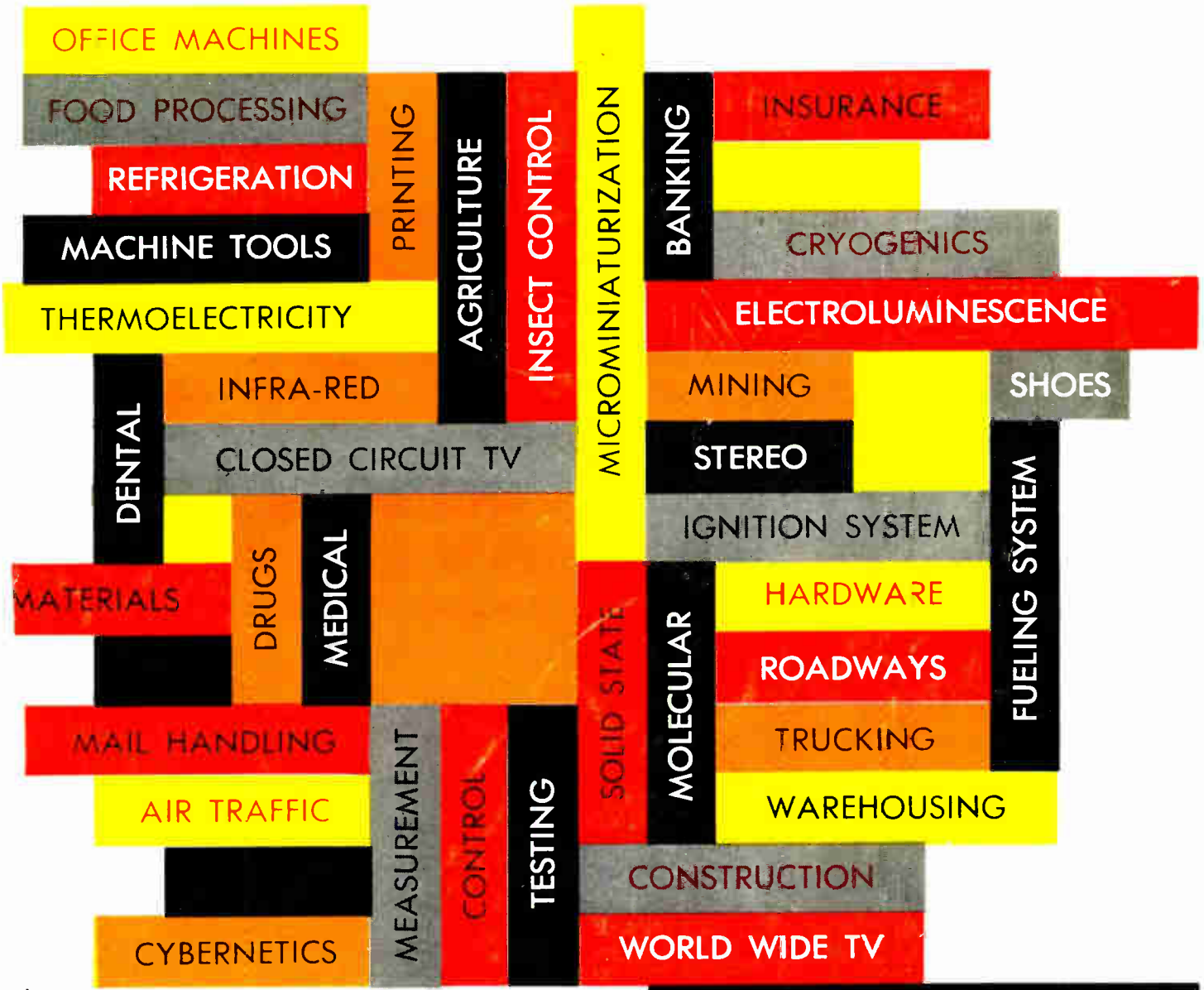
ELECTRONIC INDUSTRIES

A CHILTON PUBLICATION



New and Expanding

ELECTRONIC MARKETS

Also In This Issue:

- Calculating Antenna Matching Networks...
- Solid State Circuit Breakers!

July
1960

TYPE C

Temperature compensating type that meets or exceeds EIA RS-198 specifications. Rated at 1000 working volts.

TYPE B

Designed for by-passing, coupling or filtering applications. Manufactured in capacities between .00015 and 04. MFD.

RMC DISCAPS

TYPE JF

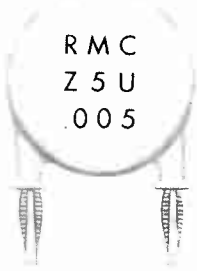
Feature a superior frequency stability over similar types. Available in capacities between 150 MMF and 10,000 MMF.

TYPE SM

For use in applications where limited space is a prime factor. Meet all specifications of EIA RS-198 for Z5U capacitors.

TYPE JL

Exhibit minimum capacity change over extreme temperature range. Change is only ±7.5% between −60 and +110° C.



FIN-LOCK LEADS

Special leads for printed circuits. Eliminate lead crimping. Available on all DISCAPS of standard voltages, ratings and spacing.

DISCAP CERAMIC CAPACITORS

RMC

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

Circle 1 on Inquiry Card

ELECTRONIC INDUSTRIES

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

Proceed... but with Caution

EVEN after the Japanese welcome mat evaporated, President Eisenhower, on his return from the Far East, urged continued trade cooperation in the interest of peace and national security. Events in recent years show that many American industries have accepted this idea and have been cooperative. Each year has seen more and more Japanese products in our market place.

This spirit of international cooperation is a fine thing only as long as both parties mutually agree and share equally. Experience has shown, however, that all too often we fail to adequately communicate our high level aims, desires and motives to our international partner. Things just seem to go astray when it comes to implementation through governmental agencies.

We thought you'd be interested in the text of a letter which recently came into our possession through another Chilton publication. The names of the Japanese writer and the American firm involved have been omitted for obvious reasons.

28 May, 1960

Please expand your business activities utilizing Japanese Plastic Industry

Gentlemen:

We owe your name and address to *an American trade directory* as plastic fabricators.

The writer, professional plastic business man having 15 years' experience in these fields, is very happy to write you, asking for your special attention to the abilities of our Japanese Plastic Industry.

Some items which will belong to your present products, will be made cheaper here in Japan but with equal quality.

Both your and our Government had already confirmed that in very near future there should be a true free trade between the U.S.A. and Japan.

This policy means, in its economic effect, that Japan will become one State of the U.S.A. and Japanese Industrial Facilities will be available at your people's disposal.

It will not be necessary for you to manufacture by: ourselves all the products of your present lines and of future.

Please utilize Japanese Industrial Facilities for you to serve your present customers and also to develop your markets hereafter.

Please note, in Japan, machines are cheaper, molds & tools are cheaper, and labors are far cheaper but very skillful.

The writer had been in the States already three times and notices there are many advantages of Japanese Plastic Industry.

If you leave them alone, they will be strong competitors against you in some plastic fields.

If you will give them chances of working with you, they will be very glad to co-operate with you.

The writer, himself, is very willing to use his own professional experiences and knowledges for your business expansion, and to work here as your agent, for example, as your purchasing agent.

Expecting to hear from you soon, the writer remains.

Yours very truly.

We think that the "you better join us or we'll bury you" attitude of this writer clearly indicates that once again a high level concept has not penetrated properly at the other end.

The electronic industries are particularly susceptible to the effects of foreign imports. For the past two years the meteoric rise of Japanese electronic products has been an ever mounting source of concern to our own producers of consumer products. Already military and government products account for more than 50% of our gross national electronic output. Foreign imports tend to further reduce what heretofore was one of the more stable segments of our industry. All of us are now seeking new stable markets in the industrial area for electronic products but the development of these will still take considerable time.

We believe the time has come to give some thought to reasonable limitations on electronic imports. On the other hand, if, in the interests of national security, further dilution of home markets is mandatory we can proceed—but we should proceed only with the utmost caution.

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ELECTRONIC INDUSTRIES

Vol. 19, No. 7 July, 1960

MONTHLY NEWS ROUND-UP

NEW PRODUCTS & TECH DATA

DEPARTMENTS

Highlights of this issue

Calculating Bandwidths For Matching Networks page 70

Matching networks are used between source and load to obtain maximum energy transfer and to eliminate reflection losses. They also provide selectivity. Values obtained from the Smith Chart are inaccurate when the impedances are located close to the rim of the chart. A technique is described to calculate the bandwidth. The correction factor for loss of the inductor is also presented.

How To Analyze Control Systems With Time Lag page 75

The degree of stability of systems with time delay depends on the location of the zeros of the characteristic equation on the complex plane. A numerical procedure is outlined which produces accurate location by replacing the exponential in the characteristic equation with an approximation and solving polynomials.

The Transistor Guard—A Solid State Circuit Breaker page 78

The short circuit protection of low level circuitry is often overlooked because of the scarcity of effective fuses and circuit breakers in the milliampere range. A device is described—a solid state circuit breaker based on the bistable flip-flop—that fills this need.

A Test Set For Determining Cathode Warm-Up Time page 90

In tube design one of the objects is to have fast cathode warm-up time. This will reduce arcing and transients, thereby improving tube life and reliability. Complete information is given to permit construction of a laboratory type test set.

RFI in Transmission Lines and Filters page 93

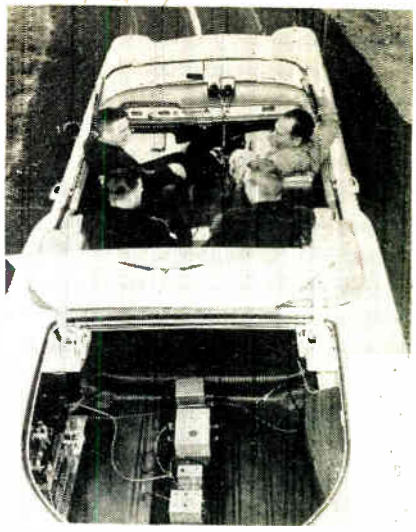
In designing and installing transmission lines it is necessary to consider their role in RFI. The basic considerations are given here. Included are the physical characteristics which are associated with the analysis or control of interference situations. The mathematical techniques used are demonstrated step-by-step.

Searching For New Electronic Markets page 101

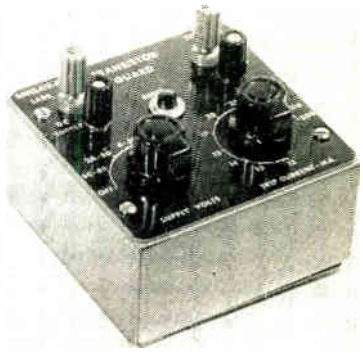
Editorial staff study is the first in a series on new electronic markets. Interesting electronic products are opening up new markets . . . Industrial problems are ripe for electronic solutions. For example: truck-fleet owners expect electronic equipment to solve some rather tricky problems.

Transistorized Closed-Circuit TV Camera page 176

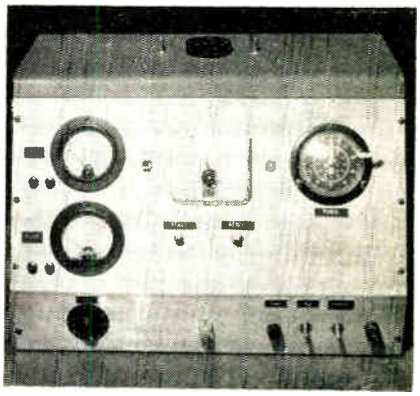
The rigid requirements of military and heavy industrial applications demand a high level of reliability, maintainability and performance. These goals are attained here by designing around new components, using time-tested assembly methods that also permit easy testing.



New Electronic Markets

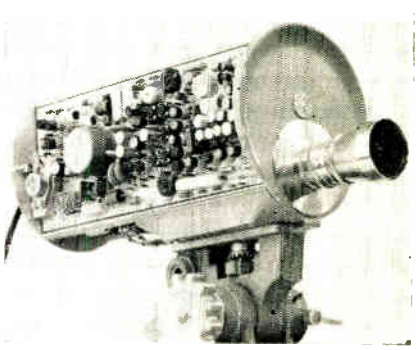


The Transistor Guard



Checking Warm-Up Time

Transistorized CCTV Camera



RADARSCOPE

SKY SCANNER

Time exposure provided this dramatic shot of the 85-ft radio telescope at the National Radio Astronomy Observatory in Green Bank, W. Va. Surface accuracy of the reflector, fabricated by Blaw-Knox, is within average error of about ⅛ in. The reflector can be aimed skyward with error of about 30″ of arc.

JAPANESE ELECTRONICS is continuing the strong upward trend. Production in 1959 was valued at $936 million. compared with $498 million in 1958. The most rapid increase is in consumer electronics, which rose to $531 million.

R&D RESEARCH & DEVELOPMENT EXPENDITURES for 1961, for all areas of science, are expected to top $14 million—almost three times the amount spent for R&D in 1953.

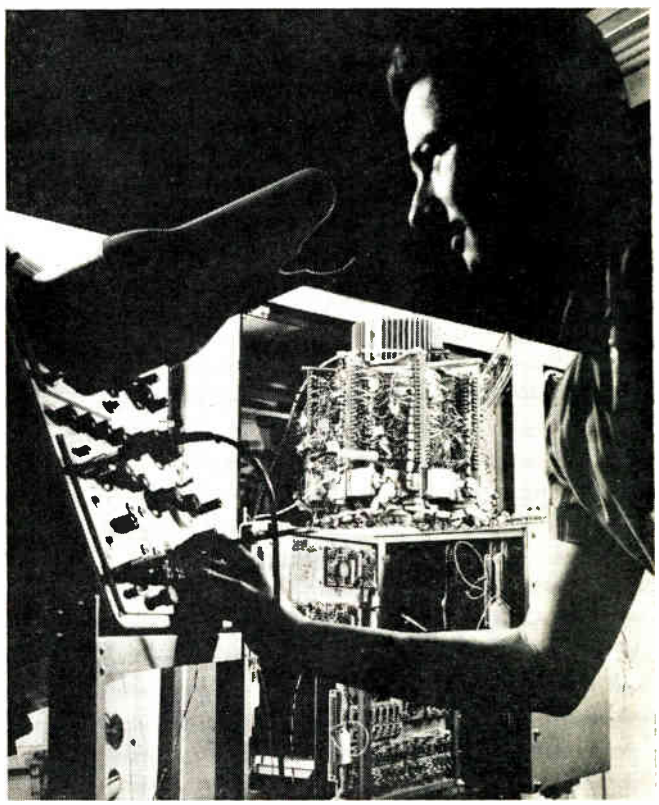
EIA is asking Congress to make the minimum wages established by the Fair Labor Standards Act applicable to all segments of the electronic industry, including Government contractors. At the moment, Government contractors are bound by the higher minimum wage standards set by the Walsh-Healey Act, and EIA is pointing out that the higher wage requirements have forced many small firms to discontinue bidding on Government contracts. The most serious objection that EIA raises is "the Walsh-Healey Act (minimum wage) requirements" stifles the growth of small business concerns and impairs their ability to secure Government business and "the Walsh-Healey Act produces inflation and contributes to increased Government costs."

EXPANDED ENGINEERING CURRICULUM is being recommended by more and more educators and engineering executives. It became particularly obvious at the recent hearings before the House Committee on Science and Astronautics, that the four-year college course is not adequate to provide the necessary fundamental education of the engineer. This education has to be more extensive. There is also sentiment to make research an integral part of graduate studies.

JAPANESE VIDEO TAPE RECORDER, developed by Tokyo Shibaura, was demonstrated to U. S. engineers last month. Like U. S. tape recorders, tape is driven 15 in./sec. and FM is used for video recording. Dr. Sawazaki, one of the developers, claimed these advantages for the Toshiba over the U. S. tape systems: (1) few adjustments (2) simplified construction (3) dropouts extremely decreased (4) recording conditions can be monitored from the recording head (5) picture can be reproduced at any tape speed and (6) "remarkable advantages for NTSC color since it is unnecessary to switch the head in the middle of a picture." There is considerable skepticism, however, that even if these advantages do exist the Japanese model can overcome the advantages that U. S. TV tape recorders have in their acceptance as "standard for the television broadcasting industry."

AIR TRAFFIC CONTROL

Technician uses 'scope to check operation of high speed buffer memory drum for Data Processor designed and manufactured by Librascope Div., General Precision, Inc. Processor is part of semiautomatic system designed for orderly air traffic control.



HYBRIDS OF PRESENT MICROWAVE BEAM TUBES will play a very important role in the future, says Dr. William A. Edson of GE's Microwave laboratory. The hybrid devices, now under development, will combine the best features of conventional multi-cavity klystrons and helix traveling wave tubes. In many important applications, he says, they will ultimately replace both basic tube types combining the best features of the klystron and TWT's that will result in the microwave tube at high stability and efficiency, coupled with substantial frequency range in power.

AEROSPACE INDUSTRY'S EARNINGS dropped to a new low in 1959 to 1.5% profit on sales. This compared with an average of 4½% of profit to sales for all manufacturing corporations. Earnings of the aerospace industry have declined steadily since 1955 when income was 3.8% of sales.

SEVEN SMALL BUSINESS INVESTMENT COMPANIES located in 5 states have formed the first syndicate to provide cooperative financing for small manufacturers. The syndicate is formed under the Small Business Act of 1958. The first venture for the syndicate is in purchasing $186,000 in convertible debentures of the Belfort Instrument Co., Baltimore, Md., manufacturers of photogrametric plotting and weather recording instruments.

U. S. ELECTRONIC EXPORTS amounted to approximately $400 million last year. Manufacturers are complaining that high tariffs, licensing requirements, restrictive standards, an excess of taxation and, in some instances, surcharges that range up to 200% before duties are calculated, stand as formidable barriers to expansion of the export trade. The Bureau of Foreign Commerce has asked for comments to guide U. S. negotiators at the forthcoming sessions under the General Agreement on Tariffs & Trade (GATT) when mutual tariff concessions are considered.

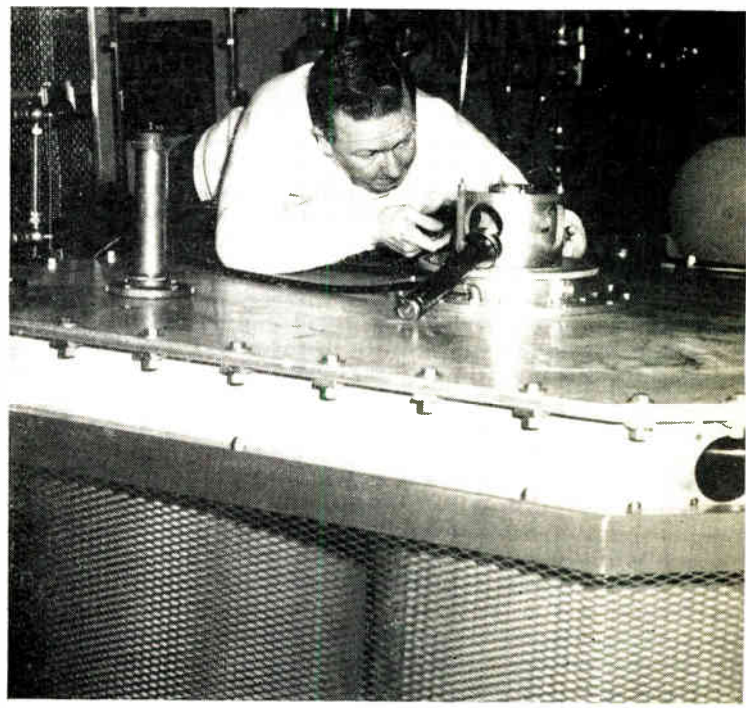
NATIONWIDE REGISTRATION of engineers is coming. The only question is who is going to do it, and how soon. In one version the Air Research and Development Command (ARDC) as part of its "PROJECT CATE" (ARDC Technical Efforts) is preparing an index of nearly 50,000 scientists and engineers. The Air Force wants to know their specialty and how to locate them as quickly as possible. The Air Force is interested in all areas of science: electronics, materials, biosciences, research, communications, nuclear warfare, etc. When completed the rosters of Air Force specialists will be distributed to industry scientists and engineers who registered with CATE and will be revised quarterly. Further information on PROJECT CATE can be obtained from ARDC (CATE PROGRAM), Andrews Air Force Base, Washington 25, D. C.

CERAMIC COATINGS can protect the structural strength of tungsten of temperatures of more than 3000°F, it has been found at the University of Illinois, Dept. of Ceramic Engineering. Researchers used a vitreous-type bonded refractory in which zircon was bonded with a high temperature glass. This coating system protects tungsten from oxidation up to 10 hrs. at temperatures exceeding 3000°F.

GOVERNMENT PATENT POLICIES, particularly with regard to the rights of Government contractors, are in for a going over from Congress. Congress is most concerned over the fact that 95% of Government Research and Development funds go to the largest companies. When the rights to the patents remain with the R&D firms after the Government contracts have been fulfilled, the firms get unfair commercial advantages over the other companies in the industry. It is being pointed out that 60% of all industrial researches are financed by the people through the Government. The Government then gives away the fruits of the research to private firms who make the public pay again "through monopoly profits." A bill to specifically prohibit this practice is being presented by Senator Russell E. Long (D-La.) During 1959 about $8 billion was spent by the Federal Government on R&D.

SIMULATE NUCLEAR EXPLOSION

Certain aspects of high-altitude nuclear detonations are being simulated in a new pulse power laboratory at ARDC's Air Force Special Weapons Center, Albuquerque, N. M. Here Dr. A. H. Guenther prepares the explosion chamber, located above 4 low inductance condensers capable of storing 16,000 joules at 125,000 v.



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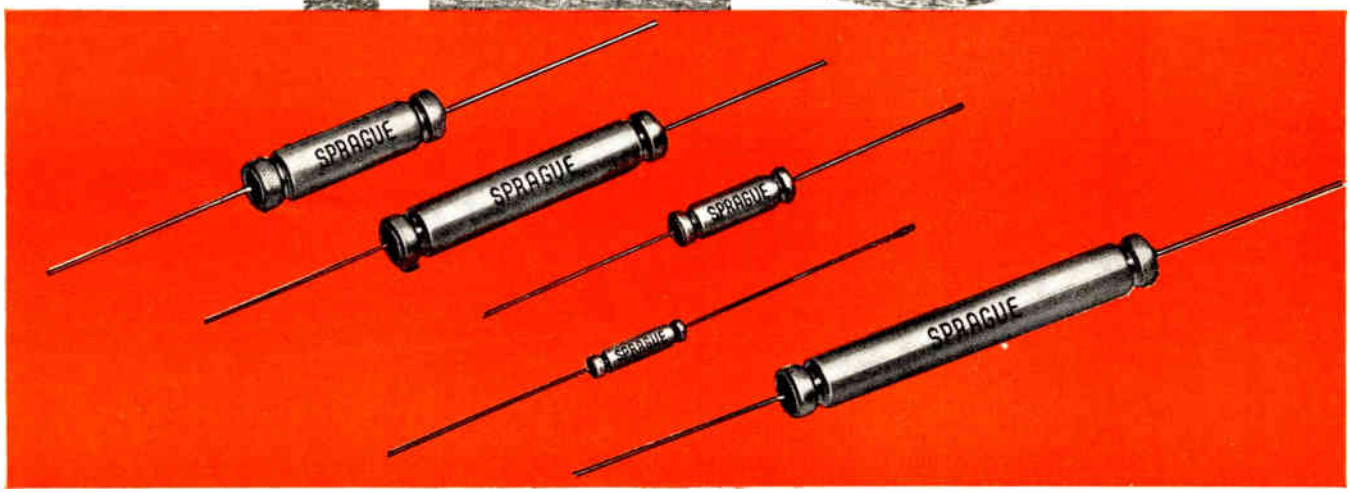


NEW! Etched and Plain Foil Single-Case Tantalex® Capacitors in Both Polar and Non-Polar Designs

When you specify *Sprague*, you pay no penalty in size and weight because of an extra outer shell on 125°C tubular foil tantalum capacitors!

Sprague's new family of foil Tantalex capacitors for 125°C operation uses only a single case. An improved end-seal construction does away with the need for a supplementary second outer case.

Manufactured to exceed the performance requirements of Military Specification MIL-C-3965B, this new series of capacitors sets new standards of reliability for all types of military and industrial applications.

Polarized capacitors are available under the designation Type 120D in plain foil construction and Type 122D in etched foil construction, while non-polarized units are listed as Type 121D in plain foil and Type 123D in etched foil designs.

