industry. It is the newness—or perhaps the novelty—of these inventions, developments and new products which gives them particular importance in America's outlook toward international trade.

Balance of Trade Deficit

With a deficit in the American international balance of payments running at the rate of about $4 billion annually, the United States needs critically to re-establish its exports at the peak levels of 1957 or even higher.

It is not likely that this can be done with the conventional products of the last two or three decades. The United States must rely on new and novel products. We must utilize our ingenuity and creativity to the nth degree. In such an effort, electron devices are key elements around which new product concepts can originate, in extraordinarily wide fields of endeavor, ranging from home products to those for use in industry, in transportation, in communications and by science.

This is the keynote of my message to you today. This is the com-

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Harvey Williams, is Chairman, Executive Committee, Electronic Industries Association, International Dept., Member, Executive Council, The U. S. National Committee, International Electrotechnical Commission.

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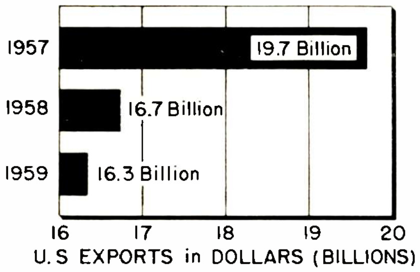
* Presented to the First Annual Meeting of The Joint Electron Device Engineering Council, Philadelphia, Pa., Nov. 17, 1959.

pelling reason why the American corporations participating in the electronic industries will find it both a selfish necessity and a national duty to support programs of international standardization as they relate to tubes and semiconductor devices as well as to other electronic equipment. Participation in such standardization can make and retain opportunities for export sales of these products.

The Changing Trade Picture

Let us see what has happened to the United States in international trade between 1946 and 1959. Then let us come back to the importance of the acceptability of American electron devices, components and electronic equipment, not only in other industrial countries of the world but also in the less developed nations where communications, transportation, industrialization, radio and television are all likely to develop at much higher growth rates during the next two decades than in the United States. From these facts, it will be obvious that intelligent, continuous and effective participation in programs of international standardization is fully as important to the overseas programs of our companies as is the maintenance of research engineering and export selling. Any company would be left behind the procession very quickly in our domestic market if it did not maintain its research programs. Similarly, the United States quickly can be left behind the international procession in promising markets overseas unless it maintains continuously its active, attentive participation in international standardization.



The fourteen years since the end of World War II can be divided roughly into three periods.

Only Major Producer

The first period, from 1945 to the Korean War, was one during which the United States was the only major producer of consumer and capital goods for international markets. Britain, Germany, France, Italy, the Benelux countries and Japan largely were out of commission as productive economies due to the war's destruction. The United States enjoyed large exports, frequently sold with little competition, and became accustomed to embarrassingly large favorable balances of trade.

This was a period when export and industrial opportunities abroad were relatively easy to select and to finance. It was a seller's market. Worldwide expansion of industry and trade seemed inevitable. Profit potentials were very promising, but patience was needed in considering repatriation of capital from soft currency areas.

During this initial period, the United States subsidized the rehabilitation of production in Britain, Germany, France, Italy, Benelux and Japan by Marshall aid. Basically, this was a life-saving device designed to preserve the Western way of life against further Communist infiltration and control.

Aid Begins to Pay Off

The second period was from the Korean War to the middle 1950's, during which many of the overseas projects launched in earlier years began to pay off handsomely. Latin American countries began to encourage local industrialization. Some closed their borders to certain manufactured products to protect new local enterprises. Exports from the United States of complete radio and television receivers became more difficult although components, for local assembly, could still be sold successfully.

Production in Britain and the three major Western European nations began to meet essential domestic needs and to provide more and more for export. Importing countries began to be less dependent upon the United States and to find that they could do increasing business with other more industrialized nations. We began to feel this competition in electronic componentry as well as in complete finished products. But our favorable balance of trade continued. The selection and evaluation of foreign projects by American companies still was reasonably simple. The dollar continued to be very hard. The European currencies were still soft.

Real Competition

The third period begins in different areas of trade and industry at various times between 1954 and 1956. It might be called "The Renaissance of Production *Outside* the United States."