These outstanding new Tantalex capacitors are available promptly in production quantities. If you need small quantities overnight, key Sprague industrial distributors stock the more popular items in the Type 120D and 122D polarized designs. Non-standard ratings are also available for special applications.

For complete technical data on these new Tantalex capacitors, write for Engineering Bulletin 3602A to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

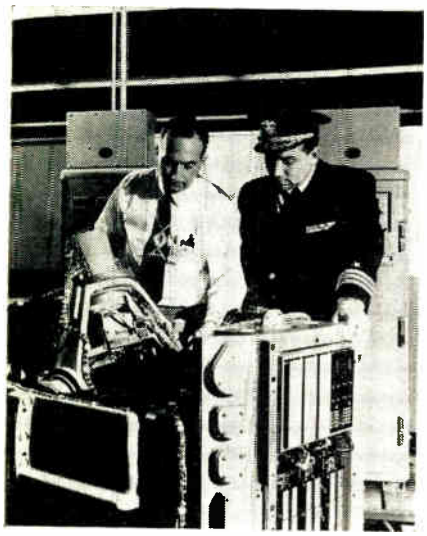
SPRAGUE®
THE MARK OF RELIABILITY

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...

SINS—FOR NUCLEAR SUBS

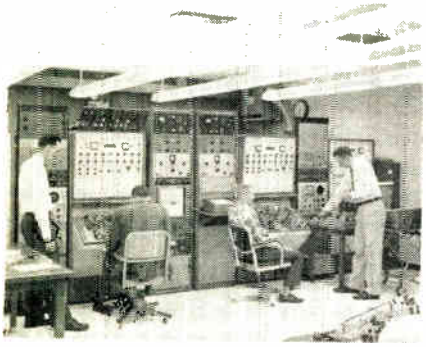


SINS—(S)hips (I)nertial (N)avigation (S)ystems will guide Polaris subs and pinpoint their positions for missile launchings. Its three units sense movement and translate it into heading, speed, and position. Developed by Sperry Gyroscope Co., Marine Div., Syosset, N. Y., the system must operate for long periods of time compared to missile systems.

GE Opens New R&D Facility at Ithaca, N. Y.

A new million-dollar research and development facility was opened June 16 in Ithaca, N. Y., by GE's Light Military Electronics Department.

Ten general-purpose engineering laboratories, a computer installation, an environmental laboratory, a test penthouse, a technical library, 50 engineering offices, and a variety of support activities are housed in the 52,000 sq. ft. of floor space at the LMED Advanced Electronics Center.



Analog computer facilities at GE LMED's Advanced Electronics Center, Ithaca, N. Y.

The new building is the first unit of Cornell University's projected Industry Research Park.

Electronic Role For Synthetic-Mica "Paper"

Scientists of the Bureau of Mines, Dept. of Interior, have developed a synthetic mica, formed into paper-thin sheets from tiny flakes, that may prove superior to natural mica for certain uses in electronics.

The synthetic-mica sheets are both strong and flexible, with "high dielectric strength," and it is expected they will make an excellent material for use in capacitors, tube spacers and other parts of such electronic devices as computers, radar and missile-guidance systems.

Preliminary tests show they retain their properties even better than natural mica when high temperatures are encountered. The flakes absorb water readily, an advantage when formed into sheets. However, a disadvantage is that the paper soaks up moisture during storage, thus lowering its dielectric strength.

The General Telephone and Electronic Laboratories, Inc., of Flushing, L. I., N. Y. is studying methods to reduce the mica paper's tendency to absorb water in storage and to improve its properties.

The synthetic-mica flakes are made by crystallizing a melted mixture of feldspar, sand, magnesia, lithium fluoride and other minerals.

Solar Telescope For Kitt Peak Observatory

A $4 million grant for the Kitt Peak Solar Program from the National Science Foundation will finance construction of the world's largest solar telescope. Construction will begin in the fall of 1960. It will be completed within two years.

The instrument will have a focal length of 300 ft. and will be made up of three large reflecting surfaces combined in a system. It will require a supporting structure about the size of a 10-story office building.

An 80 inch flat mirror, termed a heliostat, will stand 110 ft. above the ground atop Kitt Peak, a 6,875 ft. mountain located 40 miles southwest of Tucson, Ariz., on the Papago Indian reservation.

MEASURING SYSTEM

Robert L. Rod, President of Acoustica Associates, Inc., Los Angeles, and Frank DeLuca, Executive Vice President, exhibit computer assembly which determines whether the mixture of propellants in the Atlas ICBM are in the correct ratio to achieve optimum fueling in flight. The Company's propellant-utilization system uses ultrasonic sensing probes of piezo-electric crystals for measuring at various "discreet" levels in the system.

Microwave Components Business At $90 Million

A survey study of 141 microwave component establishments during mid-1959 by the Electronics Div., Business and Defense Services Administration, U. S. Dept. of Commerce, reveals a $90 million annual business in specialized microwave components manufacturing. Almost 80% are destined for military end-use, between microwave antennas and transmitters or receivers or as test and measuring devices.

Despite substantial engineering and a high technological level in design and manufacture, the bulk of the total output has been contributed by small establishments employing less than 500 persons each. Production is highly concentrated in the New York Metropolitan area.

The study, "Microwave Components: Production and Related Data, 1958," contains unit and value of shipments data, both military and non-military, on 43 categories of microwave components, including ferrite components.

Copies may be procured at 10¢ per copy from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. or Field Offices of the Department of Commerce.

More News on Page 8

Electronic SHORTS

▶ **Six 250,000-watt short-wave radio transmitters being built by General Electric will help the Voice of America beam stronger broadcast signals throughout the world. They will be installed in the U. S. Information Agency's VOA East Coast installation near Greenville, N. C.**

▶ A new magnetic-tape flight-performance recorder with uniquely flexible playback capability for use in airline operations and maintenance programs has been demonstrated to FAA officials by Minneapolis-Honeywell Regulator Co. The unit will sell for less than $10,000 and be available to airlines in December.

▶ **An advanced guidance subsystem which can direct missiles or manned aircraft to their targets with extreme accuracy is being developed by the Aeronautics Div. of Chance Vought. The subsystem is self-contained and does not depend on ground stations for guidance to the target.**

▶ The deep-water television observation system, which has been developed to operate the Navy's remote control ocean bottom crawler, was fabricated by Orbitran Co., Inc.

▶ **Apropos of the summer season, we have just received a report that automatic controls have made possible precision brewing at the Jacob Ruppert Brewery in New York City. The instrumentation, engineered by Minneapolis-Honeywell's Brown Instruments Div., not only contributes to product uniformity, but also helps solve the problem of how the process can be accommodated within shortened work shifts.**

▶ Tomorrow's satellites may be accompanied into space by their own electronic "photographers," traveling beside them and sending back visual reports on their performance. RCA scientists pictured the operation this way: The satellite would be accompanied by a separate camera-carrying vehicle, launched separately or on the same rocket. In space, the camera would travel 100 ft. from the main satellite. A pulsed light source would be used for the tracking system and to provide illumination when the spheres are on the dark side of the earth.

▶ **A computer soon will take over the heretofore manual job of controlling manufacturing at the world's largest synthetic rubber plant owned by Goodyear Tire & Rubber Co., in Houston, Tex.**

▶ Two important scientific fields—nuclear energy and cryogenics—will be put to work on an advanced nuclear reactor when static tests take place next year. Air Products, Inc., has started construction of a test cell at the Nevada Test Site for this latest phase of Project Rover.

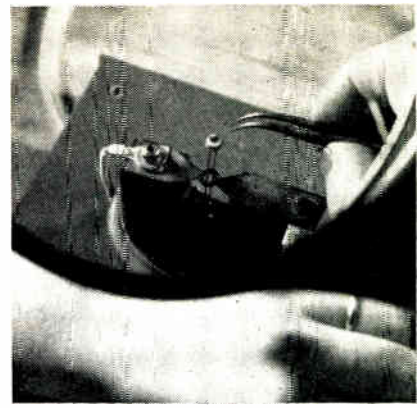
▶ **An operative model of a new electronic star tracking system that someday may tell space vehicles where they are and where they are going was one of the highlights of the ITT Corp. display at a recent Aeronautical Electronics Conference.**

▶ A system designed to give continuous physiological information on pilots in jets or other aircraft as well as radio this informaton back to earth in numerical form has been successfully tested by the Air Force. The system, developed by Gulton Industries, Inc. is known as a Physiological Data Acquisition System.

▶ **A magnetic field plotting system of unprecedented speed and accuracy makes possible evaluation of the detailed performance of a cyclotron before it is built. It was developed and placed in operation by Oak Ridge National Laboratory which is operated for the AEC by Union Carbide Corp.**

▶ The first completely self-contained commercial aircraft ever built will be a twin-jet Mark VII Caravelle. The French built jet liner will carry its own ground power provided by an on-board AiResearch small gas turbine. Delivery this summer will introduce the Mark VII version of the French jet, designed for the American and world commercial markets.

NEW TUNNEL DIODE



New technique for mounting triangular tunnel diode tab effects a low series inductance of 1 mμh and a low series resistance of 1 ohm. Peak voltage (typical) is 55 mv; valley voltage is 320 mv. Capacity is μμf while negative resistance is 120 ohms (typical). Philco Corp's Lansdale Div., Lansdale, Pa. has prototype quantities available.

DOD Sets Up Single Communications System

Two new directives, signed by Defense Sec., Thomas Gates, Jr., provide for a Defense Communications Agency and a Defense Communications System, both under the direction, authority, and control of the Secretary of Defense. General responsibility for the operational control and supervision of the system will be assigned to the agency. The system will furnish facilities for command and control functions, intelligence, weather, logistics, and administration. Communications requirements in support of NASA, formerly met by the Military Services, will be furnished by the new agency.

The agency will be headed by an officer of general or flag rank with command responsibility direct from the Secretary of Defense through the Joint Chiefs of Staff. The plan is expected to be in operation about 9 months after appointment of the agency chief.

SONAR for Frogmen

Stromberg-Carlson, San Diego, Calif., and the U. S. Navy Electronics Lab., have developed new sonar equipment for use by frogmen. The equipment is powered by standard flashlight batteries. The equipment, AN/PQS-1, is a 20 lb. sphere, slightly larger than a basketball. Ear phones provide the frogman (or diver) with audio information on objects detected by the searching sonar beam.

More News on Page 26

WHEN YOU NEED FAST SWITCHING specify new Hughes 2N1254-2N1259 P-N-P transistors

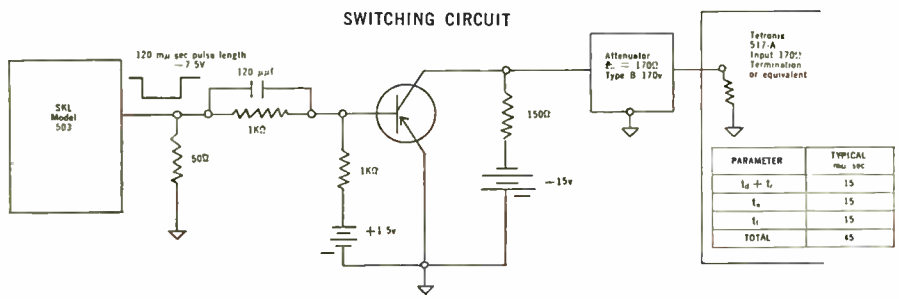
Here are the fastest switching p-n-p silicon mesa transistors ever developed. Look at these outstanding features: Typ. f_T of 75MC... thin base region...low stored base charge...low t_d t_r t_s t_f... β of 1.5 min at 50MC... β of 1.75 typ. at 50MC...low collector capacitance. These transistors have good high-level gain characteristics, exceptional low-level gain characteristics, plus high breakdown voltage. They give excellent performance at low voltages, and they are *outstanding* for high-voltage switching.*

These new high-speed transistors are available in production quantities—right now!

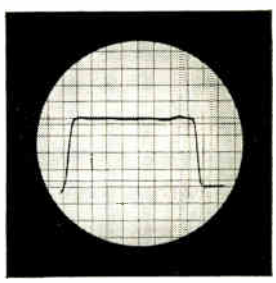
*The series is also available with the same electrical characteristics in a collector-grounded configuration with a free air power dissipation of 750 MW.

There is a Hughes sales office or authorized distributor in your area. Give them a call today. Or, if you prefer, write Hughes Semiconductor Division, Marketing Department, Newport Beach, California.

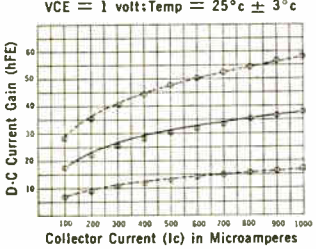
SWITCHING CIRCUIT



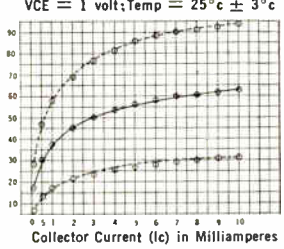
PARAMETER	TYPICAL mμ sec
$t_d + t_r$	15
t_s	15
t_f	15
TOTAL	45



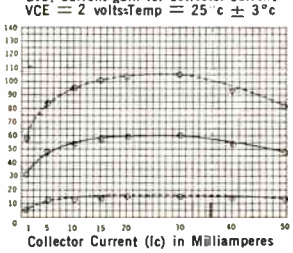
Types—2N1255, 2N1257, 2N1259
D.C. Current gain vs. Collector current
VCE = 1 volt; Temp = 25°c ± 3°c



Types—2N1255, 2N1257, 2N1259
D.C. Current gain vs. Collector current
VCE = 1 volt; Temp = 25°c ± 3°c



Types—2N1255, 2N1257, 2N1259
D.C. Current gain vs. Collector current
VCE = 2 volts; Temp = 25°c ± 3°c



Typical Value ------ 68% Limits

Creating a new world with ELECTRONICS

HUGHES

SEMICONDUCTOR DIVISION
HUGHES AIRCRAFT COMPANY

What do these 38 prod

Representing only a few of the many items produced by VTP, these 38 products (and others like them now in research, development and manufacturing stages) offer you "built-in" reliability and highest quality—*at competitive prices.* These products break down into five broad categories:

Storage Tubes: World's most complete linel 21 different types. Screen diameters: 3" to 21". Electrostatic focusing. Electrostatic or magnetic deflection. *Tonotron** Half-tone Display Tubes. *Typotron®* Character Display Tubes. *Memotron®* Image-retention Tubes.

Special Purpose CRTs: Special configurations, phosphors, electrical characteristics—or for *special* environmental conditions. Screen diameters: 1" to 18". Electrostatic or magnetic deflection and focusing. Packaged, shielded versions are available. A choice of 28 different phosphors to meet your exact needs.

Vacuum Gauge Tubes & Equipment: Most complete line of high vacuum gauge tubes and controls (including: ionization, cold discharge and thermocouple gauge tubes; electronic ultra-high-vacuum pumps.) Single source supply for all of your high-vacuum requirements.

Welders, Controls & Accessories: Complete line of precision electronic welding equipment for joining thin metal parts (.0001" to .08"). Half and full-cycle AC power supplies, stored energy power supplies, inert-gas shielded-arc welder controls—plus welding heads and accessories.

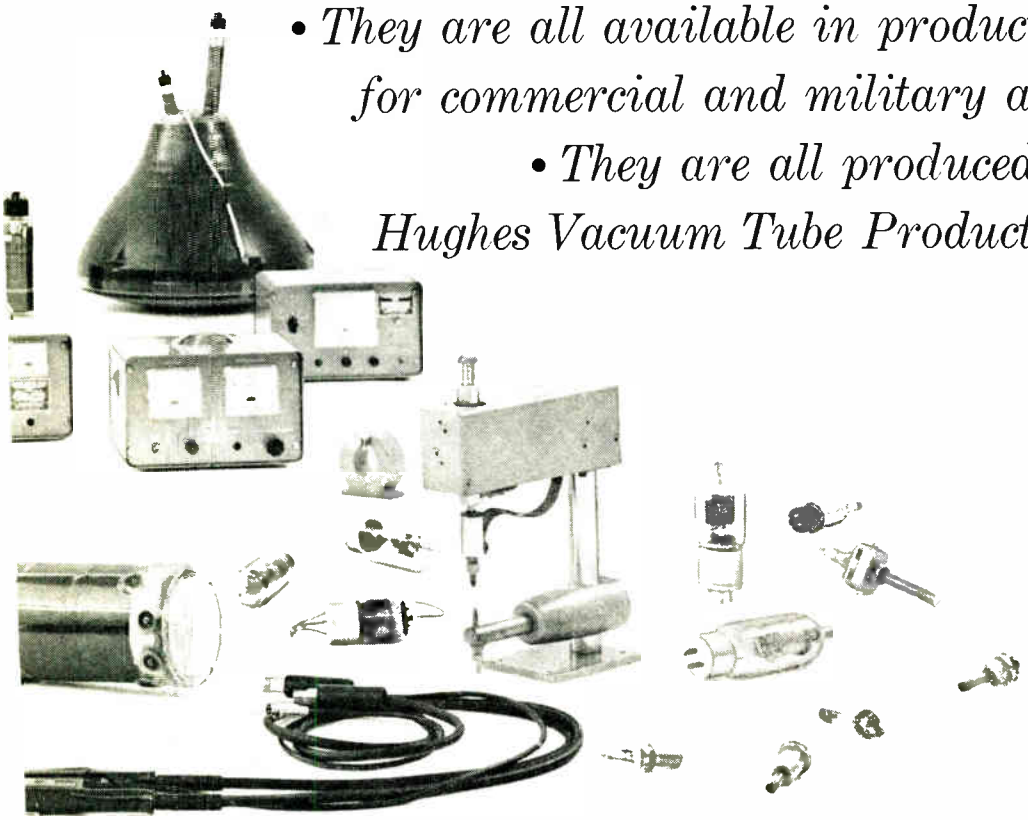
Rectifiers & Transmitting Tubes: Heavy-duty rectifiers, xenon thyratrons, clipper diodes and triode transmitting tubes are now available in production quantities to fill all of your requirements.

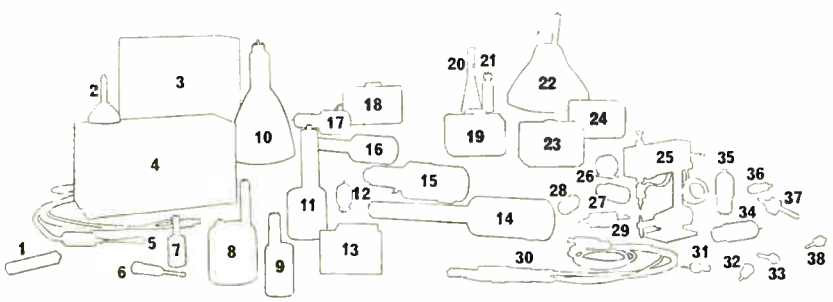
See the complete Vacuum Tube Products lines on display at WESCON, Booths 2826-2827.

ucts have in common?

Basically, 3 things–

- *They are all electronic in nature.*
- *They are all available in production quantities for commercial and military applications.*
- *They are all produced by Hughes Vacuum Tube Products Division.*





1) Monoscope (2) 5" CRT (3) Capacitor Welding Power Supply (4) Thermocouple/Ionization Vacuum Gauge Control (5) Seam Welding Handpiece (6) Thermocouple Vacuum Gauge Tube (7) Ionization Gauge Tube (8) (9) 5" & 3" *Tonotron* Tubes (10) 17" CRT (11) 5" *Tonotron* Tube (12) High Vacuum Diode (13) Thermocouple Vacuum Gauge Control (14) 5" *Typotron* Tube (15) 5" Shielded CRT (16) 5" *Memotron* Tube (17) 5" *Tonotron* Tube (18) (19) Electrolytic Welding Power Supplys (20) (21) 5" & 3" CRTs (22) 21" *Tonotron* Tube (23) Thermocouple Vacuum Gauge Control (24) Philips Vacuum Gauge Control (25) Precision Welding Head (26) Ion Pump (27) Power Triode (28) High Vacuum Diode (29) Xenon Thyratron (30) Welding Handpiece (31) High Vacuum Diode (32) Thermocouple Vacuum Gauge Tube (33) High-Voltage Vacuum Switch (34) High Vacuum Diode (35) Clipper Diode/Rectifier (36) Halogen Vacuum Leak Detector (37) Philips Vacuum Gauge Tube (38) Thermocouple Vacuum Gauge Tube.

Circle 4 on Inquiry Card

For full information on reliable, high-quality products in any of these fields, write or wire today: HUGHES, Vacuum Tube Products Division, 2020 Short Street, Oceanside, Calif.

For export information, write Hughes International, Culver City, Calif.

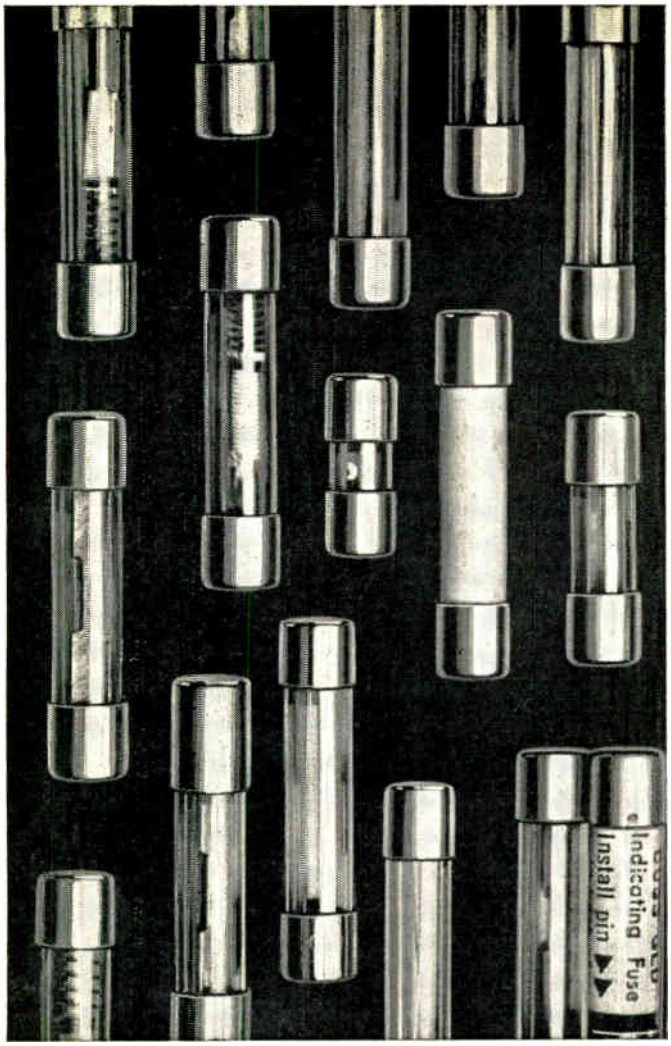
Creating a new world with ELECTRONICS

HUGHES

VACUUM TUBE PRODUCTS DIVISION

HUGHES AIRCRAFT COMPANY

*Trademark of Hughes Aircraft Company



Why "Experiment"...

with electrical protective devices

when BUSS fuses have proven their dependability?

With the many types of electrical protective devices on the market, perhaps you have asked yourself, "Which line is best for me?".

It doesn't pay to "experiment".

Protective devices that fail to protect or that open needlessly may reflect on the quality and reliability of your product — which in turn can affect your sales curve.

BUSS and FUSETRON fuses, on the other hand, *do* provide dependable electrical protection under all service conditions . . . and have for the last 45 years in the home, in industry and on the farm.

Electronic testing assures dependability.

Every BUSS and FUSETRON fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

Complete Line. There is a complete line of BUSS fuses in sizes from 1/500 ampere up . . . plus a companion line of fuse clips, blocks and holders.

If your protection problem is unusual . . . let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse already available in local wholesalers' stock so that your products can be easily serviced wherever sold.

For more information on the complete line of BUSS and FUSETRON Small Dimension Fuses and Fuseholders, write for Bulletin SFB.

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McGraw-Edison Co.
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760

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 BUSS — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — McGRAW EDISON

Coming Events in the electronic industry

July 1-29: Army Signal Corps Centennial Exhibit, Smithsonian Institute, Washington, D. C.

July 4-7: 2nd Annual Conf., British Computer Society Ltd.; Sun Pavilion, Harrogate, Yorkshire, England.

July 4-8: Gordon Research Conf. on Chemistry and Physics of Isotopes, American Assoc. for the Advancement of Science; New Hampton School, New Hampton, N. H.

July 4-8: Symp. on Polarization Phenomena of Nucleons, International Union of Pure and Applied Physics; Basle, Switzerland.

July 11-12: Conf. on Response of Materials to High Velocity Deformation, AIME; Estes Park, Colo.

July 11-14: Annual Music Industry Conv. and Trade Show, National Assoc. of Music Merchants; Palmer House, Chicago, Ill.

July 11-15: 3rd Annual Institute in Technical and Industrial Communications, Colorado State University; Colorado State University, Ft. Collins, Colo.

July 19-21: Western Packaging & Materials Handling Exposition; Pan Pacific Auditorium, Los Angeles, Calif.

July 20-22: 11th Annual Conf., Forestry, Conservation Comm. Assoc.; Hotel Duluth, Duluth, Minn.

July 21-27: 3rd International Conf. on Medical Electronics, IEE (Brit.); Olympia, London, England.

July 21-30: International Nuclear Power Exhibition, Nuclear Power Exh., Ltd.; Earls Court, London, England.

July 24-28: 47th Annual Conv. American Electroplaters' Society, Inc.; Statler Hotel, Los Angeles, Calif.

Aug. 1-3: 4th National Symp. on Global Communications, IRE, U. S. Signal Corp., Statler Hotel, Washington, D. C.

Aug. 6-9: 20th Annual National Conv. & Exhibit, National Audio-Visual Assoc.; Morrison Hotel, Chicago, Ill.

Aug. 8-10: Annual Meeting, Assoc. of the United States Army; Sheraton-Park Hotel, Washington, D. C.

Aug. 8-12: Pacific General Meeting, AIEE; San Diego, Calif.

Aug. 10-12: 5th Annual Conf. of the G-15 Users' Organization; Pittsburgh Hilton Hotel, Pittsburgh, Pa.

Aug. 15-17: Heat Transfer Conf. & Exhibit, ASME, AICHE; Statler-Hilton Hotel, Buffalo, N. Y.

Aug. 18-19: Electronic Packaging Symp.; Univ. of Colorado, Boulder, Colo.

Aug. 22-26: Symp: Introduction to Thermonuclear Plasma Physics, Oak Ridge National Laboratory, Oak Ridge Institute of Nuclear Studies, U. S. AEC; Gatlinburg, Tenn.

Aug. 23-25: National Meeting, Assoc. for Computing Machinery; Marquette Univ., Milwaukee, Wis.

Aug. 23-26: WESCON, IRE, WEMA; Ambassador Hotel & Memorial Sports Arena, Los Angeles, Calif.

Aug. 24-Sept. 3: Radio and TV Exhibition; Earls Court, London, England.

Aug. 25-Sept. 3: Int. Conf. on High Energy Nuclear Physics, International Union of Pure & Applied Physics, Commission on High Energy Physics; Rochester, N. Y.

Aug. 29-31: Semiconductors Conf., AIME; Statler-Hilton Hotel, Boston, Mass.

Aug. 29-Sept. 2: International Conf. on Semiconductor Physics, Czechoslovak Academy of Sciences, International Union of Pure & Applied Physics; Prague, Czechoslovakia.

Aug. 29-Sept. 3: International Information Theory Meeting, IEE, IRE; London, England.

Aug. 29-Sept. 3: International Conf. on Nuclear Structure, International Union of Pure & Applied Physics, Atomic Energy of Canada Ltd.; Queens Univ., Kingston, Ont., Canada.

Sept. 5-15: International Scientific Radio Union, 13th General Assembly; University College, London, England.

Sept. 6-8: Joint Automatic Control Conf., IRE (PGAC), ASME, ISA, AIEE, AIChE; Mass. Inst. of Technology, Cambridge, Mass.

Sept. 6-16: Production Engineering Show; Navy Pier, Chicago, Ill.

Sept. 9-10: Conf: Tomorrow's Techniques in Electronics—A Survey, IRE, Roosevelt Hotel, Cedar Rapids, Iowa.

Sept. 11: Fall Meeting, The Material Handling Institute, Inc.; The Cavalier Club, Virginia Beach, Va.

Sept. 11-17: Reliability Training Conf., IRE, ASQC; Dallas - Ft. Worth, Tex.

Sept. 12-15: International Conf. on Atomic Masses, International Union for Pure and Applied Physics, National Research Council, McMaster Univ., U. S. National Science Foundation; Hamilton, Ont., Canada.

(*Continued on page* 144)

Change your EI Coming Events Calendar

The dates for the 2nd EIA Conf. on Value Engineering, originally Sept. 7-8, have been changed to Oct. 5-6, 1960.

"CALL FOR PAPERS"

6th Annual Conf. on Magnetism and Magnetic Materials, Nov. 14-17, New Yorker Hotel, N. Y. Papers deadline is Aug. 26. Titles and abstracts to A. M. Colgston, Program Chairman, Bell Telephone Labs., Murray Hill, N. J.

1960 Northeast Electronics Research and Engineering Meeting (NEREM) Nov. 15-17, Sheraton - Plaza Hotel and Commonwealth Armory, Boston, Mass. Papers deadline is July 15. Send to: J. E. Mulligan, Jr., Dept. of Electrical Engineering, New York Univ., N. Y. 53, N. Y.

Conf. on Reliability of Semiconductor Devices, Jan. 12, 1961, Western Union Auditorium, 60 Hudson St., New York City. Titles by June 30; Abstracts (50 to 200 words) by July 30, 1960; send to: John E. Shwop, Chairman, Program Comm., U. S. Army Signal Supply Agency, 225 South 18th St., Philadelphia 3, Pa.

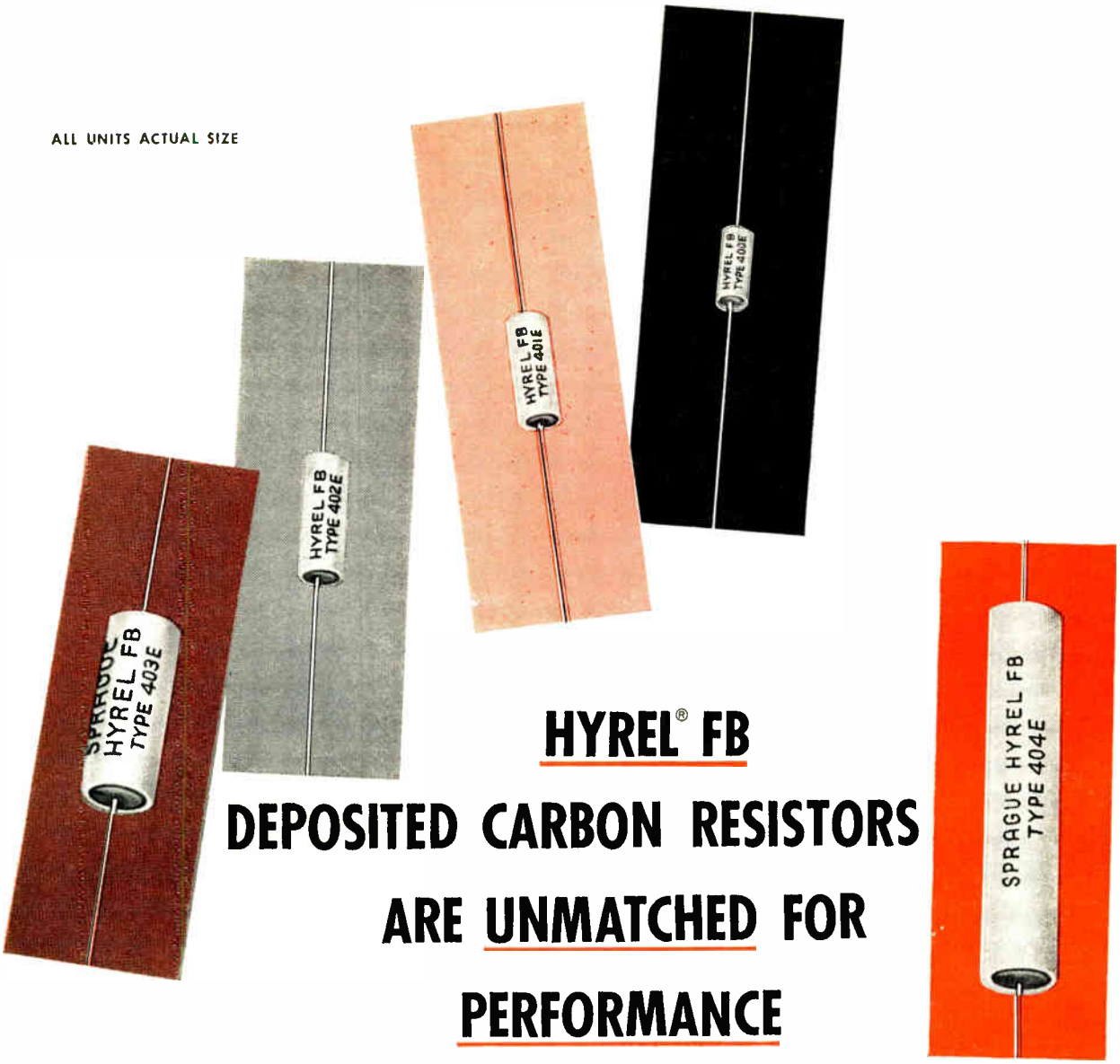
Electron Devices Meeting, Oct. 27-28, Shoreham Hotel, Washington, D. C. Deadline for titles is June 16; deadline for abstracts is August 1. Send abstracts (original and 4 copies) to: H. W. Welch, Jr., Motorola, Inc., 8201 E. McDowell Rd., Scottsdale, Ariz.

7th Annual Meeting of the Professional Group on Nuclear Science (IRE), Oct. 3-5, Gatlinburg, Tenn. Title and abstract (about 50 words) deadline is Aug. 1. Send to: L. H. E. Banta, Oak Ridge National Laboratory, P.O.B. "X", Oak Ridge, Tennessee.

Abbreviations

AEC: Atomic Energy Commission
AIChE: American Institute for Chemical Engineers
AIEE: American Institute of Electrical Enginners
AIME: American Institute of Metallurgical Engineers
ASME: American Society for Mechanical Engineers
ASQC: American Society for Quality Control
IAS: Institute of Aeronautical Sciences
IEE: Institute of Electrical Engineers (British)
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
WEMA: Western Elec. Mfr's. Association

ALL UNITS ACTUAL SIZE



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WRITE FOR ENGINEERING BULLETIN 7010B

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News Briefs

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

EAST

GENERAL INSTRUMENT CORP. and **GENERAL TRANSISTOR CORP.** Directors have agreed in principle to merge. The proposed merger is subject to further investigation and to necessary stockholder approval. The merger is expected to be transacted through an exchange of stock.

STROMBERG-CARLSON, Div. of General Dynamics Corp., has received a contract for approximately $4 million from U. S. Bureau of Naval Weapons for special airborne radio equipment.

A. B. DU MONT LABORATORIES, INC., has received a contract for $269,000 to completely re-equip the entire Fire Department of San Francisco, Calif., with two-way radio communications. This award follows the successful completion of a $235,000 contract for modernizing and engineering the City's Police Dept. two-way communications system.

WESTINGHOUSE ELECTRIC CORP. has received a Navy Bureau of Ships contract for over $12 million. The contract is for long-range shipboard radio communications equipment. This is the second production contract for this equipment to be placed with Westinghouse by the Navy. The first contract amounted to $11 million.

SYNTRON CO., Homer City, Pa., has completed plans for the construction of a new manufacturing plant for Silicon Rectifiers. It will increase their production capabilities 8 times.

GENERAL ELECTRIC CO., Light Military Electronics Dept., has been named to represent the GE Co. in its participation in the Electronic Component Reliability Center program conducted by the Battelle Memorial Institute in Columbus, Ohio. Twelve other firms who are major users of electronic components are co-sponsors of the Battelle program.

THE DU PONT CO. has announced the start-up of a plant to manufacture "hyperpure" silicon for electronic semiconductors by a new process. Licensed from International Telephone & Telegraph Co. and developed by Du Pont, the new process is based on the thermal decomposition of silane, a silicon hydride.

RAYTHEON CO. has been awarded contracts totaling $17 million by the Boston Ordnance District for continued work on the Army Hawk missile program.

BENDIX AVIATION CORP. has received an Air Force contract for $1.5 million. Contract is for initial production of the AN/GJQ-9 automatic ground check-out system for the Douglas Skybolt air-launched missile and the North American Hound Dog missile.

RADIO CORP. OF AMERICA is at work on an Air Force contract for a new Dynamic Accuracy Test System (DATS) that will determine the pre-flight operational readiness of fighter-interceptor Aircraft and Weapon Control Systems. The value of the initial contract is $2.3 million.

AMERICAN MACHINE & FOUNDRY CO. has been awarded a $3.8 million contract by the Convair Div. of General Dynamics to design and develop an underground launching system for the Atlas ICBM, and a letter of authorization of approximately $6.5 to build them. Total amount of the definitized production contract is expected to be more than $25 million.

SYLVANIA ELECTRIC PRODUCTS, INC., has made the Special Tube Operations a part of Sylvania Electronic Tubes, a major division of the company.

DYNAMIC CONTROLS CO. has moved into a 10,000 sq. ft. facility at 2225 Massachusetts Ave., Cambridge, Mass. The company has been a manufacturer of electronic power supplies and has just entered the field of digital logic modules.

TEMCO AIRCRAFT CORP. and **LING-ALTEC ELECTRONICS, INC.**, have announced managements' proposal to submit to stockholders of both companies, a plan for the merger of the businesses of Temco and Ling-Altec. The surviving company would be known as Ling-Temco Electronics, Inc.

HITEMP WIRES, INC., producer of high temperature Teflon-insulated wires and cables, announced it has received Underwriters Laboratories approval of several types of Teflon-insulated wire developed by them.

THE ELECTRONIC ASSEMBLY CO., Boston, Mass., manufacturers of transistorized power supplies has changed its name to ELASCO, INC.

RADIATION DYNAMICS, INC., has been awarded a contract by Grumman Aircraft Engineering Corp. to develop and build a positive ion Dynamitron accelerator for use by its research department in space environment studies.

MID-WEST

MINNESOTA MINING & MANUFACTURING CO. will build a 51,000 sq. ft. warehouse and work area addition to its magnetic products plant in Hutchinson, Minn. This construction provides needed additional space for quality control, warehousing and other activities.

MINNEAPOLIS-HONEYWELL REGULATOR CO., Ordnance Div., will develop and build a $3.6 million nuclear submarine training center for the Navy. Utilizing a giant computer and advanced electronic techniques, the facility will provide a startling degree of realism in the waging of mock sea battles. It will be used to train crews of Polaris-armed and other nuclear submarines in the complex tactics of modern underseas warfare. The trainer will occupy an entire wing of a 3-story building at the Navy's Submarine School at New London, Conn.

VICTOREEN INSTRUMENT CO., Cleveland, Ohio, has acquired the Electronic Products Co. The Mt. Vernon, N. Y., firm was purchased for cash and stock of Victoreen totaling approximately $800,000.

NORTH ELECTRIC CO., Galion, Ohio, manufacturer of telecommunications and automatic controls has acquired control of Power Equipment Co. Power Equipment is a producer of power supplies for computers and other electronic-electrical systems.

BURROUGHS CORP., Systems Manager for the Airborne Long Range Input (ALRI) System for the U. S. Air Force, has awarded a $3.5 million contract to Lockheed Aircraft Service, Inc., Ontario, Calif. The contract calls for Lockheed to install and flight-test the ALRI electronic system in two RC-121 (Constellation) aircraft which will provide a seaward extension of SAGE.

WEST

LOCKHEED ELECTRONICS CO., Los Angeles, has opened a new facility for the research, development and manufacture of electronic ceramics. It will be operated by the company's Avionics & Industrial Products Div.

HOFFMAN ELECTRONICS CORP., has been selected to fabricate solar power panels under a $548,000 contract from the California Institute of Technology Jet Propulsion Laboratory. The solar power panels will be used to power an instrumented package as part of NASA's lunar study program.

HUGHES AIRCRAFT CO. now has two high frequency pnp silicon transistors designed for i-f amplifier use available in production quantities.

THE GARRETT CORPORATION'S AIRESEARCH MANUFACTURING CO. of Los Angeles has received a contract for the study of infrared detector cooling systems in extremely high altitude vehicles. It was awarded by the Wright Air Development District.

INTERNATIONAL ELECTRONIC RESEARCH CORP., Burbank, Calif., has dedicated a new half-million dollar building, containing 30,000 sq. ft. of space. It is their new headquarters.

AEROLAB DEVELOPMENT CO., INC., Pasadena, Calif., subsidiary of Ryan Aeronautical Co., has been awarded a contract for engineering services and operations analysis in support of the $2 billion U. S. Post Office modernization program. Under the initial $500,000 contract, Aerolab will make available 50 engineers, principally in Washington, D. C., to work with the Post Office Dept.'s own engineering staff.

AMERICAN ELECTRONICS, INC., Instrument Div., has acquired approximately 10,000 sq. ft. of additional manufacturing space in Culver City, Calif.

ELECTRO-OPTICAL SYSTEMS, INC., Pasadena, Calif., has been awarded $1,190,000 contract for theoretical analysis and contruction of an ion demonstration engine. The award was made by the Air Force.

SPACE ELECTRONICS CORP. has announced plans for an additional 15,000 sq. ft. building in Glendale, Calif. Identical to the company's present facility, the new building will be attached and immediately adjacent to the location at 930 Air Way.

VARO MFG. CO., INC., Garland, Tex., has received a contract in excess of $550,000 for the development and production of a complete static ac power system.

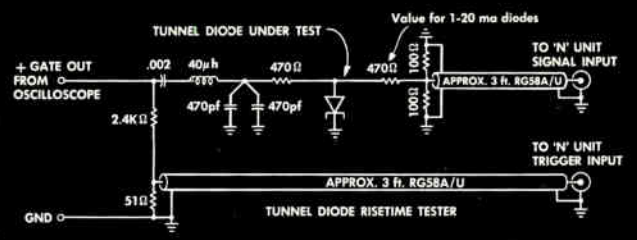
GIANNINI CONTROLS CORP. has moved its general offices and Gyro Div. from Pasadena, Calif., to the company's 11-acre site at Duarte, Los Angeles County.

LEAR, INC., has received a contract from Lockheed Missile and Space Div. to design and produce a digital servo system. The systems will be produced in Lear's Instrument Div. in Grand Rapids, Mich. The amount of the contract was not disclosed.

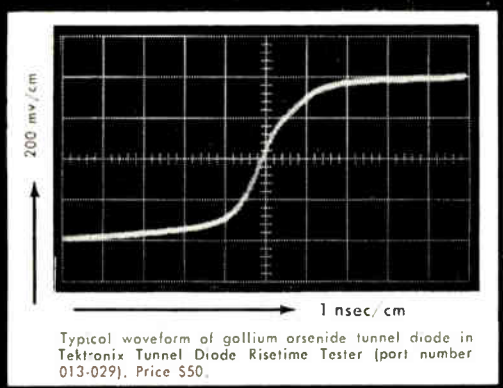
MIDWESTERN INSTRUMENTS, Tulsa, Okla., has been awarded a U. S. Navy contract for $306,000. The contract calls for the production of high gravity recording oscillographs.

Tunnel Diode Switching Time Measurement

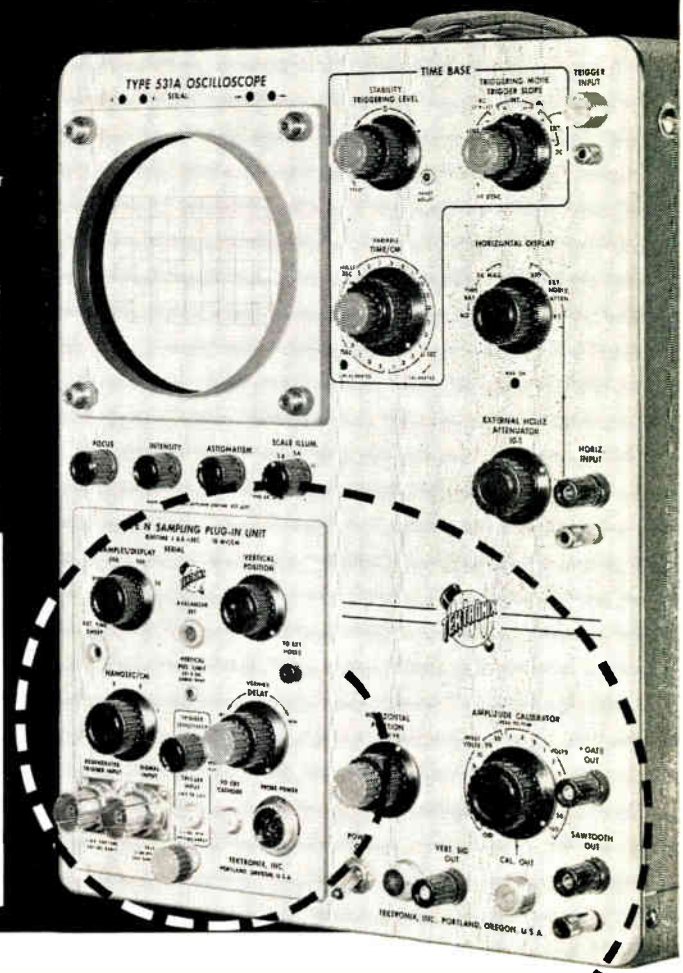
with Tektronix Type N Sampling Plug-In Unit



A convenient low-cost method of testing tunnel (Esaki) diodes with nanosecond switching speeds is shown above. A Tektronix Plug-In Oscilloscope provides both the current ramp source for the tunnel diode and the pretrigger for the Type N Unit. The N Unit is set up in the usual way — however, the oscilloscope main sweep generator is allowed to free run at 1 μsec/cm. The + GATE OUT not only triggers the N Unit but also provides a delayed current ramp with a low rate of change—which allows the tunnel diode to switch at essentially its own rate.



Typical waveform of gallium arsenide tunnel diode in Tektronix Tunnel Diode Risetime Tester (part number 013-029). Price $50.



NEW PULSE-SAMPLING UNIT

for all Tektronix Plug-In Oscilloscopes

The new Type N Unit converts your Tektronix Plug-In Oscilloscope to a Pulse-Sampling Oscilloscope with a rise-time of 0.6 nanoseconds. Applications in which the signal source can furnish a "pretrigger", such as that shown above, require no additional equipment.

For a completely versatile Pulse-Sampling System, Tektronix also manufactures a Pulse Generator and Trigger Takeoff, a 60-nsec Delay Line, a Pretrigger Pulse Generator, and several useful accessories. Please call your Tektronix Field Engineer for complete details and, if desired, a demonstration of the Type N Unit or the complete System.

Characteristics

0.6 nsec risetime (approximately 600 mc).

10 mv/cm sensitivity. (2 mv or less amplitude noise.)

1, 2, 5, and 10 nsec/cm equivalent sweep times (20 to 50 psec time noise).

50-ohm input impedance.

50, 100, 200, and 500 samples per display.

Sampling rate — 50 c to 100 kc.

±120 mv minimum linear range (safe overload 4 v).

Trigger input requirement: +0.5 v, 1 nsec duration, 40 nsec in advance of signal. Recovery time is 10 μsec. Counts down from 50 mc.

PRICE **$600**
f.o.b. factory

Tektronix, Inc.

P. O. Box 500 • Beaverton, Oregon

Phone Mitchell 4-0161 • TWX—BEAV 311 • Cable: TEKTRONIX

TEKTRONIX FIELD OFFICES: Albuquerque, N. Mex. • Atlanta, Ga. • Baltimore (Towson, Md.) • Boston (Lexington, Mass.) • Buffalo, N.Y. • Chicago (Park Ridge, Ill.) • Cleveland, Ohio • Dallas, Texas • Dayton, Ohio • Denver, Colo. • Detroit (Lathrup Village, Mich.) • Endicott (Endwell, N.Y.) • Greensboro, N.C. • Houston, Texas • Kansas City (Mission, Kan.) • East Los Angeles, Calif. • West Los Angeles, Calif. • Minneapolis, Minn • New York City Area (Albertson, L.I., N.Y. • Stamford, Conn • Union, N.J.) • Orlando, Fla. • Philadelphia Pa. • Phoenix, (Scottsdale, Ariz.) • Poughkeepsie, N.Y. • San Diego, Calif. • San Francisco (Palo Alto, Calif.) • St. Petersburg, Fla • Syracuse, N.Y. • Toronto (Willowdale, Ont.) Canada • Washington, D.C. (Annandale, Va.)