In the early part of this period, European production became adequate to meet higher domestic consumption and to maintain substantial exports. In the latter part, we find the "Renaissance of Production" spreading to Japan. It is well known what the Japanese have accomplished in radio, television and componentry.

The 1959 levels of production in Britain, Germany, France, Italy, Benelux and Japan are not only supplying their domestic markets reasonably, but are providing substantial volumes of goods for export in competition with our own American products. In fact, the competition of these overseas products *in our own domestic market* has reached new high levels because these goods please and satisfy Americans, as well as customers of other nationalities.

Conditions Reverse

How greatly have conditions reversed themselves from the first of these three periods. Today, there is so much local "know-how" available in Britain, Western Europe and Japan that often it is difficult to find a local industrial or finan-

A message to
Electronic Engineers
from R. P. Gifford,
Engineering Manager
of General Electric's
Communication Products
Department in
Lynchburg, Virginia—

"An electronic design engineer earning $10,000 should be a decision-maker *beyond* his project's immediate technical problems."

"I believe that any electronic design engineer earning $10,000 or more welcomes the authority to make a variety of high-level business decisions—in such areas as features versus cost and reliability versus weight—working closely, of course, with his marketing counterparts in Product Planning and also with the Manufacturing Engineers.

"At Communication Products Department we give the experienced engineer the *necessary authority* to do just this. He generally enters the design project early in the development planning phase, so that he can take responsibility for estimating the project expense and schedule—thus contributing to the establishment of bogeys for product cost and delivery.

"Of course our communication systems must do the customer's job, but also they must be *marketable at a profit to the Department;* to make this come true is a vital part of the design engineer's challenge. This means exposure to many management problems and a rare opportunity to grow and move ahead rapidly.

"Our communication products are primarily commercial, including Mobile Radio, Microwave Radio Relay, Terminal Equipment, Telephone Carrier, Multiplex, and Personal Communication Systems. Military contracts also in the house include a 24-channel SSB tropospheric scatter system."

Right now, we have immediate openings for Advance, Development, and Systems Engineers who have significant backgrounds in these areas:

R.F. circuit design
Multiplex equipment
Microwave systems design
Solid state devices
Microwave plumbing, antennas
Piezoelectric devices
Mobile transmitter, receiver design
Electronic equipment mechanical design
Automatic test equipment D&D
Microminiaturization

For prompt consideration, forward your resume in confidence to Mr. W. Kelly, Dept. 24-MA
COMMUNICATION PRODUCTS DEPARTMENT
GENERAL ELECTRIC
Mountain View Road, Lynchburg, Virginia

cial group interested in an alliance with an American company for manufacture and sale of a *conventional* product. In some instances, notably in Japan, local Government may not approve remittance of fees under additional manufacturing licenses for certain product lines. In fact, a flow of "know-how" *from Europe* to the United States, Latin America and elsewhere has become established.

Instead of exporting capital and consumer goods freely to any overseas market with the dollars to buy, we now find ourselves in competition with several major manufacturing and exporting economies which are demonstrating their ability to give value for money in a fashion which places a good many American exporters at a serious disadvantage. These last few years have seen a gradual decline in our favorable balances of trade. On the basis of our commercial imports and exports, it was about $3.0 billion in 1958. It may be as low as $1.0 billion in 1959.

"Dollar Confidence"

With increasing exports, the currencies of the other manufacturing countries strengthened. This trend climaxed with establishment of external convertibility for sterling at the beginning of this year. At the same time, the European Payments Union came to an end and convertibility of the other European currencies against the dollar was freed also. Remittances and repatriation of capital from these countries are problems no longer. Today, softness of the dollar is recognized in Europe. It is a major change from the first and second post-war periods.

Nevertheless, the dollar still remains the world's most important currency. This imposes upon all of us, as Americans, the responsibility for maintenance of a sound dollar and of confidence in its value in world trade.

Sound Dollar

But, our balance of international payments—the flow of cash rather than goods—has gone against us

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If you're a man who likes to accept challenge—and wants to be recognized for it—we'd be glad to hear from you. Phone Dick Eary (collect, of course) at Eastbrook 9721 in Fort Wayne or write him today for complete information.

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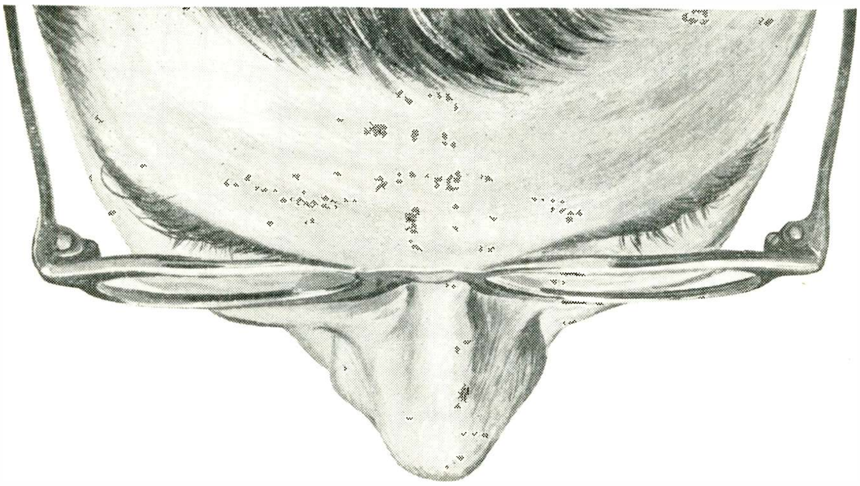

during the last two years, to a point where Secretary of the Treasury Anderson took cognizance of this fact at the World Bank meeting in Washington last September with two different remarks.

First, he proposed the formation of the International Development Association. Basically, this is a request to the major Western nations to share with the United States the burden of economic aid to the less fortunate areas of the Free World.

Second, the Secretary pointed out that with military expenditures abroad of some $3.0 billion, with a Government capital outflow —primarily for overseas economic aid—of some $2.5 billion and with private investment abroad at $2.0 billion—all annual rates—1959 may end with a net deficit of about $4.5 billion for the year. Last year, our international deficit on a similar cash basis, was between $2.5 and $3.0 billion. Obviously, a trend of this sort cannot continue unless we are prepared to suffer a reduction in our standard of living.

This trend has developed for several simple reasons. The American people are finding good values and much satisfaction in their purchases of foreign goods. The imports of Japanese radios and European automobiles are examples. As the most powerful nation in the Free World and as the champion of free multilateral world trade, we should find it difficult to impose import quotas to restrict the quantities of overseas merchandise which our population is permitted to enjoy.

Much better is the positive approach taken by Under Secretary of State, C. Douglas Dillon, seeking to open wider the markets of other countries to our American goods. Already, France and Britain have responded by eliminating or reducing the quotas imposed against imports of American products.

Import Importance

Our economy depends more and more on imported raw materials. Our steel companies bring ore from Canada, Venezuela and Africa. Our aluminum companies obtain bauxite or concentrates from Africa, the Caribbean and elsewhere. Uranium comes from Australia, the Congo and Canada; coffee from Chile; tin from Malaya and Bolivia; lead and zinc from Mexico and Australia, etc., etc. Our expenditures for raw material imports will become greater and greater as our population and our industrial needs expand.

American expenditures for foreign travel are mounting annually. With fast, inexpensive air transport across the Atlantic, to Central and South America and to the Far East, we can expect this trend to continue. Consequently, cash outflow for imports, for raw materials, and for tourism are reaching new highs, sending more and more dollars abroad each year.

Then there must be added the remittances of some $7.5 billion annually for military aid, economic aid and private investment overseas. These amounts are small compared to $430 billion of Gross National Product but they are large compared to $20 billion of gold reserves.

The imbalance, which concerns Secretary of the Treasury Anderson, grows from the fact that our American international remittances are greater than the cash regained by payments to this country from abroad.

Must Increase Exports

The major source of payments to us from abroad is for our exports. From a 1957 peak of $19.7 billion, our exports dropped in 1958 to $16.3 billion and may just reach $16.0 billion in 1959. Think of these exports as income *flowing to the United States* as well as goods going abroad. It must be clear that to overcome our annual net deficit in international payments, *we must increase our exports and the incoming payments for them.* Also, we could increase our cash return from our foreign investments and operations. These are the only two safe sources of dollars returning to the United States.