TEKTRONIX ENGINEERING REPRESENTATIVES: Hawthorne Electronics; Portland, Oregon • Seattle, Washington. Tektronix is represented in twenty overseas countries by qualified engineering organizations.

In Europe please write Tektronix Inc., Victoria Ave., St. Sampsons, Guernsey C.I., for the address of the Tektronix Representative in your country.

Circle 7 on Inquiry Card

GREATEST PERFORMANCE PER DOLLAR

SAT®... SILICON SURFACE ALLOY TRANSISTORS

	APPLICATIONS	FREQ. (MIN.)	SPECIAL PROPERTIES
2N495	Amplifier, Switch, Control	f_{max}-8 mc	V_{CE}=25v, TO-1 case
2N496	Switch	f_T-7.2 mc	very low V saturation, TO-1 case
2N1118	Amplifier, Switch, Control	f_{max}-8 mc	electrical equivalent of 2N495, TO-5 case
2N1118A	Amplifier, Switch, Control	f_{max}-8 mc	high beta version 2N1118
2N1119	Switch	f_T-7.2 mc	electrical equivalent of 2N496, TO-5 case
2N1428	Amplifier, Switch, Control	f_{max}-18 mc	low cost, high beta, TO-1 case
2N1429	Amplifier, Switch, Control	f_{max}-18 mc	low cost, high beta, TO-5 case

SADT®... SILICON SURFACE ALLOY DIFFUSED-BASE TRANSISTORS

(All TO-9 cases)

	APPLICATIONS	FREQ. (MIN.)	SPECIAL PROPERTIES
2N1199	Switch	f_T-75 mc	superior temperature stability
2N1267	Med. Frequency Amplifier	f_{max}-43 mc	low beta (video amplifier)
2N1268	Med. Frequency Amplifier	f_{max}-43 mc	medium beta
2N1269	Med. Frequency Amplifier	f_{max}-43 mc	high beta
2N1270	High Frequency Amplifier	f_{max}-125 mc	low beta (video amplifier)
2N1271	High Frequency Amplifier	f_{max}-125 mc	medium beta
2N1272	High Frequency Amplifier	f_{max}-125 mc	high beta
2N1472	Switch	f_T-75 mc	very low V saturation superior temperature stability
2N1663	Switch	f_T-100 mc	superior temp. stability . . . high beta

PHILCO SILICON HIGH FREQUENCY TRANSISTORS

Philco SATs and SADTs have established the industry's greatest history of reliability in high frequency silicon transistors. They were the first of this type to be made available in production quantities and have been used extensively in thousands of critical military and commercial applications. Philco also has led the industry in the development of high-speed automatic production methods which have made possible a steady reduction of prices. This leadership in both reliability and low price results in the greatest performance per dollar in the high-frequency silicon field. For complete data, application information and prices on any of these silicon types, write Department EI760.

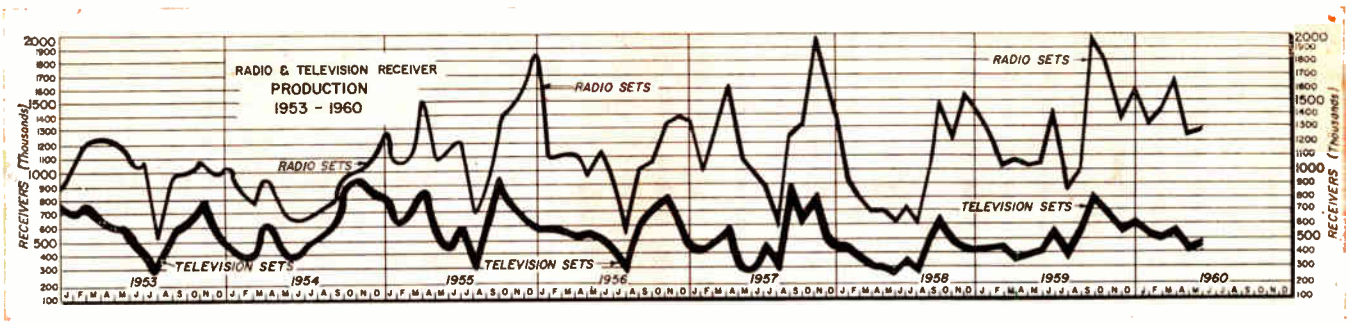
Immediately available in quantities 1-999 from your local Philco Industrial Semiconductor Distributor

PHILCO®

Famous for Quality the World Over

LANSDALE DIVISION • LANSDALE, PENNSYLVANIA

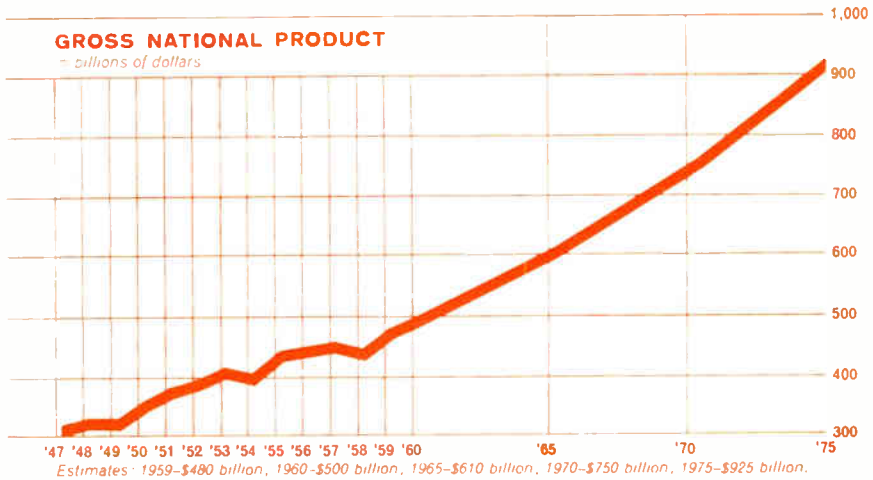
Circle 8 on Inquiry Card



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in April, 1960.

Accelerometers	42,500
Accelerometers, electron	60,000
Amplifiers	50,225
Amplifiers, instrument	39,259
Amplifiers—Oscillators	26,235
Amplifiers, radar	109,914
Amplifiers, synchro signal	274,946
Analyzers, spectrum	73,128
Antennas	29,529
Batteries, dry	123,313
Batteries, storage	74,301
Beacon, radar	44,100
Cable, telephone	137,762
Chambers, anechoic	97,822
Compass sets, magnetic	35,962
Components, radar	47,740
Computers	45,500
Computers, ballistic	2,000,000
Connectors	29,238
Controls, air-traffic	2,590,084
Controls, generator	130,334
Controls, intercom	50,356
Controls, panel	115,920
Controls, radio set	58,176
Countermeasure sets	28,738
Couplers, Antenna	82,600
Data sets, coordinate	2,016,250
Dynamotors	115,974
Equipment, communications	1,116,521
Filters, r-f	202,712
Generators, signal	625,025
Ground Stations, FM/FM telemetry	84,867
Ground stations, satellite	200,000
Gyroscopes	369,955
Indicators, radio navigation	324,383
Indicators, temperature	26,186
Instrumentation, digital	33,114
Kits, navigation-communications	54,611
Lugs, terminal	30,518
Multipliers, frequency	25,503
Meters, volt	28,874
Motors, servo	443,120
Oscillographs	332,512
Panels, control	399,518
Potentiometers	120,225
Potentiometers, indicating	48,000
Power supplies	125,140
Pre-amplifiers	77,822
Programmer, electronic	27,650
Pullers, fuze	25,748
Radar sets	3,500,000
Radio sets	2,640,000
Radiosonde sets	408,948
Radio stations	37,189
Receivers, command destruct	28,000
Receivers, data link	784,000
Receivers, radio	5,468,789
Receivers, radio telescope	191,000
Receivers, synchro	31,301
Receivers/transmitters	1,506,085
Receivers/transmitters, radio	2,064,858
Recorders	61,509
Recorders, facsimile	166,075
Recorders/reproducers, magnetic tape	267,852
Recorders, temperature	84,802
Recorders, video tape	86,600
Rectifiers	63,756
Relay assemblies	155,768
Relays	27,733
Relay, armature	92,691
Relays, frequency sensitive	45,680
Resistors	178,847
Resistors, variable	78,997
Resolvers, servo	325,162
Simulator, digital	38,028
Standards, frequency	27,150
Standards, voltage, audio	40,080
Stop mechanism, torn tape	124,777
Switches	241,153
Switches, pressure	637,189
Switches, r-f	37,316
Switches, rotary	44,039
Switches, thermostatic	195,231
Synchros	52,849
Systems, infrared tracking	134,125
Teletypewriters	40,271
Test sets, insulation	56,162
Transceivers	52,291
Transducers	25,350
Transformers	111,030
Transformers, pulse	37,904
Transmitters	12,209,452
Transmonder sets	33,266
Tubes, electron	3,247,308
Tubes, magnetron	66,321
Waveguide	37,983
Wire	87,490



Estimates: 1959–$480 billion, 1960–$500 billion, 1965–$610 billion, 1970–$750 billion, 1975–$925 billion.

—American-Marietta Co.

FACTORY SALES BY SELECTED YEARS 1950-1959

(Add 000,000 dollars)

Year	Consumer Products	Industrial Products	Military Products	Replacement Parts, Tubes Semiconductors	Total
1950	$1,500	$350	$500	$250	$2,600
1951	1,400	450	1,050	350	3,250
1952	1,300	500	2,050	400	4,250
1953	1,400	600	2,650	500	5,150
1954	1,400	650	2,700	650	5,400
1955	1,500	750	2,800	750	5,800
1956	1,600	950	3,450	850	6,850
1957	1,700	1,300	4,100	900	8,000
1958	1,600	1,380	4,400	860	8,240
1959	$2,000	$1,600	$4,700	$900	$9,200

—Electronic Industries Assoc. "Fact Book"

INTERNATIONAL Electronic News

FRENCH PRESIDENT GETS FIRST-HAND LOOK

Charles De Gaulle, French President, inspects microwave test equipment at Hewlett-Packard's Palo Alto plant. He was surprised at the broad range of equipment and fascinated by the complexity of the operation. W. R. Hewlett (right foreground), Executive V. P. of the Company, conducted tour.

WEST GERMANY

German Products Directory

Munich — Seibt Publications, Munich, West Germany, has appointed The Publications Div. of American Machinery Importers, Inc., 15738 Wyoming Ave., Detroit 38, Michigan, as distributor of the Seibt Export Directory of German Industries. It contains information on 63,000 products made in Germany, manufacturers, and suppliers. It contains Spanish and French translations of technical terms.

German Patents—Russian Research

English translations of recent German patent applications dealing with computer & control elements, semiconductors, ferrites, etc., and Russian research papers in the same fields are available from Research Information Service, 40 East 23rd St., New York 10, N. Y. A bulletin, "No. 184 Electronics" lists abstracts, bibliographic information, and prices for each report.

Outer Space Research

Bonn—The Bonn University Observatory will make an intensive investigation of the temperatures prevailing in interstellar gas. The research program is under the direction of Professor Becker assisted by Heinz G. Muller.

They will use special amplifying equipment made by Marconi's Wireless Telegraph Co., Ltd., Chelmsford, Essex, Eng. The radiotelescope, a parabolic mirror 83 ft. in dia. mounted on a pyramidal tower about 60 ft. high, scans the sky picking up the cosmic continuum radiation emanating from galactic and extra-galatic radio sources under observation. The signals in the neighborhood of the hydrogen line frequency, are amplified by one pair of TW tubes, the other pair being used to amplify reference noise signals from a resistor at a known temperature.

The outputs from the two amplifying channels are detected, integrated, and compared and the effective cosmic temperature determined; from these data contour maps are prepared. Initial tests show a discrimination of 0.1° K.

Form German Subsidiary

Lindenberg, South Germany—A new company, Interaero GmbH, has been formed by a German Industrialist and Garrett International S.A., Geneva. Garrett International is a wholly-owned subsidiary of the Garrett Corp. Los Angeles. The new firm will manufacture Garrett designed air conditioning and pressurization systems, electronic central air data systems for the Lockheed F-104G (German) airplane and similar equipment for the Fiat G.91 (Italian) airplane. A manufacturing plant will be built in Lindenberg.

UNITED KINGDOM

Flying Telescope

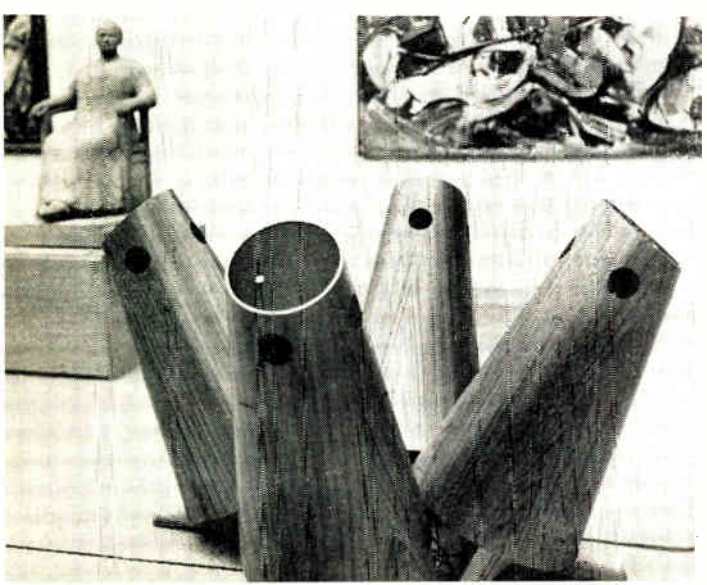
London—A five-man team of space scientists working at University College, London has built a telescope which, when mounted in the nose-cone of a rocket, will build up a TV type picture of hitherto unknown aspects of the sky. At the same time it will measure the intensity of ultra-violet light beyond the earth's atmosphere. The picture will be telemetered back to earth. Scanning will be achieved from the action of the rocket itself.

It will be used in a Skylark rocket at the Woomera range in South Australia. Rocket height will be over 100 miles above the earth's surface before pictures are taken.

Combined readings will build up a composite picture of the sky and will distinguish between point sources of ultra-violet light from stars and other sources of light known as gaseous nebulae—vast clouds of interstellar gas billions of miles wide.

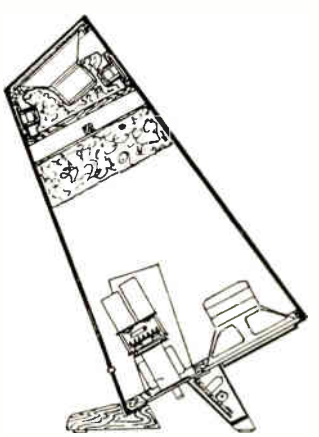
British 3-D Microscope

London—Cambridge University Psychological Laboratory has developed a microscope which gives a luminous



A NEW ROYAL ART

Unusual hi-fi enclosure (4 units shown above), was designed by Sigvard Bernadotte, son of Sweden's King. It has 4 matched speakers and special amplifier. The amplifier's frequency response can be varied to compensate for the speaker's characteristic so that response of the complete system is flat. Electron Lund AB, Malmo, Sweden, makes the system.



three-dimensional image of living cells (which, in cancer research may be bombarded with radiation). A solid image is given projected into a cube of space. Thick sections can be observed in depth.

A projected use is for examining thick sections of suitably strained brain tissue in order to see how the brain cells are related to each other.

Opportunities in Ireland

"Northern Ireland, a New Horizon for Industrial Development," a 20-page pamphlet, is available from: U. S. Representative, The Northern Ireland Development Council, 7th Floor, 99 Park Ave., New York 16, N. Y.

It tells of Government assistance that can be negotiated for owning or leasing standard advance or custom-built plants. It also talks about taking profits in American dollars or selling the capital investment for them.

Trademark Rights Obtained

Sweden—Svenska AB Gasaccumulator has acquired from the Elastic Stop Nut Corp. the right to the AGA trademark originally held by American Gasaccumulator of Elizabeth, N. J. (a subsidiary of Elastic Stop Nut Corp.).

A new company, the AGA Corp of America, has been formed with offices at 2013 Park Ave., South Plainfield, N. J., and in the Graybar Bldg., 420 Lexington Ave., N. Y. The new company will sell and service products of the Swedish company.

Electronic Executive Impressed with NATO

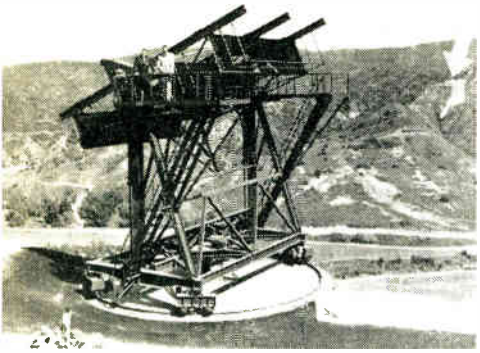
Doctor George A. Downsbrough, President of Boonton Radio Corp., just returned from an extensive tour of U. S. and NATO installations in Europe, reports that the main impression he received was the very real and heartening extent to which NATO exists, both physically and in spirit, as a deterring force in Europe. His travels took him to England, France, Germany, Italy, and Spain.

One purpose of his trip was to study electronic needs of the military as a guide to future research and development projects for his company. He visited the 17th Air Force headquarters at Ramstein, Germany, and visited the European underground communications center where information on all aircraft activity in critical European areas is centralized.

Form Sales Agreement

Sensitive Research Instrument Corp., New Rochelle, N. Y., and Tinsley Instruments (Canada) Ltd., have signed an international sales agreement. Each will handle the other company's products in their own country.

(*Continued on Page 24*)



ANTENNA ROTOR

Rotatable mount, 30 ft. high, can turn 360° and tilt 90° with a 25-ton antenna. Hughes Aircraft will use it with transmitter (arrow), 4000 ft. away, to test advanced antennas at new test center near Yorba Linda, Cal.

WEATHER EYE

Relative size of tiny RCA vidicon, similar to that used in TIROS—the weather satellite—orbitting 450 miles in space, is depicted. One of the cloud formation pictures sent back by space craft is shown in background.

UNDERWATER EYE

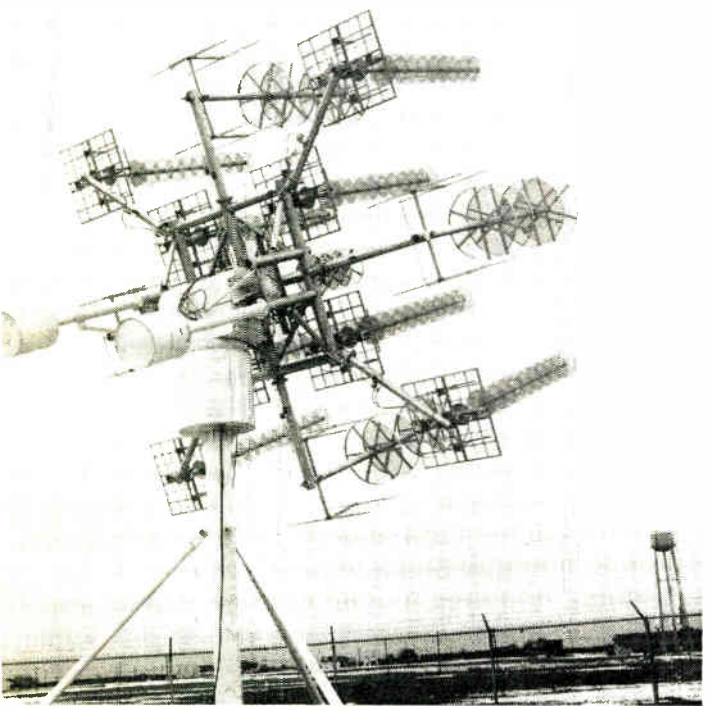
Navy frogman tests new sonar equipment developed by Stromberg-Carlson-San Diego to locate underwater objects. Powered by standard flashlight cells, it supplies audio information on detected objects.

Snapshots . . .

of the Electronic Industries

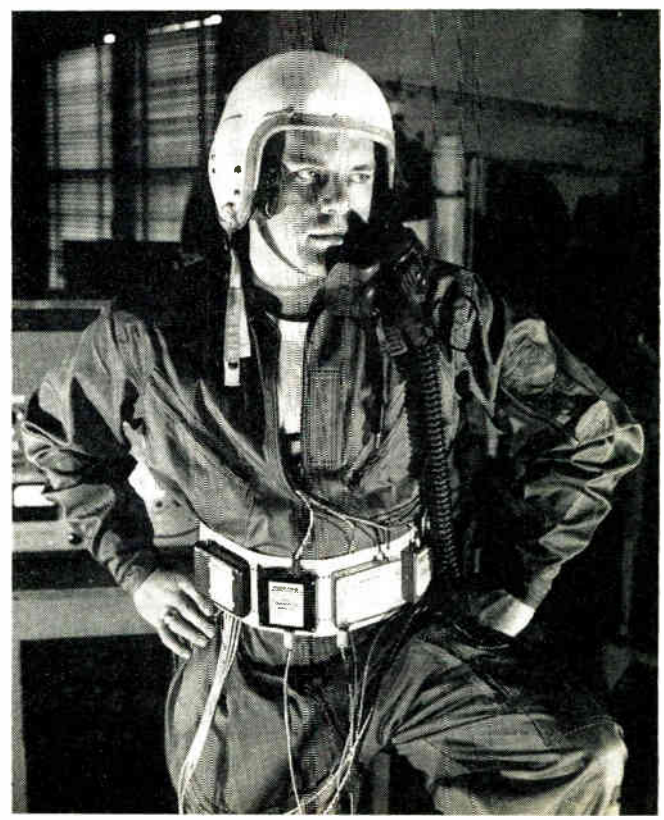
SKY EYE RECEIVER

Interlaced end-fire array provides equivalent of two 28 ft. and one 12 ft. parabolic antennas as it serves as "ears" for TIROS. The economy of this 24 ft. Swept Volume Efficiency antenna, designed by GB Electronics, is obvious.



SPACE MEDICINE

Simultaneous recording of vital bodily functions using miniaturized instruments is possible with new instrument belt. The belts, adaptable to space use were developed by Boeing Space Medicine bioscientists.

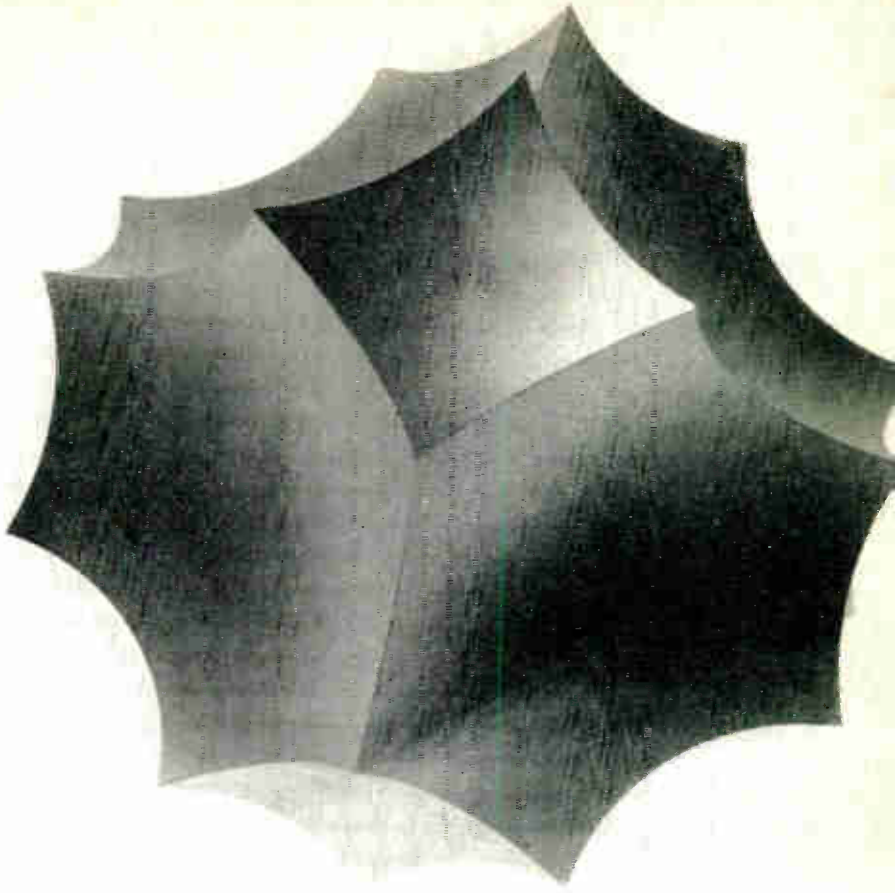


DOUBLE DOME

Two heads are better than one for BTL research into the way people locate sound. Practical results may be improvement of stereo radio and TV programs transmitted over telephone facilities.