We face an American dilemma in world economic relations. Let me summarize it. We are spending

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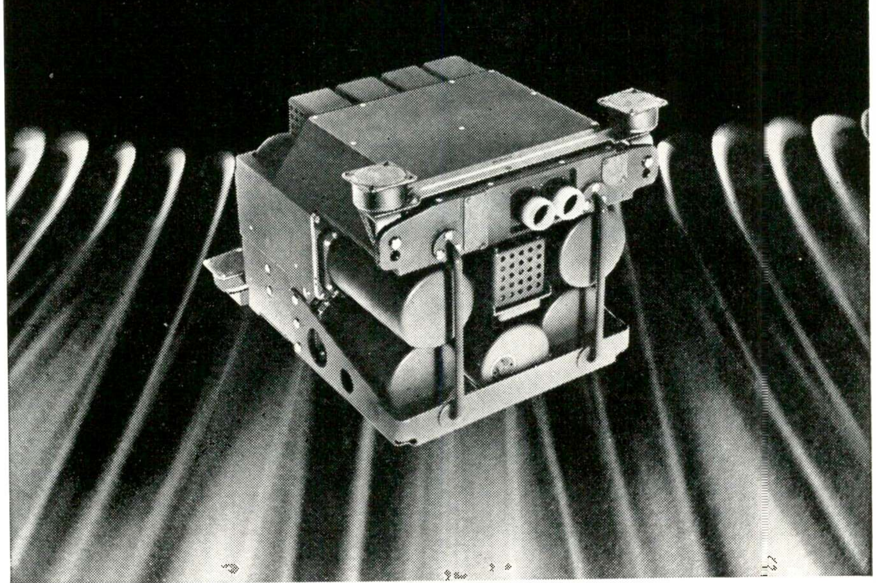

• *AiResearch Central Air Data Computer for North American's A3J, Navy's first weapon system, provides information dealing with bombing, navigation, engine inlet control, radar, automatic flight control and cockpit instrumentation.*

Expansion in electronics and electromechanical activity is creating excellent openings at all levels for qualified engineers. Diversified programs include Central Air Data systems on the Air Force B-70 and F-108, North American A3J and McDonnell F-4H, as well as other commercial and military aircraft and missile projects.

Openings in the following areas:

- **FLIGHT SYSTEMS RESEARCH** General problems in motivation and navigation in air and space; required background in astronomy, physics, engineering.
- **DATA SYSTEMS RESEARCH** Experience with physical measuring devices using electromagnetic, atomic, thermionic and mechanical approaches.
- **CONTROLS ANALYSIS** Work in preliminary design stage involves servomechanisms analysis and analog computer techniques.
- **FLIGHT DATA COMPONENTS** Analysis proposal, design and development work in the following specialties: circuit analysis, servo theory, transducers, transistors, airborne instrument and analog development of high and low temperature problems.
- **ELECTROMAGNETIC DEVELOPMENT** Work with magnetic amplifiers requires knowledge of electromagnetic theory, materials and design methods.
- **INSTRUMENT DESIGN** Electromechanical design of force-balance instruments, pressure measuring devices, precision gear trains and servo-driven positioning devices. Experience in electrical and electromagnetic transducers desirable.
- **AIRBORNE INSTRUMENTATION ANALYSIS AND DESIGN** Work involves solving problems in accuracy, response and environmental effects.

Send resume to:
Mr. R. H. Horst

THE GARRETT CORPORATION
AiResearch Manufacturing Division
9851 SO. SEPULVEDA BLVD., LOS ANGELES 45, CALIFORNIA

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more and more for imports because we need more and more raw materials for our industries and because our consumers are getting a greater and greater taste for foreign goods and for travel abroad. Our overseas military expenditures, private investments and Government economic aid bring our total disbursement to levels where we are $3.0 to $5.0 billion a year in deficit.

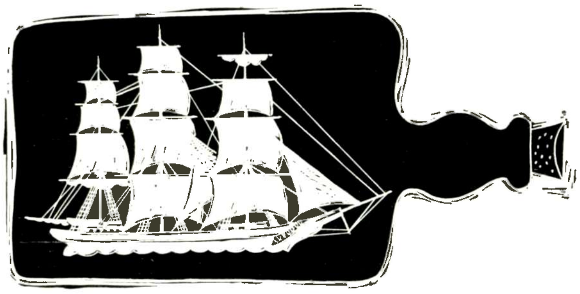
We earn dollars by exports, by making overseas investments and by carrying on operations abroad which return license fees, dividends or profits to us. In simple language, we are earning $3.0 to $5.0 billion per year less than we are spending. The officers and directors of a corporation would not countenance such a situation for long.