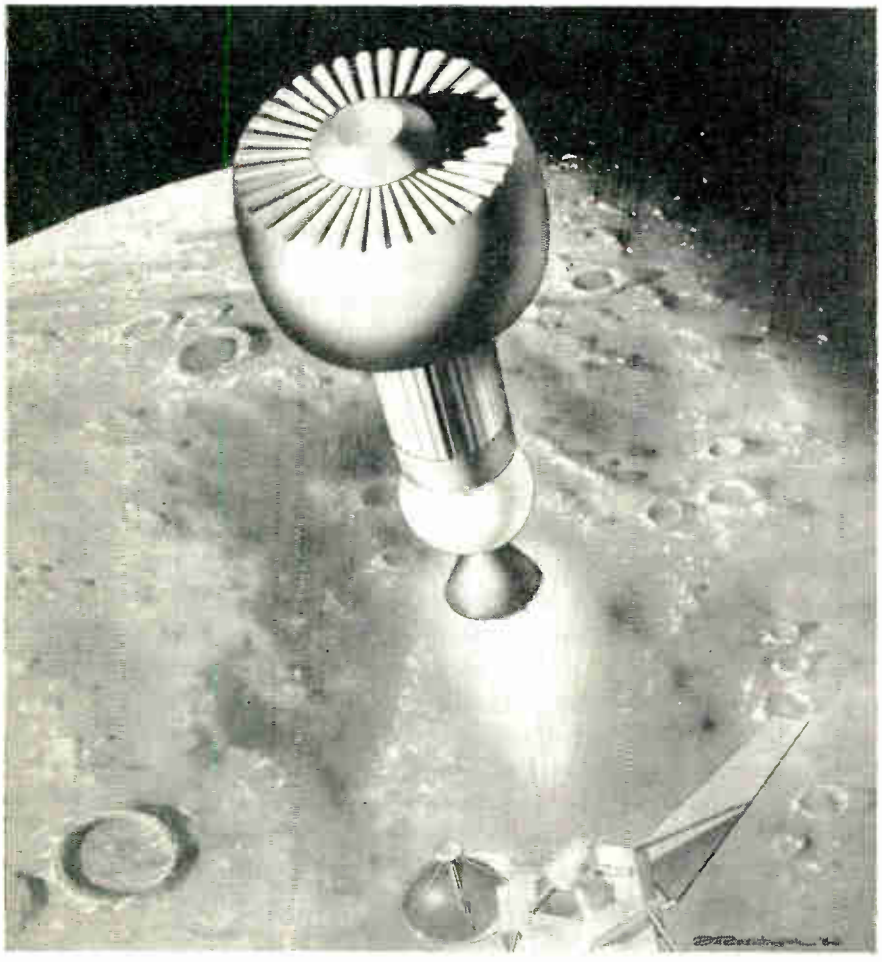
TARGET MOON

Negotiations for construction of this 300-lb. instrumented package are in progress between NASA and Aeronutronic. Schedule calls for impact on the moon within the next two years. The lunar capsule will be separated from its larger spacecraft about 20 miles from moon surface and impact eased with retro-rockets.



FERMI SURFACE

Machined aluminum model, with 14 concave faces, illustrates the momenta of conduction electrons. Dr. B. W. Roberts, GE Research Lab., designed the model in the course of studying the electronic properties of metals.



SPACE EYES?

Ends of centrifuge arms loom like eyes as engineer adjusts missile warhead prior to testing at Bulova R & D Labs. Centrifuge simulates missile flight for checking of warhead and its components.

GE's L. Berkley Davis Is New EIA President

The new President of Electronic Industries Association is L. Berkley Davis, Vice President of General Electric and General Manager of GE's Electronic Components Div. His election climaxed the 36th annual convention of the EIA which honored retiring President, David R. Hull, Raytheon Co., with EIA's "Medal of Honor."

Outstanding actions during the convention were: recommendations that EIA endorse legislation requiring Walsh-Healey and Bacon-Davis minimum wage determinations to conform to with the Fair Labor Standards Act; Direction to the general counsel to review all laws relating to imports and recommend legislative action to curb competition from foreign countries with far lower wage levels than in the U. S.; Authorization of a proxy membership meeting to vote on a proposed EIA by-law amendment which would increase the number of directors representing the Tube and Semiconductor Div. from 6 to 8; and Redefinition by the board of directors, upon recommendation of the Membership and Scope Committee, of the qualifications for Active and Associate membership.

Other officers elected: Leslie F. Muter (re-elected), Treas.; James D. Secrest (re-elected), Exec. Vice-Pres.; John B. Olverson (re-elected), General Counsel. Robert S. Bell, President, Packard Bell Electronics Corp., was re-elected Senior Vice-President. Also re-elected were Sidney R. Curtis, Vice President (Military Products Div.) and A. L. Chapman, Vice President (Tube and Semiconductor Div.).

New division chairmen are: E. R. Taylor, Motorola, Consumer Products Div.; L. L. Waite, North American Aviation, Military Products Div.; and W. Myron Owen, Aerovox Corp., Parts Div.

Instrument Exhibit

Six of the nation's leading instrument manufacturers are planning a traveling technical show which will feature an operational array of complementary laboratory and production-test instruments with ranges from dc to 220 KMC. The six companies are: FXR, Inc., Woodside, N. Y.; General Radio Co., West Concord, Mass.; Lambda

(*Continued on page* 28)

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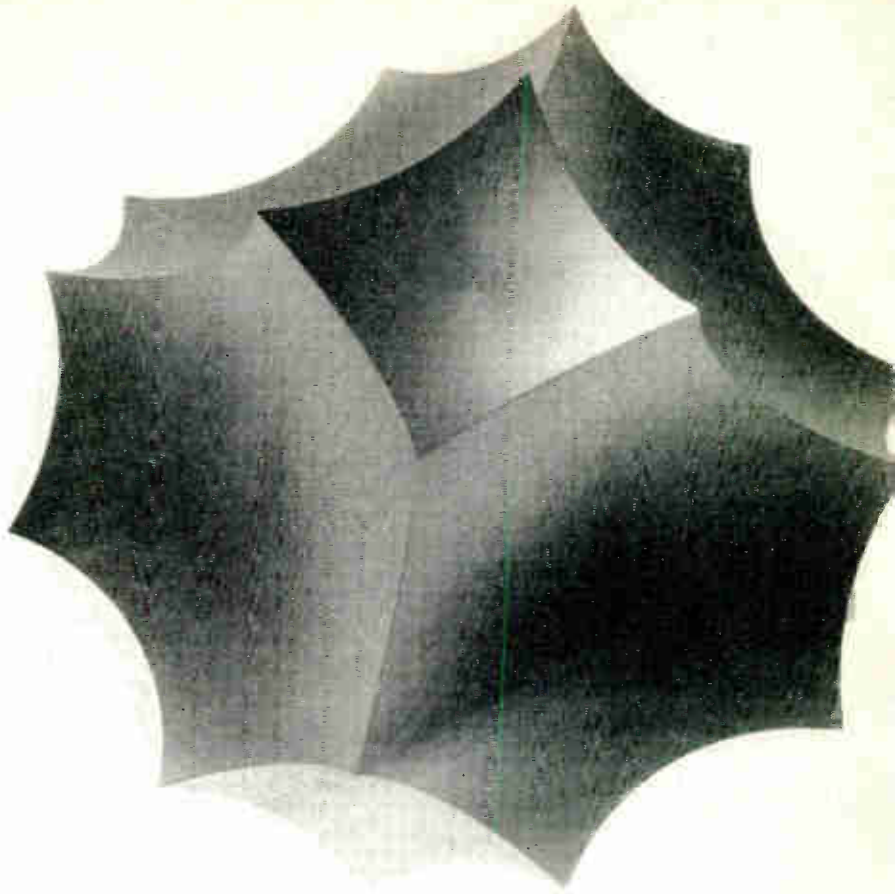

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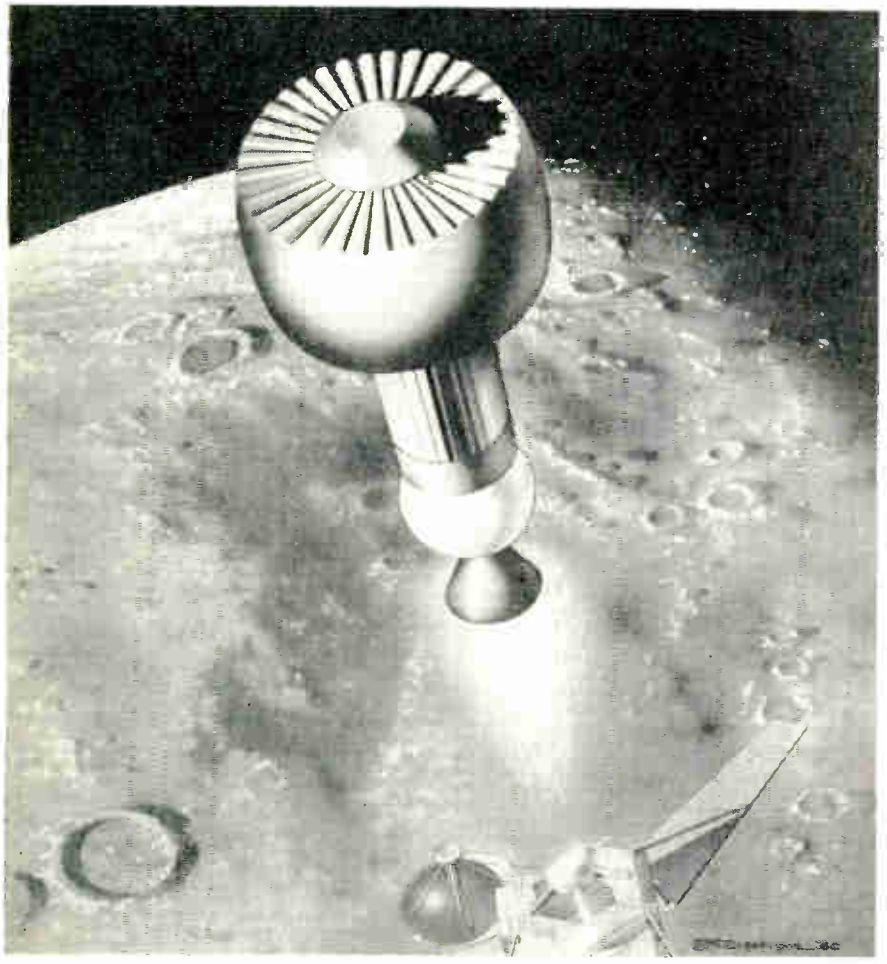

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International News

(*Continued from page* 21)

Foreign Trade Opportunities

International trade opportunities for small businesses are highlighted in a new leaflet from the Small Business Administration, Lafayette Building, Washington 25, D. C. The leaflet, number 114, "How the Bureau of Foreign Commerce Can Help Small Manufacturers," was prepared by the Bureau of Foreign Commerce, U. S. Dept. of Commerce.

The new aid discusses Government assistance available to small concerns interested in foreign commerce. Pointers on reducing barriers in areas of foreign import duties, quotas, and other restrictions are noted.

Basic questions discussed are: "Should You Market Abroad," "How Do You Find Reliable Foreign Partners," "Which Countries Afford the Best Markets," "How Do You Learn of Opportunities," "What About Foreign Duties and Regulations," "How Do You Get Foreign Market Data," and "What About U. S. Export Controls." SBA has also published an informational booklet, "Pointers on International Trade."

RCA Exec Gets Brazilian Award

W. Walter Watts, Group Executive Vice President, Radio Corp. of America has been awarded the Cruzeiro do Sol (Order of the Southern Cross) by the Brazilian Government.

The award was for the job done by RCA's International Division (which executed the job), RCA Victor Co., Ltd., of Canada (made the equipment) and the project group of engineers in Brazil in installing a cross-country microwave telecommunications system in time for the dedication of Brazil's new capital city, Brasilia.

Conference on Information Processing Proceedings

New York—The complete proceedings of the first International Conference on Information Processing (600 pages, $25.00) have been published by the United Nations Educational, Scientific, and Cultural Organization, 801 Third Ave., New York 22, N. Y.

Over 2,000 electronic computer experts from 39 countries attended the conference. The conference covered these major topics: Methods of Digital Computing; Common Symbolic Language for Computers; Automatic Translation of Languages; Pattern Recognition and Machine Learning; Logical Design of Computers; Future Computer Techniques: and Miscellaneous.

"FREON"-TF SOLVENT

This magnet wire wos exposed to "Freon" solvent liquid. The "Glyptal" coating on this wire is completely unaffected by "Freon"-TF.

ORDINARY CHLORINATED SOLVENT

This "Glyptol"-insulated wire wos exposed to ordinary chlorinated solvent for the same length of time os the one on the left. The solvent dissolved the resin binder aad softened the olkyd finish.

Comparison with ordinary chlorinated solvent proves:

FREON® solvents won't damage metal, elastomers or plastics . . . are safer for degreasing precision equipment

"Freon" solvents give you an effective and remarkably safe means of cleaning electric motors, ultra-precision mechanical and electronic equipment, and component parts. They minimize swelling of elastomers and plastics . . . will not soften paint, wire coatings or insulators. "Freon" solvents are also non-corrosive to metals without inhibitors. In addition, "Freon" solvents leave no residue when they dry and can be recovered and reused readily.

"Freon" solvents are safe for personnel, too. They are non-explosive and non-flammable. "Freon" is virtually non-toxic. Vapors are odorless and will not cause nausea or headaches.

FREE 12-PAGE BOOKLET explains the unique properties of "Freon" solvents and how they minimize cleaning hazards.

FREON®

solvents

DUPONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
"Freon" Products Division 557
Wilmington 98, Delaware

Send me your free, 12-page booklet on "Freon" solvents.

Name _____

Company _____

Address _____

City _____ *State* _____

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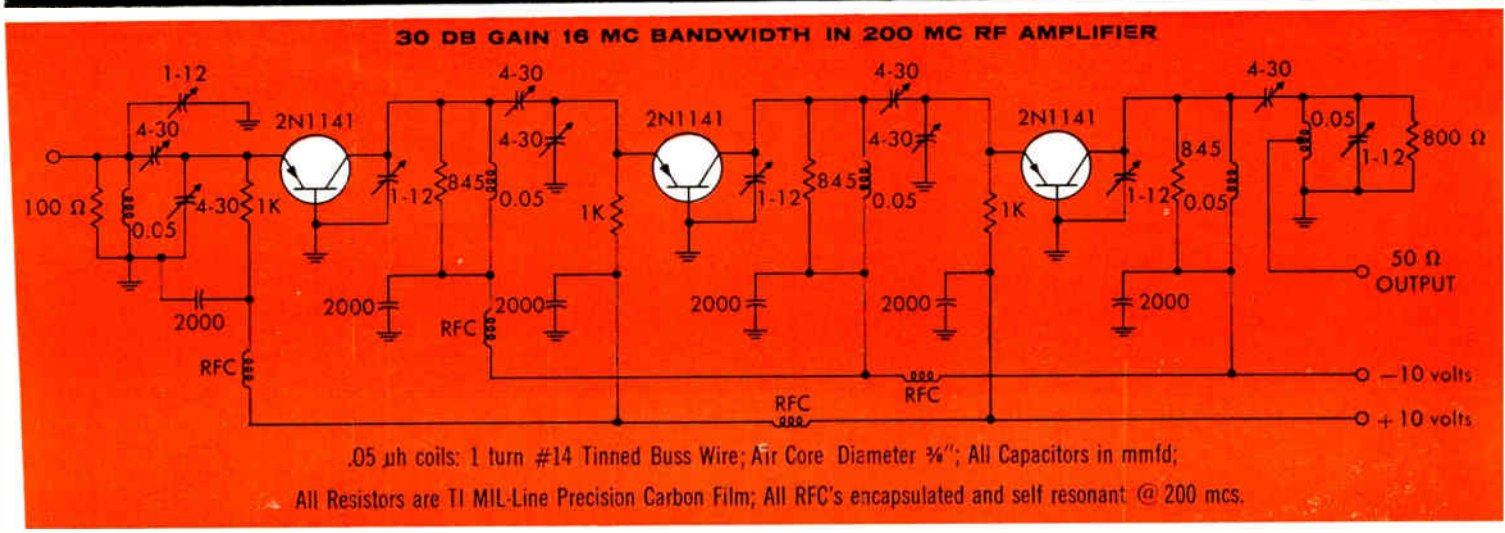
(*Continued on page* 28)

30 db gain in 200 mc RF amplifier

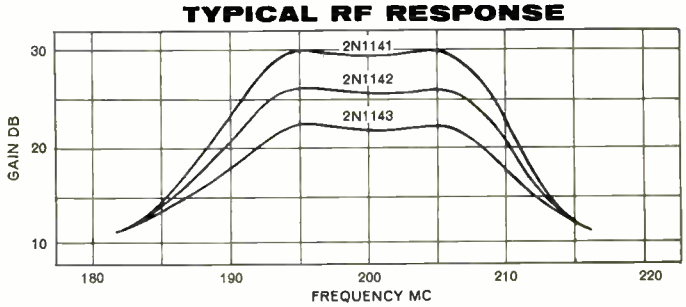


...with TI 2N1141 series germanium mesa transistors

Exceptionally high ac beta TI 2N1141 germanium mesa transistors provide 30 db gain — *with 16 mc bandwidth* — in a 200 mc RF amplifier. Ideal for your high frequency amplifiers and power oscillators, 2N1141 series diffused base transistors give you . . . maximum dissipation to 750 mw . . . voltage ratings to 35v at 100 μa I_c . . . 750 mc alpha cutoff.

These devices are backed by *more than 3,500,000 unit hours* of life test reliability data . . . see curves below.

TYPICAL RF RESPONSE

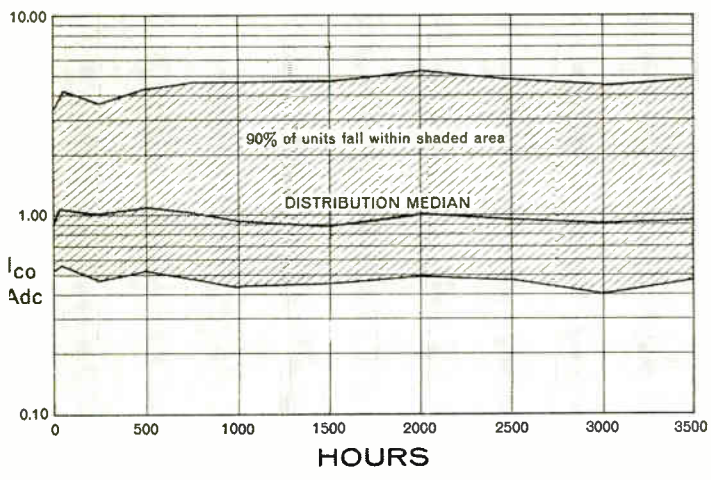


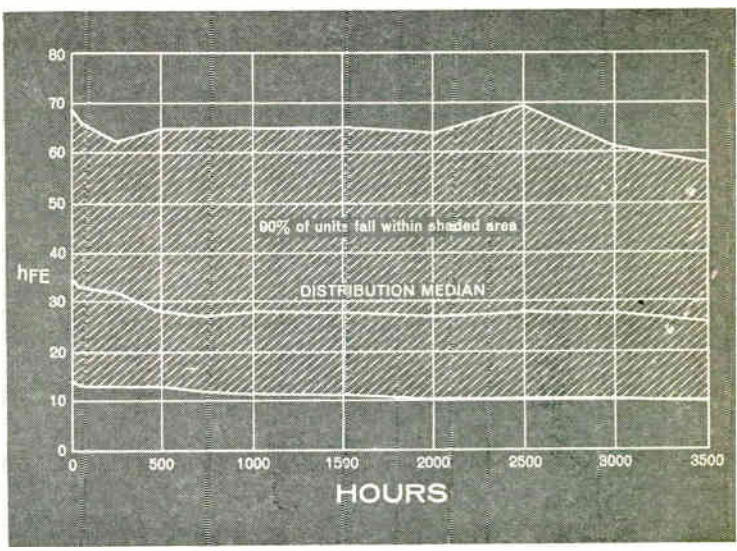
TYPICAL CHARACTERISTICS AT 25°C

	2N1141	2N1142	2N1143	unit
$f_{\alpha b}$	750	600	480	mc
C_{Tc}	1.2	1.4	1.5	μμf
r_b'	65	80	110	ohms

UNIT TYPE 2N1142: I_{CBO} AND h_{FE} VS HOURS OF STORAGE AT +100°C

TEST LEGEND: Sample Size: 1000 units ▪ Test Condition: Storage at +100°C ▪ I_{co} Measured at: V_{CB} = −20v, I_E = 0 ▪ h_{FE} Measured at: V_{CE} = −6v, I_C = −10ma





Contact your nearest TI distributor or sales office for immediate delivery.

DESIGN LEADERSHIP IN QUALITY GERMANIUM TRANSISTORS

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

Circle 13 on Inquiry Card

(Continued from page 26)

Electronics Corp., College Point, L. I.; Panoramic Radio Products Co., Inc., Mt. Vernon, N. Y.; Sensitive Research Instrument Corp., New Rochelle, N. Y.; and Tektronix Inc., Portland, Oregon.

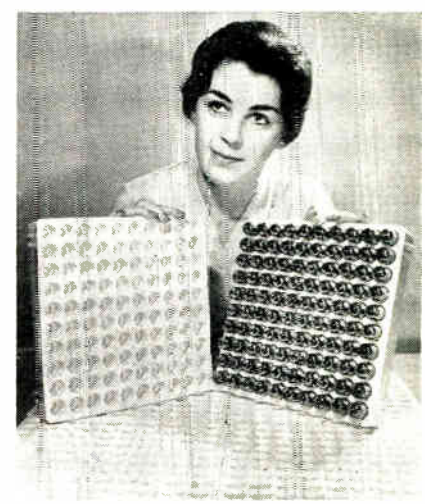
Equipment will include: precision microwave, power supplies, spectrum analyzers, laboratory

Plans for exhibit are discussed by: (L to R seated) B. Schlessel, Panoramic Radio; W. D. Marshall, FXR; S. Weston, Lamba Electronics, and M. Steinberg, Sensitive Research Instrument (Standing L to R) T. N. Anderson, FXR and W. R. Saylor, General Radio.

standard meters and other calibration devices, cathode-ray oscilloscopes, and accessory equipment.

Exhibit areas will be: (Oct. 5-6) Long Island (Garden City) Sagamore Room, Roosevelt Field Shopping Center; (Oct. 11) Connecticut (Norwalk)—Treadway Inn; (Oct. 13) New York (Poughkeepsie)—Nelson House; (Oct. 17) Northern New Jersey (Cedar Grove); (Oct. 19-20) Philadelphia-Moorestown, N. J.—Cherry Hill Inn.

PROTECTS TUBES



New plastic package, being used by RCA's Electron Tube Div. to ship miniature tubes, holds 100 tubes and protects them from shock and vibration. Container is about 10½ in. square.