I feel confident in forecasting that you will hear much more of these subjects over the months to come than you have in the past. I feel confident that top management executives will become more interested in the international economic policies of the United States during the 1960's than they may have been during the 1950's.

International Standardization

Among the group of companies which support your two sponsoring associations—The Electronic Industries Association and the National Electrical Manufacturers Association—over 70% are engaged in overseas production. All of them are interested in export sales. Their foreign operations are carried on in all the principal nations of the Free World. Combine these facts with the growth possibilities in the Electronic Industries and with the acceptability of the new and unique products which your research organizations are constantly bringing to commercial reality, and other arguments are not necessary to demonstrate the vital interest which your top management executives need to have in international standardization as the key to international trade.

There are highly competent and very large organizations in the



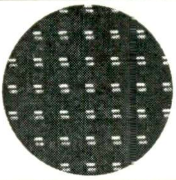
electronic industries of Britain, Germany, Holland, France, Italy and Japan. In these countries, also, research is driving ahead. In these countries interest is keen and active in exports not only to the other more advanced and industrialized nations but also to all the less developed countries of Latin America, Africa, the Middle East and Southeast Asia. Each of these major manufacturing and exporting countries seriously follows international standardization. Each participates actively through its local National Committee of the International Electrotechnical Commission and through attendance at its international meetings. It is not unusual for Britain, France, Germany, Italy or Japan to have more members in their delegations at one of these international standardization meetings than there are in the American delegation.

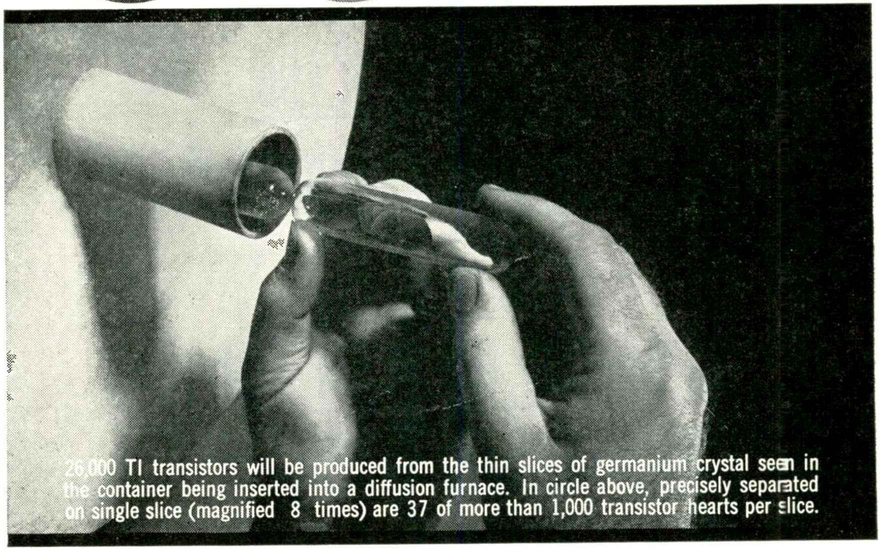
This is partly because the local National Committees of some of the thirty-three member nations in the International Electrotechnical Commission are wholly government sponsored. In other member nations, there is joint sponsorship of the local National Committee by industry and government, as in the case of Great Britain.

IEC Support

In a few member countries, notably the United States, the work of the local National Committee is entirely a responsibility of private industry. Therefore, the extent to which our American point of view is represented, with regard to the standardization of dimensions or of procedures for the measurement of performance, in the discussions which ultimately lead to international agreement upon an acceptable standard is entirely dependent upon the understanding and support of our top corporate managements.

Various agencies of the United States Government are amongst the largest purchasers of electronic equipment. The American position in international standardization activities can be strengthened by participation of these government agencies and of the National Bureau of Standards in meetings on international standards for tubes





International Standards

and semi-conductor devices as well as for other components.

Standardization & Overseas Sales

How often do your senior sales executives consciously stop to realize that the sale of electronic equipment and components in international markets is dependent upon the acceptability of these products to the customer overseas?

How often does the president of your corporation and the executive in charge of your overseas manufacturing operations or exports stop to realize how the direction of overseas production and of export sales could be facilitated by compatibility between our dimensional standards and standards of performance and the similar standards used abroad? *The development of such acceptability and compatibility is the objective of international standardization.*

If dimensional standards in a country of destination are different from ours, your potential export sale fails on the first test—namely, that of "acceptability." After all, your tube must fit the other fellow's socket.

Applying this same thought to the guidance of manufacturing overseas, as a specific example, how pleasant it would be if the sockets and tubes abroad were identical with those which you use in the United States. This would make the interchange of sockets and tubes between your foreign operations and your domestic production a simple matter. So, compatibility of standards can be as important to efficient overseas production as to export sales.

While international dimensional standards are essential, standards of measurement for evaluating performance are equally important. If the procedures for evaluating the performance of your product in a country of destination are not the same as those which you use in measuring the performance of your product at home, you may fail in another primary requirement for acceptability to your overseas customer. Here is a simple illustration.

The performance of automobiles in the United States is measured in terms of miles per gallon of gasoline with respect to fuel consumption. But a European talks in terms of liters per hundred kilometers. Can you compare readily 17 miles to the gallon with 12 liters per hundred kilometers. The two statements are not compatible because the standards of measurement are dissimilar.

With the help of some conversion sion factors and a little arithmetic, a comparison which is accurate can be calculated; but if we are dealing with the performance of electron devices, components or electronic equipment, this kind of incompatibility in the procedure and language of measurement of performance is a real handicap to acceptibility and, therefore, to export sales.

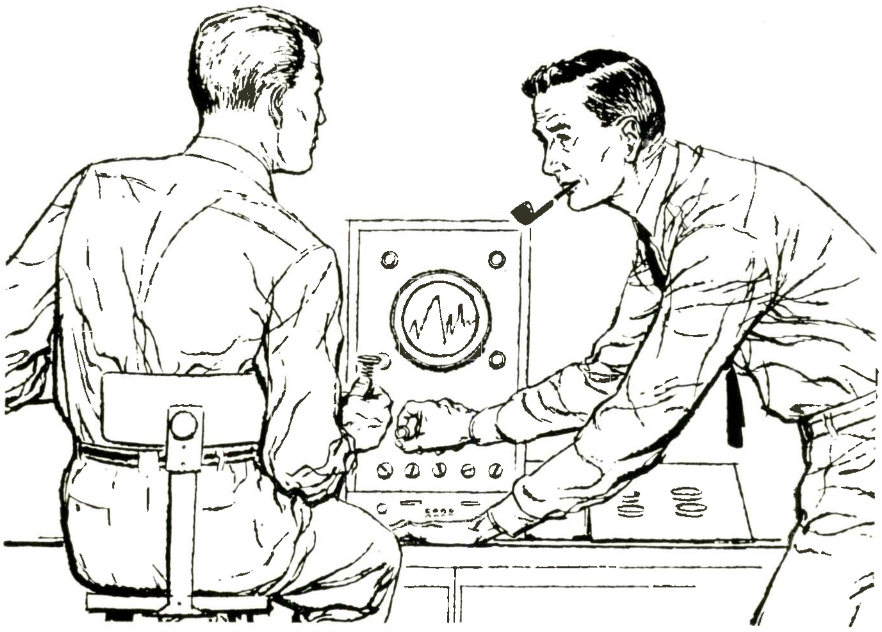
Therefore, you will agree that international acceptability and compatibility are prime requisites to the most economical and efficient development of your overseas manufacturing operations, and equally necessary to the success of your export sales. Then, certainly, you will accept the fact that international standardization in terms which are compatible with American practices are of vital importance.

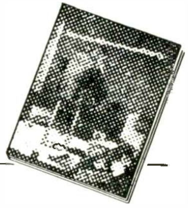
EIA & JEDEC

We are fortunate in having the mechanism for introducing American practices and procedures into standards which are adapted internationally. That mechanism starts in your own committees of EIA and JEDEC. It is carried from there through the United States National Committee of the International Electrotechnical Commission to the appropriate international IEC Committee.