More News on Page 32

EXTRA QUALITY AT NO EXTRA COST WITH BENDIX TRANSISTORS

Bendix Bulletin

Up-to-the-minute news about transistors

NEW DRIVER TRANSISTORS SWEEPING THE FIELD

Extra-versatile Bendix units beat high costs, design limitations over wide front

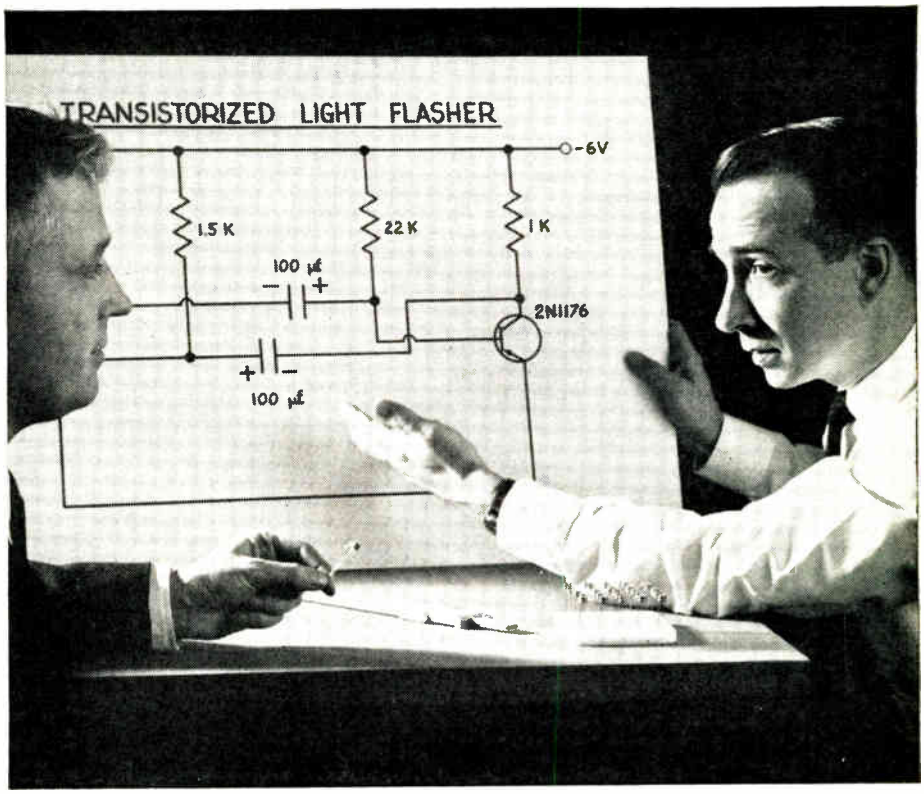
Called the "workhorse of the transistor industry," the new Bendix* Driver Transistor series is winning the nod from more and more engineers daily. These men find it the answer to audio frequency and switching applications requiring extra performance without extra cost.

Here is a special device for use where reliability, versatility, and low cost are primary requirements. The Bendix units combine higher voltage rating and high current gain with more linear current gain characteristics for low distortion and more efficient switching.

They're now in high production for rapid delivery in JEDEC TO-9 packages.

NEW BENDIX SEMICONDUCTOR CATALOG on our complete line of power transistors, power rectifiers, and driver transistors available on request. Write SEMICONDUCTOR PRODUCTS, THE BENDIX CORPORATION, LONG BRANCH, N. J. for information about employment opportunities write personnel manager.

*TRADEMARK



ENGINEERS KNOW the new Bendix Driver Transistor line-up meets an unusually wide range of circuitry applications. Bendix Applications Engineering Department suggestions on circuitry problems are helpful, too.

APPLICATION, PERFORMANCE DATA INDICATE BROAD USAGE

TYPE NUMBERS	MAXIMUM RATINGS					TYPICAL OPERATION		
	Vce	Ic	Pc	Tj	T storage	hfe	fαb	Vce(Sat)
	Vdc	mAdc	mW	°C	°C	Ic = 10 mAdc		Ic = 100 mAdc Ib = 10 mAdc
2N1008	−20	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1008A	−40	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1008B	−60	300	400	85	−65 to +85	90	1.2 mc	0.15 Vdc
2N1176	−15	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc
2N1176A	−40	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc
2N1176B	−60	300	300	85	−65 to +85	65	1.2 mc	0.15 Vdc

Ideal for such applications as:

TRANSISTOR DRIVER • AUDIO AMPLIFIER (CLASS A OR B) POWER SUPPLY • SERVO CONTROL • AUDIO OSCILLATOR MOTOR CONTROL • RELAY DRIVER • POWER SWITCH

SEMICONDUCTOR PRODUCTS

Red Bank Division

LONG BRANCH, N. J.

THE Bendix CORPORATION

West Coast Sales Office:
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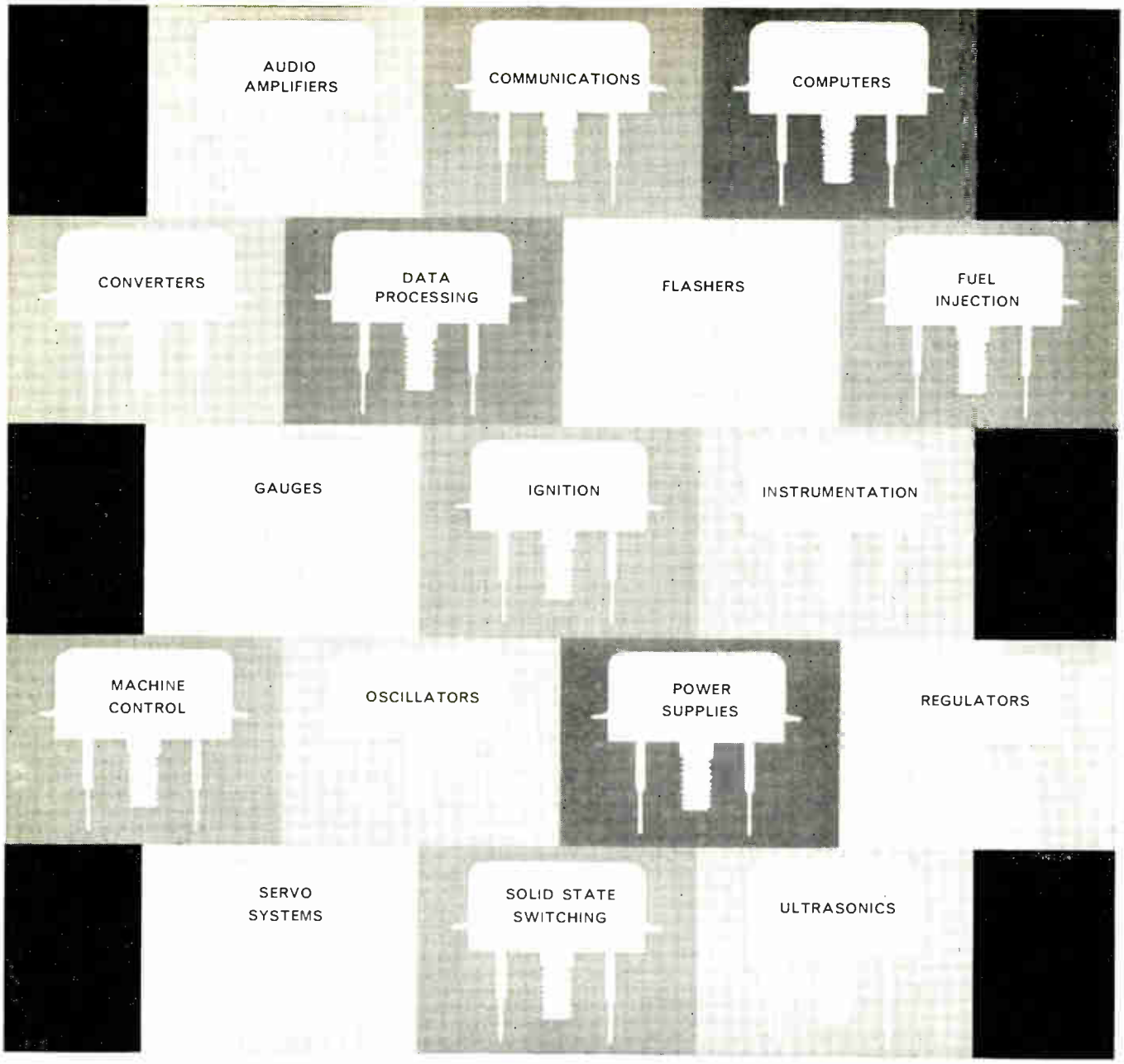
Midwest Sales Office:
2N565 York Road, Elmhurst, Illinois

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, Ontorio, Canado



ONE TRANSISTOR— HUNDREDS OF USES

DELCO RADIO'S VERSATILE 2N174

For top performance in a wide, wide range of applications, depend on Delco Radio's 2N174.

■ This multi-purpose PNP germanium transistor is designed for general use with 28-volt power supplies, and for use with 12-volt power supplies where high reliability is desired despite the presence of voltage transients. ■ It has a high maximum emitter current of 15 amperes, a maximum collector diode rating of 80 volts and a thermal resistance below .8°C per watt. The maximum power dissipation at 71°C mounting base temperature is 30 watts. Low saturation resistance gives high efficiency in switching operations. ■ The 2N174 is versatile, rugged, reliable, stable and low priced. For more details or applications assistance on the 2N174 or other highly reliable Delco transistors, contact your nearest Delco Radio sales office.

DELCO RADIO

Division of General Motors · Kokomo, Indiana

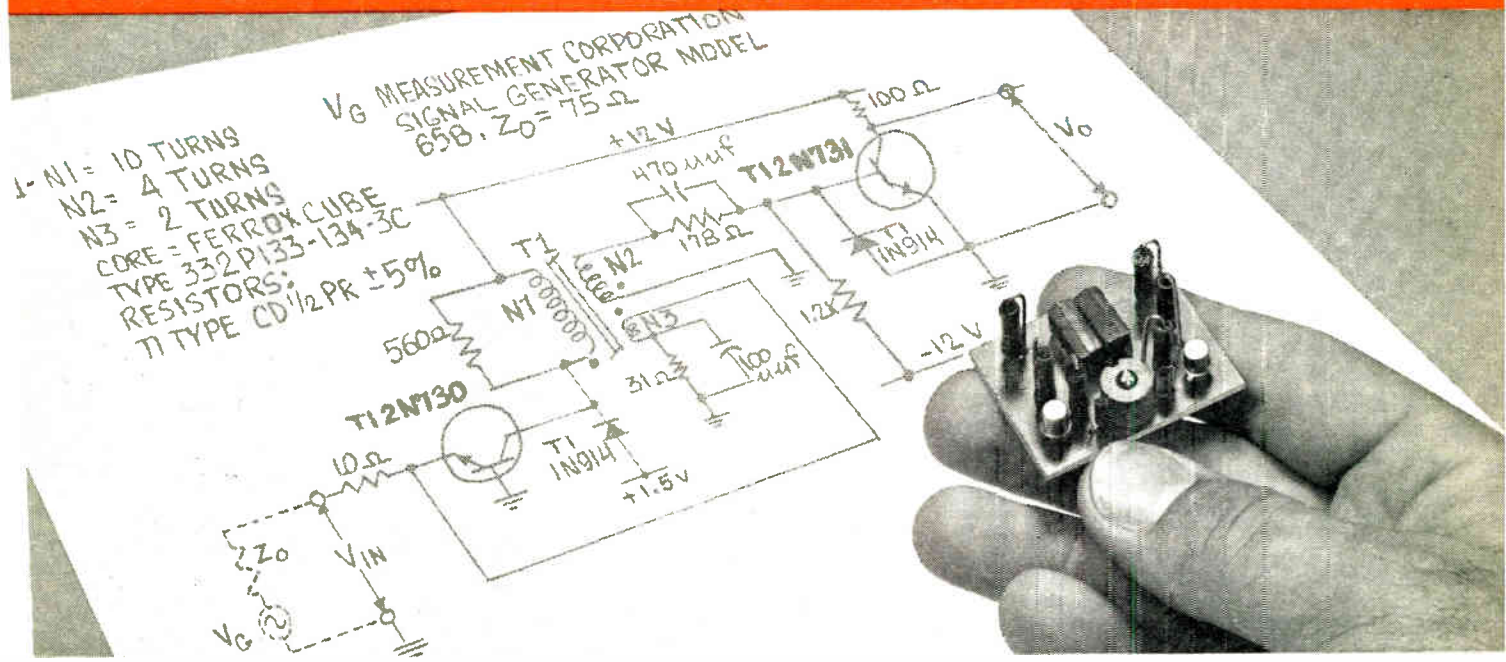
Newark, New Jersey
1180 Raymond Boulevard
Tel.: Mitchell 2-6165

Santa Monica, California
726 Santa Monica Boulevard
Tel.: Exbrook 3-1465

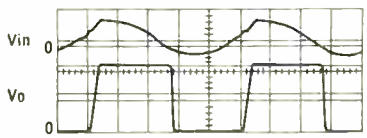
Chicago, Illinois
5750 West 51st Street
Tel.: Portsmouth 7-3500

Detroit, Michigan
57 Harper Avenue
Tel.: Trinity 3-6560

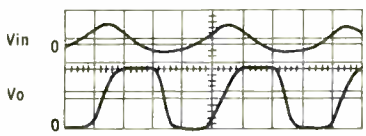
HOW TO GENERATE 100-ma PULSES AT 10 mc



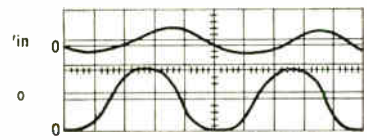
. . . WITH TI 2N730 and 2N731 SILICON MESA TRANSISTORS



1 Megacycle
VERT.—5v /cm
HORIZ.—.2 μsec /cm
T_A—25°C



5 Megacycles
VERT.—5v /cm
HORIZ.—50 mμsec /cm
T_A—25°C



10 Megacycles
VERT.—5v /cm
HORIZ.—20 mμsec /cm
T_A—25°C

See how these performance-proved characteristics apply to your high-current, high-speed switching circuits . . .

High-current loads — Switch *100 ma* at 10-mc rates using TI 2N730 and 2N731 transistors (see applications circuit) • *Fast switching* — Note *20 millimicrosecond* rise and fall times on the waveforms illustrated • *Size and weight* — Save *both* size and weight with the subminiature TO-18 packaging of the TI 2N730 and 2N731 'mesas' • *Dissipation* — Get a full *500 mw* (T_A=25°C) or *1.5w* (T_C=25°C) with beta spreads of 20-60 (2N730) and 40-120 (2N731) • *Reliability* — TI Quality Assurance *guarantees* you performance to specifications • *Applications* — Use the TI 2N730 and 2N731 guaranteed performance in your digital computer clock pulse generators and similar high-load, high-speed, high-reliability circuits. Check these specifications:

electrical characteristics at 25°C ambient (unless otherwise noted)

	PARAMETER	TEST CONDITIONS		2N730 min	2N730 max	2N731 min	2N731 max	unit
I_{CBO}	Collector Reverse Current	V_{CB}=30v	I_E=0	—	1.0	—	1.0	μa
I_{CBO}	Collector Reverse Current at 150°C	V_{CB}=30v	I_E=0	—	100	—	100	μa
BV_{CBO}	Collector-Base Breakdown Voltage	I_C=100μa	I_E=0	60	—	60	—	v
BV_{CER}	Collector-Emitter Breakdown Voltage	I_{CER}=100ma R_{BE}=10 ohms		40	—	40	—	v
BV_{EBO}	Emitter-Base Breakdown Voltage	I_E=100 μa	I_C=0	5	—	5	—	v
h_{FE}	OC Forward Current Transfer Ratio	I_C=150ma	V_{CE}=10v	20	60	40	120	
$V_{BE(sat)}$	Base-Emitter Voltage	I_C=150ma	I_B=15ma	—	1.3	—	1.3	v
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=150ma	I_B=15ma	—	1.5	—	1.5	v
h_{fe}	AC Common Emitter Forward Current Transfer Ratio	I_C=50ma f=20mc	V_{CE}=10v	2.0	—	2.5		
C_{ob}	Common-Base Output Capacitance	I_E=0	V_{CB}=10v	—				
		f=1mc		—	35	—	35	μμf

Pulse conditions: Length = 300μs, duty cycle < 2%

Collector-Base Voltage	60v
Collector-Emitter Voltage	40v
Emitter-Base Voltage	5v
Total Device Dissipation	0.5w
Total Device Dissipation at Case Temperature 25°C	1.5w
Storage Temperature Range	−65°C to +175°C

CALL YOUR TI SALES OFFICE OR LOCAL AUTHORIZED TI DISTRIBUTOR FOR PRICE, DELIVERY AND COMPLETE TECHNICAL DATA.

the FIRST silicon transistor manufacturer

TEXAS INSTRUMENTS
INCORPORATED
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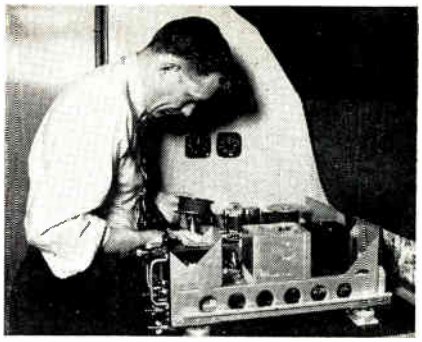
FOR AIRPLANE SAFETY



Project Engineer, William Plice, installs magnetic tape in Flight Recorder which monitors 65 flight condition variables. Analysis of performance provides statistical means to determine when maintenance is needed. Minneapolis-Honeywell, Regulator Co., developers, demonstrated the recorder for Federal Aviation Agency Officials.

Reprocess Air in Space Capsule with 120 lb Unit

A General Electric scientist, J. J. Konikoff, says that a system weighing as little as 120 lbs can be built to supply all of a man's oxygen needs in space indefinitely. The system would reprocess the air in the space capsule. It would chemically and electrically convert carbon dioxide and water—waste products given off by man into the air—into breathable oxygen.

The complete oxygen-regeneration cycle has been performed experimentally using the "Fischer-Tropsch Synthesis" system which converts carbon dioxide to water and methane. The water is then decomposed electrically (electrolysis) to release the oxygen. Energy to operate the system could be supplied by the sun, a fuel cell (with the cycle reversed) or other devices.

Need Work?

U.S.I.A. Seeks Engineers

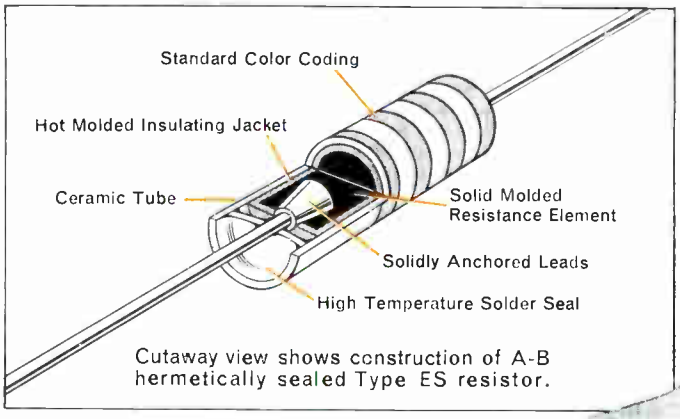
The U. S. Information Agency's broadcasting service, the Voice of America, needs engineers for building a 4-million watt transmitting station in Greenville, N. C. Needed are electronic, civil/construction, and mechanical engineers to supervise construction and installation of high powered radio broadcasting and communication facilities. They are also looking for engineers for overseas projects.

Base salaries range from $5,985 to $10,130 (Greenville and Washington, D.C.) and from $9,095 to $11,770 (plus allowances) overseas. A college degree and a min. of 3 years professional experience are required. Applications should be sent to the Employment Branch, U. S. Information Agency, 1776 Pennsylvania Ave., Wash. 25, D. C.

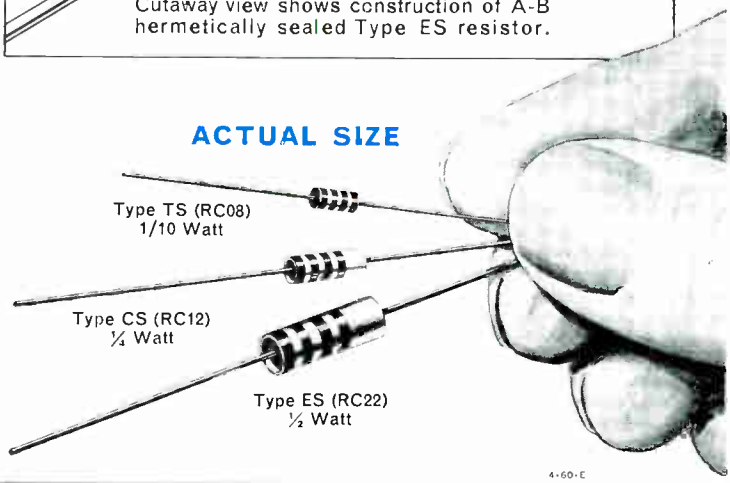
. . . . . A-B hermetically sealed composition resistors defy the severest atmospheric conditions

Allen-Bradley hermetically sealed composition resistors provide stability, reliability, and uniformity under extremes of humidity, such as illustrated above. This resistor consists of a specially processed, hot molded, carbon composition unit with an integral insulating jacket surrounding the carbon element. The entire unit is then hermetically sealed by means of a metallic seal and a ceramic jacket. This assures complete immunity to all effects of moisture and humidity. And under extremes of vibration and shock, A-B resistors remain undamaged, stable, and extremely low in noise factor.

A-B ceramic encased resistors are available in 2% and 5% tolerances in standard EIA values to 22 megohms, and in higher values on special order. Since catastrophic failure does not occur in A-B hot molded resistors, these units combine narrow tolerances with absolute reliability. Designed for continuous operation at full rated wattage at 70°C, Type ES resistors have a zero derating of 165°C; Type CS and Type TS at 150°C and 110°C respectively. For full details, write for Technical Bulletin 5003.



Cutaway view shows construction of A-B hermetically sealed Type ES resistor.

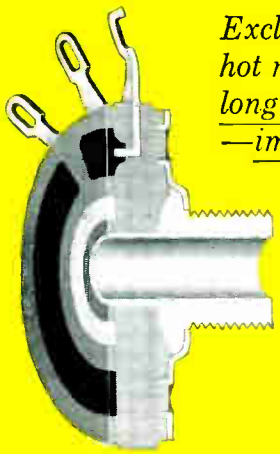


4-60-E

ALLEN-BRADLEY | *Quality* Electronic Components

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Choose ALLEN-BRADLEY QUALITY POTENTIOMETERS for your critical circuits



Exclusive one-piece hot molded element assures long life, quiet operation —improving with age!

With this solid molded resistance element, control is always smooth—there are never any abrupt changes. This also assures low "noise" even after long use. The sectional view of the Type "J" shows how the terminals, resistance element, faceplate, and threaded bushing are all molded together into *one* integral structure.

A-B Type J Potentiometer

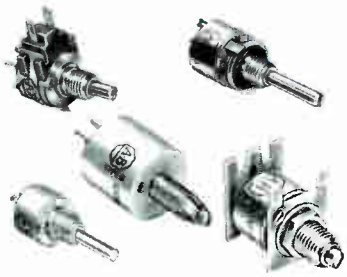
A-B Type G Potentiometer

For the ultimate in performance, select from the Allen-Bradley family of quality potentiometers.

THE ALLEN-BRADLEY FAMILY OF POTENTIOMETERS

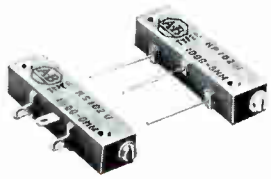
TYPE J—rated 2 watts at 70°C. Total resistances to 5 megohms. Single, dual, and triple units. *Many RV-4 types in stock for overnight shipment of prototype quantities. Send for list.*

TYPE K—like Type J, but rated 1 watt at 125°C, 2 watts at 100°C, and 3 watts at 70°C. Can be used to 150°C under "no load."



TYPE G—rated ½ watt at 70°C. Total resistances to 5 megohms. Wide selection of styles and various optional features, including switch. *Many RV-6 types in stock for overnight shipment of prototype quantities. Send for list.*

TYPE L—similar to Type G, but rated at ¼ watt at 100°C. Can be used to 150°C under "no load."



TYPE R—adjustable fixed resistor. Rated ¼ watt at 70°C. Total resistance ranges from 100 ohms to 2.5 megohms. Self-locking features hold settings under extremes of shock.

TYPE F—rated ¼ watt at 70°C. For printed wiring boards. Has screwdriver adjustment.

TYPE T—rated ½ watt at 70°C. Extremely thin; plastic cover serves as actuator.

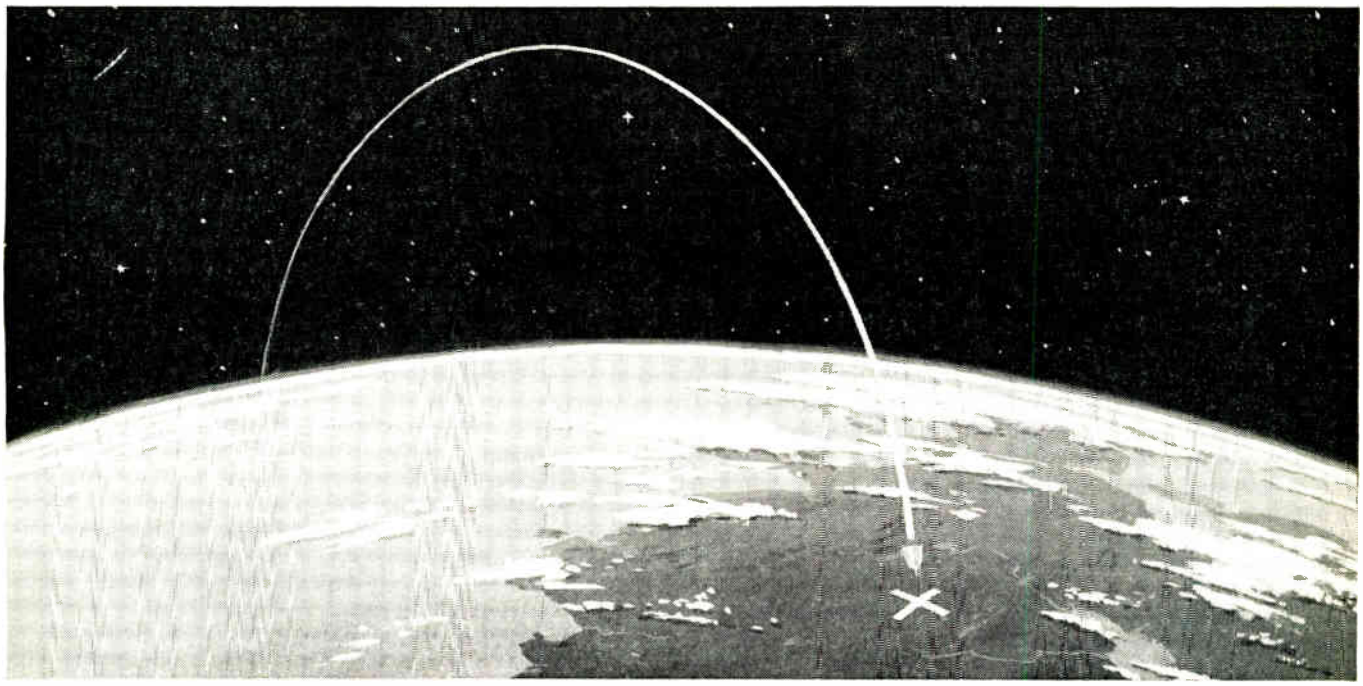
TYPE H—rated 5 watts at 40°C, with a maximum continuous voltage of 750 volts. Designed for industrial applications. Total resistances to 2.5 megohms.

4-60-3

Allen-Bradley Co., 222 W. Greenfield Ave., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY

Quality Electronic Components

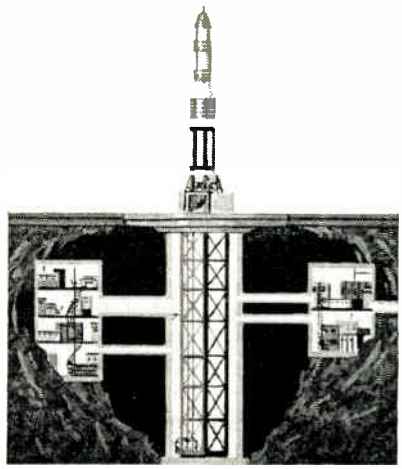


ASSIGNMENT: HIT A TARGET 6000 MILES AWAY

Can you guide a 110-ton Air Force Titan missile far up into the sky, to bring its nuclear warhead down with pinpoint accuracy on a target one-fourth the way around the globe—a target you not only can't see but which continually moves with the spinning earth?

This was the problem in missile guidance the Air Force presented to Bell Telephone Laboratories and its manufacturing partner, Western Electric. The answer was the development of a command guidance system which steers the Titan with high accuracy.

Unlike self-contained systems which demand complex guidance equipment in the missile itself, Bell Laboratories Command Guidance System keeps its master control equipment on the ground where it can be used over and over again. Thus a minimum of equipment is carried in the missile, and the ground station has full control of the missile during its guided flight. Techniques drawn from the communications art render the system immune to radio jamming.



Bell Laboratories scientists and engineers designed the transmission and switching systems for the world's most versatile telephone network, developed much of our nation's radar, and pioneered in missile systems. From their vast storehouse of knowledge and experience comes the guidance system for the Titan.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Tele-Tips

HOW TO KEEP ENGINEERS. One large eastern electronics manufacturer sent its top engineers — and wives — on a 1-week all-expense paid vacation to Miami, Fla. The only hooker—it was during the week of the IRE Convention!

"NO-MEN" OR "YES-MEN"—who gets ahead? Opinion Research Corp. of Princeton, N. J. interviewed top officers and department managers of 12 big corporations, to find out. According to executives the "organization man" isn't doing too well in big corporations. It's the non-conformist, they say—the man of daring and initiative—who gets ahead. But the second echelon is not nearly so unanimous in endorsing this view. Almost a third of them emphasized the need to just "get along" in order to get ahead. One advised, "Be a personality boy. Avoid making decisions that could go either way."

TRANSISTOR ANALYZERS on the market use vacuum tubes almost exclusively.

PRICE OF PROGRESS. In the early days of transistor manufacturing each family of transistors had a cheap and dirty cousin at the tail end of the line—the poorest quality transistor of the lot. But with today's improved techniques it is very difficult to make these poor-quality types — so the cheapest of yesterday becomes the "most expensive" of today.

ELECTRONIC ENGINEERS were assigned "noncombatant status" —along with "ordinary laborers, clergy and older women" by a San Francisco liquor firm who are setting out to introduce a new drink to the American public. Engineers, they say—with tongue in cheek—are too unimaginative and set in their ways to give up their martinis in favor of the new drink —called, by the way—the buffalo.

(*Continued on page* 42)

ELECTRONIC INDUSTRIES

WESCON 1960

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A MAJOR ADVANCE FROM Transitron...

DIFFUSED MESA TRANSISTORS FOR EVERY POWER RANGE!

...WITH ADVANCED PACKAGES, HIGH VOLTAGES,

INTERMEDIATE POWER TRANSISTORS

- **Now in stud-mounted package**

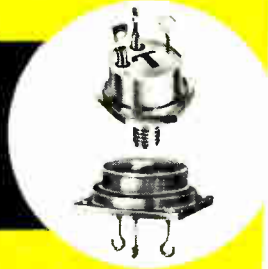
For regulated power supplies and amplifier output stages — replaces 2N1047-50 and 2N1483-86—offering low R_{cs}, good Beta linearity and voltage ratings to 120V.

Type	Maximum Power Dissipation @ 100°C (watts)	Typical DC Current Gain @ I_c = 1 amp	Maximum Collector Voltage (Volts)	Typical Saturation Resistance (ohms)	Typical DC Input Voltage (Volts)
2N1647	20	25	80V.	1.7 @ 1A.	2 @ 1A.
2N1648	20	25	120V.	1.7 @ 1A.	2 @ 1A.
2N1649	20	45	80V.	1.7 @ 1A.	2 @ 1A.
2N1650	20	45	120V.	1.7 @ 1A.	2 @ 1A.

WRITE FOR BULLETIN TE-1355S

Circle 96 on Inquiry Card

HIGH POWER TRANSISTORS



- **Available in two package styles — 11/16" hex stud mount and square flange**

For regulated power supplies and amplifier output stages — replaces 2N1015-16, 2N424, 2N389, 2N1487-90 — with low R_{cs} (typical .8 ohms), good Beta linearity, high cut-off frequencies, and high voltage.

Type	Maximum Power Dissipation @ 100°C (Watts)	Maximum Collector Current (amps)	Maximum Collector Voltage (Volts)	Maximum Saturation Resistance (ohms)	Maximum DC Input Voltage (Volts)	DC Beta @ 2 amps	
						Min.	Max.
2N1616 2N1210	30	5	60	1 @ 2A.	3 @ 2A.	15	75
2N1617 2N1211	30	5	80	1 @ 2A.	3 @ 2A.	15	75
2N1618 2N1620	30	5	100	1 @ 2A.	3 @ 2A.	15	75

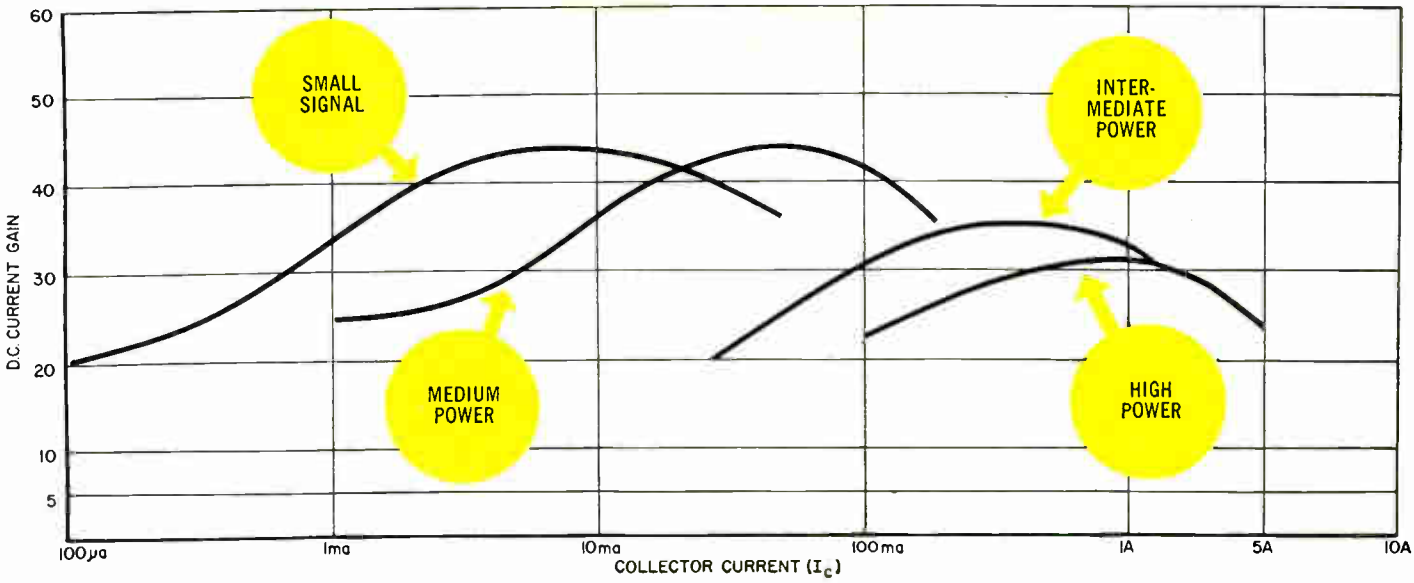
WRITE FOR BULLETIN TE-1355F

Circle 97 on Inquiry Card

With these new transistors, Transitron offers improved performance and outstanding features in all power ratings from 100 microamps to 5 amps. Each functions in a wide operating range — permitting use of fewer types, simplifying equipment manufacture. All provide the ruggedness and reliability of mesa silicon construction. All are available now, at prices competitive with lower-performance devices.

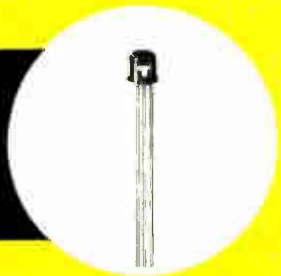
COMPUTER DESIGNERS ATTENTION

Watch for announcement o Transitron's revolutionar new switching device - coming next month and a WESCON show!
Booth 2638-39



HIGH CUT-OFF FREQUENCIES, LOW R_{CS} AND BETA LINEARITY

SMALL SIGNAL TRANSISTORS



For low level high voltage switching and amplification. Replaces 2N332-2N343 with higher cut-off frequencies (30mc), lower R_{cs}, smaller sized TO-18 package, and higher voltages.

SMALL SIGNAL TO-18						
Type	Maximum Collector Voltage	Minimum DC Beta			Maximum Power Dissipation @ 25°C Ambient (mw)	Typical Saturation Resistance (ohms)
		I_C 500μa	I_C 5ma	I_C 50ma		
ST1504	60	15	20	20	300	40
ST1505	100	15	20	20	300	50

WRITE FOR BULLETIN TE-1353T

Circle 98 on Inquiry Card

Circle 99 on Inquiry Card →

MEDIUM POWER TRANSISTORS

- **Collector lead isolated from case — greatly simplifying heat dissipation measures and increasing reliability**
- **Include highest standard voltage ratings available (to 125V) — for extra safety margin against overloads.**

To replace 2N332-343, with improved high frequency characteristics, good Beta linearity, and low R_{cs}.

Type	Maximum Collector Voltage (volts)	Minimum Beta			Maximum Power Dissipation (Watts) @ 25°C Case	Maximum Saturation Resistance (ohms)
		I_C 1ma AC	I_C 5ma AC	I_C 50ma DC		
•2N339A †	60	15	25	20	1	50
•2N340A	85	15	25	20	1	70
•2N341A †	125	15	25	20	1	70
••2N1054	125	20(DC) @ 200ma			5	20
•••2N696	60	20(DC) @ 150ma			2	10
••••2N697	60	40(DC) @ 150ma			2	10

† Electrical equivalents available in TO-5 package as 2N1206 and 2N1207

• WRITE FOR BULLETIN TE-1355J1 •• WRITE FOR BULLETIN TE-1355E-2

••• WRITE FOR BULLETIN TE-1355B-3 •••• WRITE FOR BULLETIN TE-1355B-4

Transitron electronic corporation
wakefield, melrose, boston, mass.

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NEW! WESTINGHOUSE HIGH VACUUM SWITCH TUBES

THE TUBES . . . New Westinghouse High Power Pulse Modulator Tubes (High Vacuum Switch Tubes).

THE APPLICATION . . . For use in radar systems, to replace hydrogen-thyratron type modulators.

THE ADVANTAGES . . .

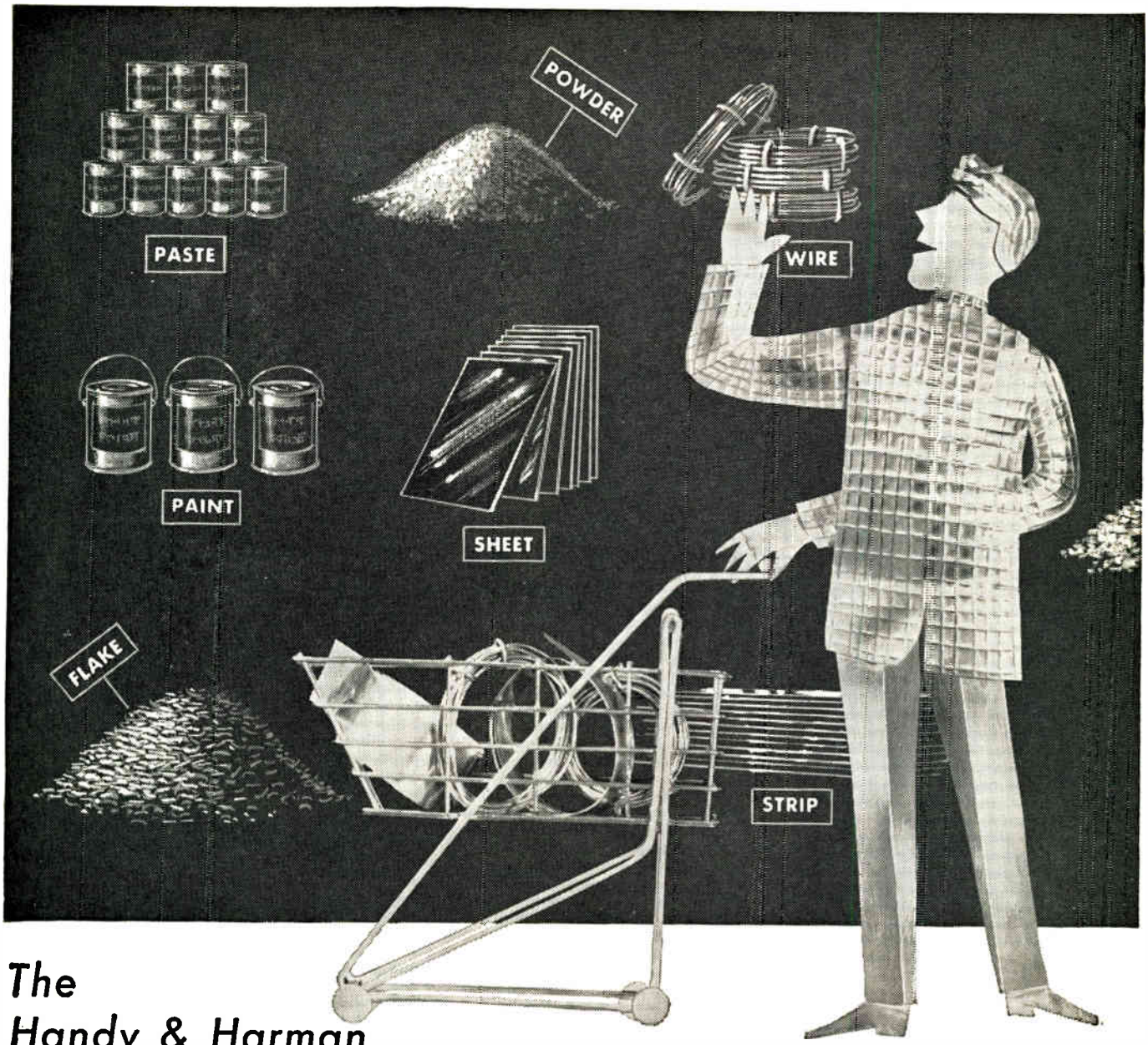
- Successive staggering of power levels gives you a complete driving chain of switch tubes for systems use
- Power range 100 kilowatts to 10 megawatts
- Operation at higher D.C. voltage levels frequently eliminates the need for pulse-transformer coupling to the RF generator
- Eliminates the jitter problem inherently associated with soft-tube modulators
- Uses thoriated-tungsten filaments for long, reliable, trouble-free life
- Air and liquid-cooled versions available from a single source

THE PLACE TO WRITE . . . For more information, contact Westinghouse Electronic Tube Division, Elmira, N. Y., or your local Westinghouse Electronic Tube Sales Office.

YOU CAN BE SURE...IF IT'S

Westinghouse

Westinghouse Electronic Tube Division, Elmira, N. Y.



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Circle 24 on Inquiry Card

Tele-Tips

(*Continued from Page 36*)

MOST PATENT-CONSCIOUS state in the U. S. is Delaware. During 1959 one patent was issued for each 1,205 people in Delaware, as compared with the national average of 1 to every 3,808 people. The national average is up from 1 per 4,019 in 1958. The states following behind Delaware are New Jersey, with one patent for every 1,472 persons; Connecticut, with 1 per 1,556; and Illinois with 1 patent for every 2,225 persons.

U. S. SCIENTISTS traveling in Russia are complaining that they are handicapped by lack of an adequate scientific translation service to enable to read the latest technical papers.

ONE-PIECE STEREO — ISN'T, says "Consumer Reports," in its March issue. The average speaker separation for 35 one-piece "stereo" consoles tested was 32 in., the magazine reported, and not one of the machines produced "stereo" sound, in their opinion, unless the listener sat three feet or less from the front of the cabinet. The C R engineers recommend that for a living room of about 15 x 18 ft. the speakers should be 6 to 10 feet apart to produce "stereo" sound.

INTERFERENCE to Internal Revenue Service domestic communication was identified by FCC monitors as originating from a station in Rio de Janeiro, over 4,000 miles away.

FCC INSPECTOR boarded a motor vessel at a California marina. The uncooperative owner ordered the inspector off the boat. When the latter stopped on the float to write his official report he was followed by the boat owner and, in a resulting altercation, somehow found himself—literally—in deep water. Not having a pen that would write under water, he had to swim for shore to complete his report. As a result, the FCC is taking administrative action against the boat owner—this time through the mails.

From the home of *Planned Pioneering*

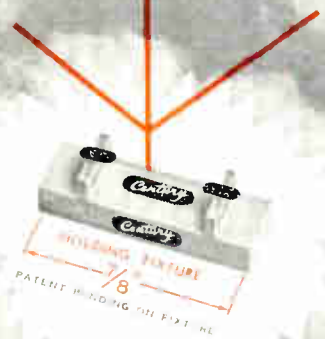
THE MODEL 711

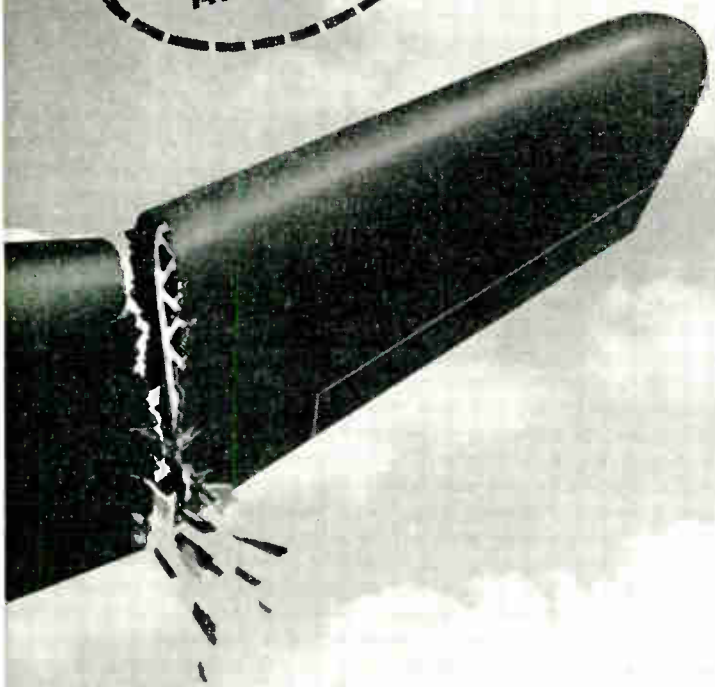
Strainistor

Ultra Sensitive Strain Sensing elements.

60 to 70 times greater Sensitivity than other metal strain gauges

FIRST COMMERCIALLY AVAILABLE!





- Strain sensitivity 120-140
- 120 Ohm nominal resistance
- Resistance change linear with strain.
- Negligible hysteresis
- Suitable for static and dynamic measurements.
- Combination mounting and handling fixture with each Strainistor.

century
ELECTRONICS & INSTRUMENTS, INC.
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LOW NOISE LEVEL SLIP RINGS FOR INSTRUMENTATION APPLICATIONS

CRITICAL HIGH SPEED

For high speed instrumentation, Breeze has designed and made hundreds of self-contained custom slip ring assemblies for use in jet engines, aircraft air conditioning systems, automotive equipment test stands, centrifuges and similar installations. These custom assemblies are produced flat, cylindrical or concentric by all standard methods . . . fabricated, electroplated or plastic molded, depending upon the requirements of the application.

Rotational Speed: 0-45,000 RPM

Linear Speed: 18,000 feet per minute

Noise: Less than 100 microvolts at 45,000 RPM and 50 milliamps current

Number of Rings: Approximately 40 at 30,000 RPM

Brush Life: 50 hours at 10,000 RPM

NORMAL SPEED

For test and laboratory applications where economy as well as reliability is important, you can choose from seven standard slip ring assemblies for strain gauge and thermocouple connections to rotating equipment. The proven flat ring standards, with ring envelope diameters from 1″ through 10½″, permit assemblies to be stacked on a common shaft to produce multiple units. These standards are available from stock, which means rapid delivery as well as modest cost. They are easily incorporated into your test equipment.