Less than the 33 member countries may be represented on a particular IEC Standardizing Committee, but you may be sure that the representation will include all the countries having a real interest in the products with which the Standardizing Committee is concerned.

As the leader of the Free World; as the country which has been able to put abroad since World War II, $81.0 billion in government aid and private investment; as the nation within which there exists the larg-





est electronic industries in the world; certainly one would expect the United States to be providing leadership in programs of international standardization related to electronic products and componentry.

Despite the fact that we have made good progress in the development of fundamental principles in the methods of testing tubes, we are behind in the field of implementing hardware. We find ourselves trailing some other countries, notably Japan and Germany, in getting our proposals for electron tube measurement methods before the appropriate Committee of IEC for international consideration.

Of course, standardization work is time-consuming. Not only is there the detailed preliminary work by the individuals participating in it but also the attendance at preparatory meetings in the United States and at the international meetings abroad. The alternative to participation of this character, by qualified personnel from companies in the industry, is a default in providing proposals for standards and counter-proposals to the standardization recommendations of other nations. The result will be that dimensional standards or standards for the measurement of performance may be adapted internationally which are more compatible than those of another country and less compatible with our own than would be the case had our own practices and procedures been strongly represented during the negotiation of the international standard.

We can feel reasonably sure that the less developed countries will be strongly guided by the electronics standards of the International Electrotechnical Commission. These countries represent a growing market potential for communications equipment, radio and television receivers, electronic controls and other gear. They are an important sales potential for all of the major manufacturing countries of the world. The American electronic industries need to be effectively represented in the international determination of electronic standards tc avoid being out of step with the final decisions and, thereby, losing this prospective trade to other countries.

European Common Market

The European Common Market is an area in which the American electronic industries are heavily interested both through local production and through exporting electronic gear to it. The six nations in the Common Market are on record that they will stick as closely as possible to the electronic standards of the International Electrotechnical Commission. Certainly, the American industries cannot afford to take a chance of being out of step with the sales potential of this area.

As many of you know, there is a tendency to increase the production of military electronic gear in Europe for use by the North Atlantic Treaty Organization. It seems reasonable that NATO will follow closely the standards of the International Electrotechnical Commission, also.

Consequently, in its own interest, the electronic industries of the United States, acting through the top managements of the companies represented here today, will find active support of the international standardization programs as necessary to the future welfare of their overseas operations and exports as the maintenance of their research departments or the strengthening of their export sales and overseas operating divisions.

Constant Participation

As long as international standardization activities in the United States are solely the function of private industry, such support will require an annual company appropriation and the provision of the time of specialized personnel for the preparation of original material, for participation in the meetings of your own committees and for participation in the international meetings of the standardizing committee of IEC. This should be a regularly budgeted outlay each year by each of your companies.

It is a happy circumstance that the selfish interests of the electronic industries and the national

ELECTRONIC INDUSTRIES Advertisers — January 1960

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International Standards

interest of the United States, in its need to increase its exports materially and soon, run parallel with each other. If I have given you a basis for discussing the importance of international standardization with your top managements in terms of its desirability—in fact, its necessity—for the industry and also for the welfare of the United States, the time which you allotted on your program has been used constructively.

Mr. R. C. Sogge of the General Electric Company, President of the United States National Committee of the IEC; Mr. Virgil M. Graham, Vice President of the USNC and the Technical Advisor to the USNC for Electron Tubes and Semiconductor Devices, and Mr. Leon Podolsky, Chairman of the EIA International Standards Committee and Technical Advisor to the USNC for components and electronic equipment, have done yeoman work in maintaining the representation of the United States in the International Standardizing Committees of IEC in which you are particularly interested.

When you return to your respective headquarters, I urge you to bring this subject to the attention of your top managements and to urge their energetic support of the program of JEDEC and of the United States National Committee.

Tutoring Machine

(*Continued from Page* 199)

What's left for the teacher? "A great deal," says Carpenter, "Education is much more than storing up factual knowledge. Machines cannot teach students how to make wise decisions. . . . The machine can't hold discussions, debates, conduct demonstrations, manage group learnings, and diagnose adjustmental problems." "Tutoring machines," he says, "will relieve teachers of monotonous chores and will give them more time to deal with emotional problems which don't require special psychological counsel."

Scientific IQ

(*Continued from Page* 199)

What to do to remedy the situation? Dr. Dale Wolfle, Executive Office of the American Association for the Advancement of Science, doubted that much could be done until the public had sufficient education in science. Pointing out TV's superb opportunity to contribute to the public's scientific education, he called for a "straight—not sensationalist" treatment of science on TV and a presentation of not only the facts but also of the deeper understanding necessary for an appreciation of news about science. Edward Stanley, Director of Public Affairs for NBC noted that a number of good science programs are already being aired but noted the difficulties of producing shows that involved abstract concepts.

College Recruitment Gets Code of Ethics

College placement officers should counsel students in job selection but not unduly influence them. Employers should not offer special gifts to students to induce them to take jobs. The employer should spell expenses policy when a student visits the company for further discussion of employment. The student should accept an offer to visit the company only when he is sincerely interested in employment. If he visits several employers on the same trip, he should prorate his expenses among them.

These and many other suggestions are contained in "The Principles and Practices of College Recruiting," a 6-page leaflet published by the College Placement Council, Inc., 35 E. Elizabeth Ave., Bethlehem, Pa., and The Chamber of Commerce of the United States, 615 H Street, N. W., Washington, D. C. The leaflet lists mutual obligations of students, employers, and placement officers. The leaflets are being sent to 1,500 college placement officers and 3,000 business, industry, and government executives. The Council and Chamber expect that, as during the hectic 1957 recruiting season, the shortage of top quality science graduates will continue.

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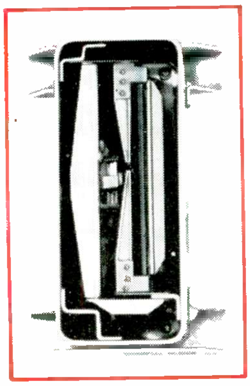

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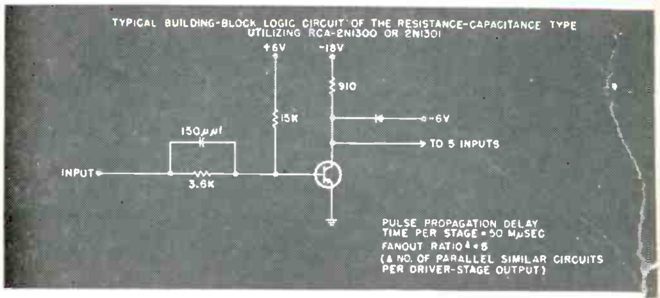
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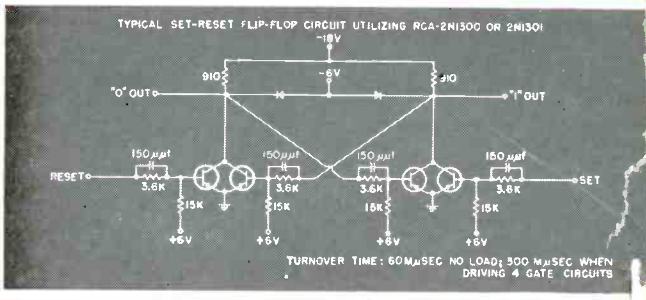
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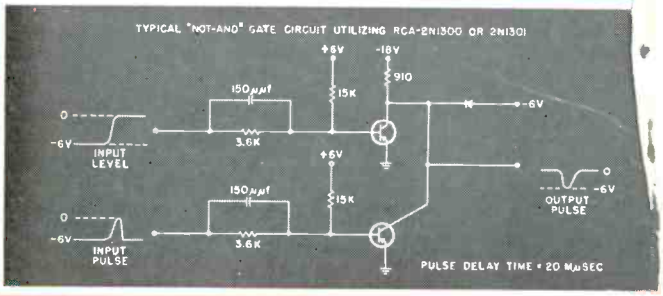
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					at 25°C	at 55°C	at 71°C	at collector ma = −10	at collector ma = −40	
2N1300	−13	−12	−1	−100	150	75	35	30	—	40
2N1301	−13	−12	−4	−100	150	75	35	30	40	60

▲For collector ma = −10 and collector-to-emitter volts = −3

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