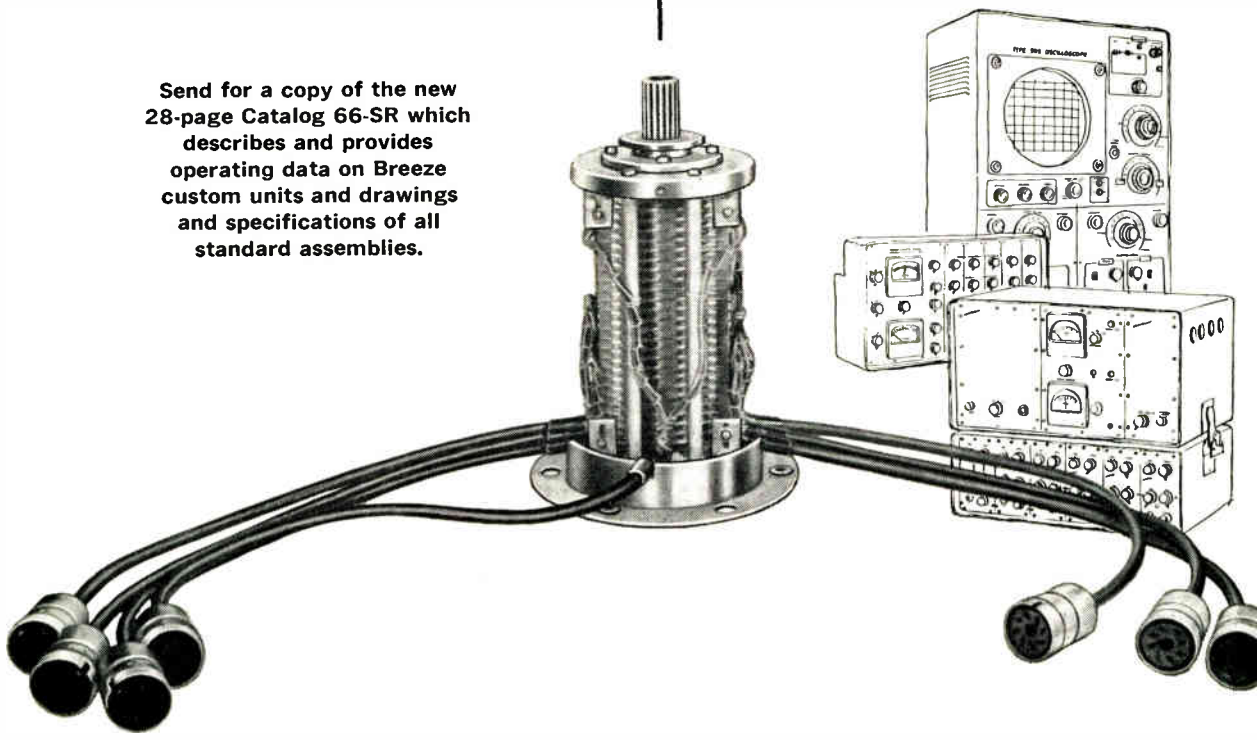
Rotational Speed: 0-5000 RPM

Linear Speed: 0-5000 feet per minute

Noise: Less than 50 microvolts at a current of 50 milliamps

Brush Life: 100 hours at 5000 RPM

Send for a copy of the new 28-page Catalog 66-SR which describes and provides operating data on Breeze custom units and drawings and specifications of all standard assemblies.



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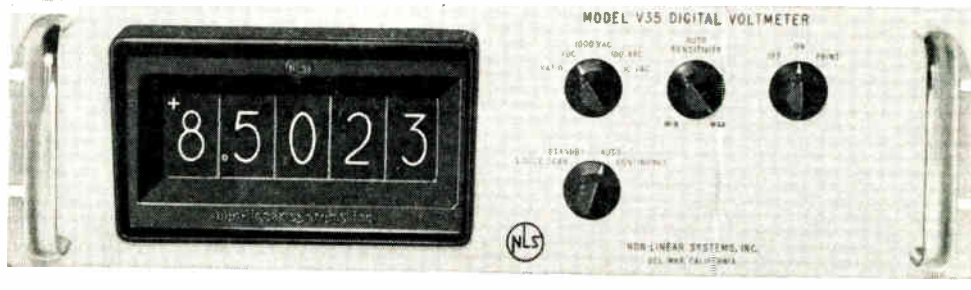


WHEN FOUR-DIGIT ACCURACY JUST ISN'T ENOUGH, specify the five-digit NLS V35 — world's most accurate digital voltmeter. Only the V35 gives you the "factual fifth figure" . . . full five-digit resolution of 0.001%. Here is the instrument for your measuring jobs demanding maximum accuracy — automatic missile checkout, readout and printout in data logging and computer systems, critical production inspection. Only the V35 offers you the benefits of "no-needless-nines" logic — greater reliability, increased speed, longer parts life. Contact NLS today for the full story.

V35 Specifications: Measures DC voltage from ±0.0001 to ±999.99; DC voltage ratio from ±00.001% to ±99.999% . . . DC voltage accuracy is ±0.01% of reading or ±1 digit . . . overall accuracy for voltage ratio is ±0.005% of reading or ±1 digit . . . "factual fifth figure" — 0.001% resolution . . . transistorized "no-needless-nines" logic . . . plug-in modular construction . . . simple external connections for AC/DC converter, pre-amplifier and data logging accessories . . . one-package design — 5¼" high — for standard rack mount . . . automatic selection and indication of range and polarity . . . interchangeable plug-in stepping switch-resistor assemblies sealed in oil . . . $3,750.00, complete. Available in four-digit model for $3,150.00, complete.

Originator of the Digital Voltmeter

non-linear systems, inc. DEL MAR (SAN DIEGO), CALIFORNIA

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

Books

Progress in Semiconductors—4

Edited by A. F. Gibson, F. W. Kroger, and R. E. Burgess. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 291 pages. Price $10.50.

A limited number of topics is taken from the whole field of semiconductors and included in this annual series of volumes. The articles generally are critical reviews, giving an assessment of the present state of knowledge. Some, however, contain significant amounts of original work. Each volume is fully international.

Electronic Engineers Reference Book, 2nd Edition

General Editor, L. E. C. Hughes. Published 1960 by the MacMillan Co., 60 Fifth Ave., New York 11. 1588 pages. Price $18.00.

The first edition of this work was completely sold out within 9 months of publication. This second edition had to be prepared at short notice. A large part of the text has been revised and a considerable amount of new material added, notably new sections on non-destructive testing, components, special components, radiation detection, digital computer applications, simulators and electronic telephone exchanges.

The Merck Index, 7th Edition

Published 1960 by Merck & Co., Inc., Rahway, N. J. 1641 pages. Price $12.00.

The completely new edition covers nearly 10,000 descriptions of individual substances, more than 3300 structural formulas, and about 30,000 names of chemicals and drugs alphabetically arranged and cross-indexed.

An outstanding feature of this book is a separate and greatly expanded cross-index section of more than 30,000 names. This enables the user of the book to locate a particular chemical description by page number regardless of whether he knows only the generic name, brand name, or systematic chemical name for a substance.

Programming Program for the BESM Computer

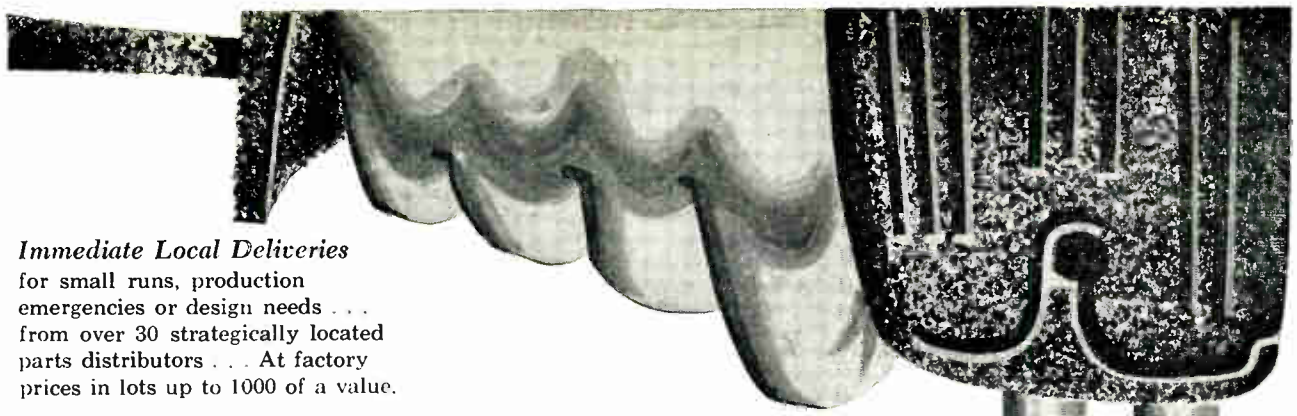
By A. P. Ershov. Translated from the Russian by M. Nadler. Published 1960 by Pergamon Press, Inc., 122 E. 55th St., New York 22. 158 pages. Price $10.00.

This book presents the results of one of the first experiments to develop a programming program for electronic computers.

The work described in this book was carried out initially in the Institute of Precision Mechanics and Calculation Techniques of the USSR Academy of Sciences and subsequently in the computation center of the Academy.

The first part of the book analyzes operators in relation to program

(*Continued on page* 54)



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Would you buy fixed resistors just because they're the **easiest to solder?**

Of course you wouldn't!

But when you add the highest degree of "solderability" of any resistors on the market to top-notch reliability in other physical and electrical characteristics — well, that's something else. Like a lot of other cost-conscious producers, you'll then be using Stackpole Coldite 70+ Resistors!

Stackpole Coldite 70+ "solderability" saves time and money in your production. It assures perfect connections that eliminate a lot of possibilities for costly field service later on.

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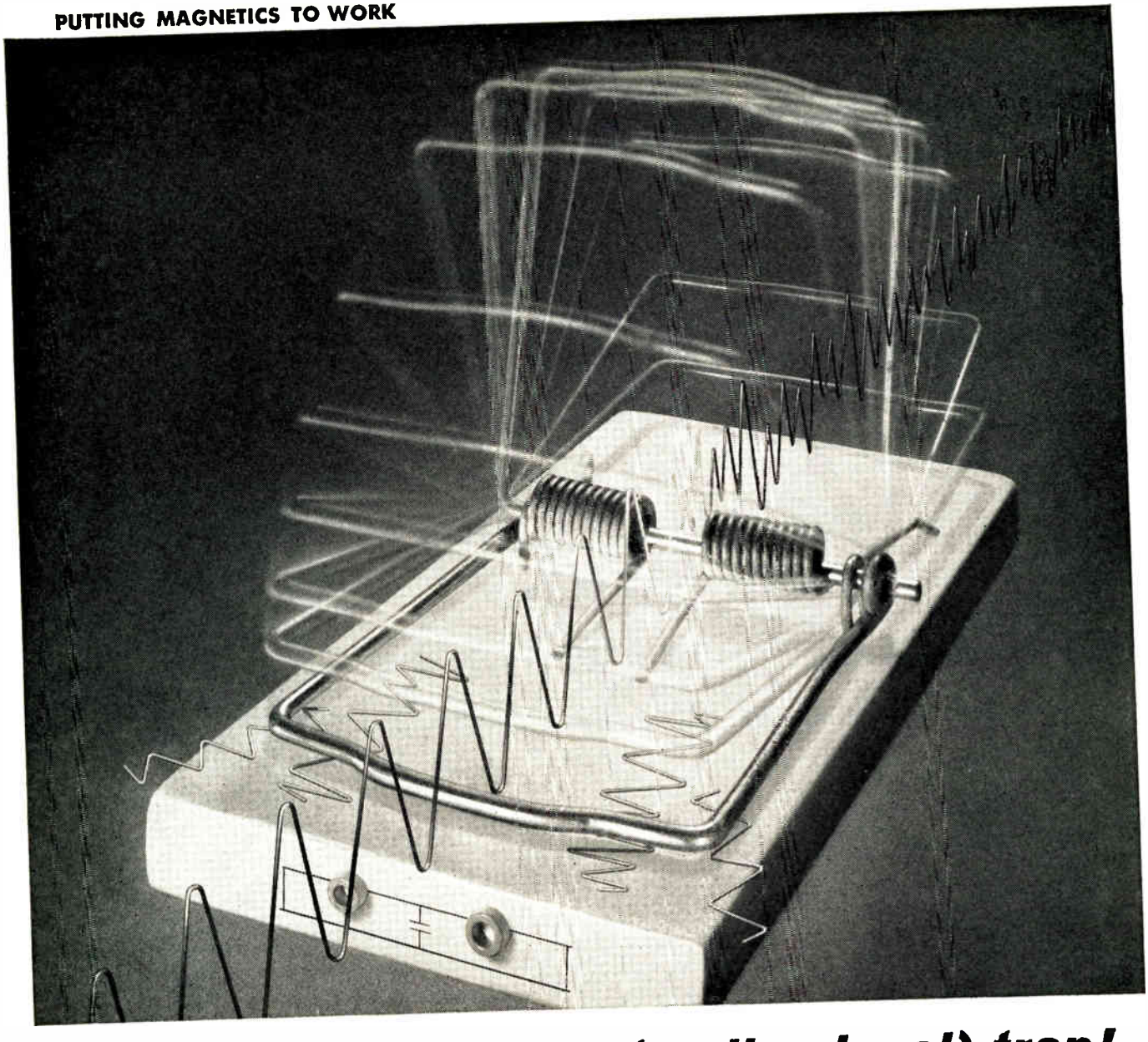
Coldite 70+®
fixed composition resistors

CERAMAG® FERRITE CORES • VARIABLE COMPOSITION RESISTORS • SLIDE & SNAP SWITCHES • CERAMAGNET® CERAMIC MAGNETS • FIXED COMPOSITION CAPACITORS BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT • ELECTRICAL CONTACTS GRAPHITE BEARINGS, SEAL RINGS, ANODES • HUNDREDS OF RELATED CARBON & GRAPHITE PRODUCTS.



How to build a better (audio signal) trap!

Magnetics Inc. permalloy powder cores give filter designers new attenuation and stability standards—and miniaturization to boot!

The art of trapping unwanted frequencies has been advanced during the past year with a succession of improvements in molybdenum permalloy powder cores by Magnetics Inc. Most audio filter designers now work with smaller cores, more stable cores and cores whose attenuation characteristics are ultra-sharp. Do you?

Do you, for example, specify our 160-mu cores when space is a problem? With this higher inductance, you need at least 10 percent fewer turns for a given inductance than with the 125-mu core. What's more, you can use heavier wire, and thus cut down d-c resistance.

What about temperature stability? Our linear cores are used with polystyrene capacitors, cutting costs in half compared to temperature stabilized moly-permalloy cores with silvered mica capacitors. Yet frequency stability over a wide swing in ambient temperatures is increased!

And what do you specify when you must rigidly define channel cut-offs, with sharp, permanent attenuation at channel crossovers? Our moly-permalloy cores have virtually no resistive component, so there is almost no core loss. The resultant high Q means sharp attenuation of blocked frequencies in high and low band pass ranges.

Why not write for complete information? Like all of our components, molybdenum permalloy powder cores are *performance-guaranteed* to standards unsurpassed in the industry. *Magnetics Inc., Dept. EL-82, Butler, Pa.*

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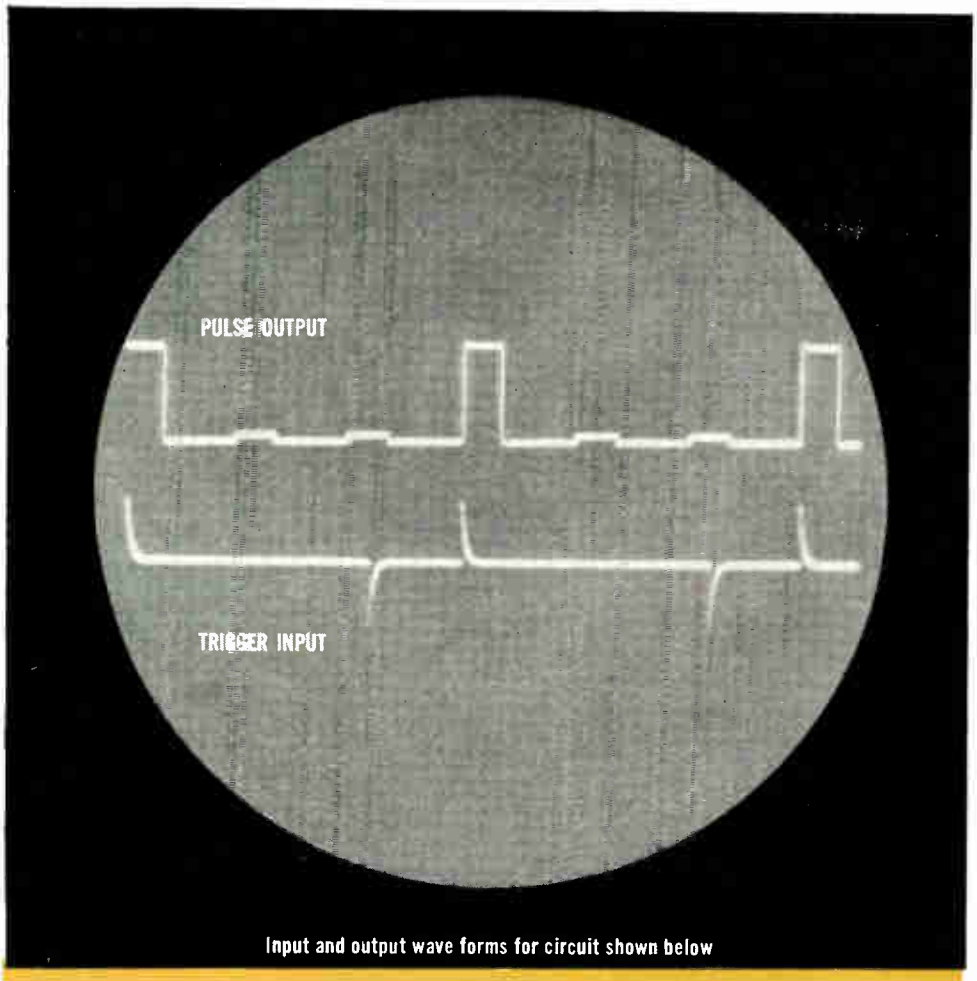
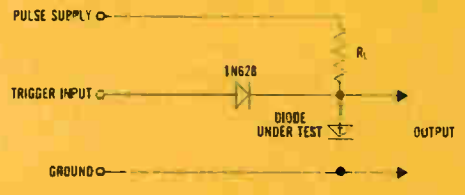
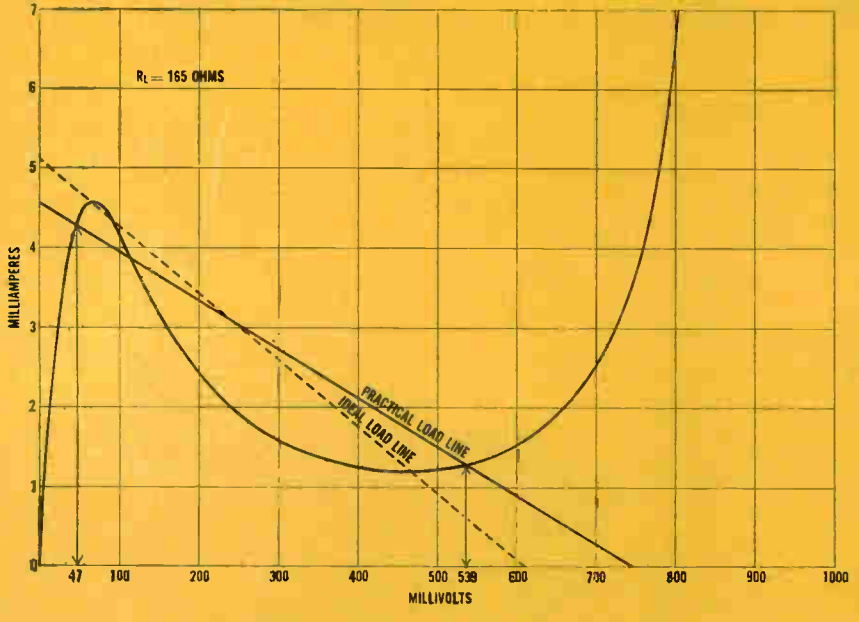
Hoffman design-aid series



Input and output wave forms for circuit shown below

Switching circuit





Practical load line indicates operation with optimum stability

FOR THE HIGHEST 0/1 VOLTAGE RATIO, SPECIFY HOFFMAN SILICON TUNNEL DIODES

With a voltage ratio as high as 7.0, the Hoffman silicon tunnel diode outperforms all other tunnel diodes in high-speed switching . . . as this table of valley-to-peak voltage ratios shows:

Hoffman silicon tunnel diode
6.3-7.0*
germanium tunnel diode
4.3-6.4**
gallium arsenide tunnel diode
3.8-4.5**

*By actual test, **As advertised

■ HIGH TEMPERATURE STABILITY
From −85°C to +200°C.

■ RUGGEDNESS
Made to withstand severe shock, vibration, acceleration, nuclear radiation.

■ UNIFORMITY
All characteristics carefully controlled by advanced manufacturing techniques.

■ RELIABILITY
Not only are these silicon devices, they are made by Hoffman—the world's leading specialist in silicon semiconductor technology.

Write for TIB 125-360-HT

10 TYPES AVAILABLE IMMEDIATELY FROM DISTRIBUTORS OR FACTORY IN QUANTITY

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OUR NEW HOME, DOUBLING OUR FORMER CAPACITY

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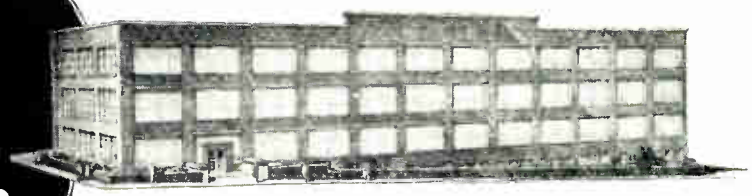

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Our instruments, 40 to 30,000 cycles, are used extensively by industry and on government projects where enduring accuracy and maximum durability are required. Your inquiries on related products are invited.

PRECISION FORK OSCILLATOR UNITS

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, Tube heater voltage and B voltage

Output, approx. 5V into 200,000 ohms

TYPE 2007-6

TRANSISTORIZED, Silicon Type
Size 1½" dia. x 3½" H. Wght. 7 ozs.

Frequencies: 360 to 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 + 85°C

Input: 10 to 30 Volts, D. C., at 6 ma.

Output: Multitap, 75 to 100,000 ohms

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.

ACCESSORY UNITS FOR 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 30 KC.

M—Power Amplifier, 2W output.

P—Power supply.

PRECISION FREQUENCY STANDARDS

TYPE 2005A

Size 8" x 8" x 7¼" High
Weight, 14 lbs.

Frequencies:
50 to 400 cycles (Specify)

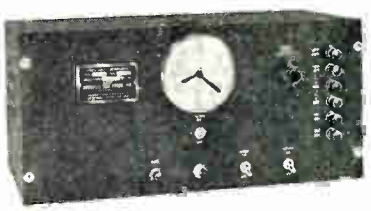
Accuracy:
±.001% from 20° to 30°C

Output, 10 Watts at 115V

Input, 115V. (50 to 400 cy.)

TYPE 2121A

Size
8¾" x 19" panel
Weight, 25 lbs.



Output: 115V
60 cycles, 10 Watt

Accuracy:
±.001% 20° to 30°C

Input,
115V (50 to 400 cy.)

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 cy.

Accuracy:
(±.002% at 15° to 35°C)

Output: 115V, 75W.

Input: 115V, 50 to 75 cy.

WHEN REQUESTING INFORMATION, PLEASE SPECIFY TYPE NUMBER

ATP

American Time Products Inc.
61-20 Woodside Avenue
Woodside 77, N. Y.

To Serve West Coast Electronics...

General Chemical announces LARGE NEW PRODUCTION FACILITIES at Los Angeles, California

To meet the West Coast's increasing demands for highest quality electronic chemicals, General Chemical has established extensive new production and packaging facilities in the Los Angeles area at its El Segundo Works.

Now, in full scale operation, these facilities supplement the company's long established plant for manufacture of "C.P." acids at Bay Point, California, as well as its modern warehouses in San Francisco and Los Angeles which maintain extensive stocks of all chemicals for electronic use.

Now, for the first time, the West Coast will have a *complete major local source of supply* for the nation's highest quality line—Baker & Adamson® "Electronic-Grade" Chemicals. The new product center at Los Angeles also assures *same day delivery* or overnight shipment.

This new supply source helps assure uninterrupted production schedules . . . eases your warehousing problems . . . and gives you immediate service you can count on in emergencies.

For a listing of products, specifications and uses, write for our new booklet, "B&A Electronic Chemicals." Company letterhead please. If you would like to have a representative call, write or phone our Los Angeles or San Francisco office.

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SAN FRANCISCO 4, CAL., 235 Montgomery St., YUkon 2-6840

Circle 34 on Inquiry Card

Books

(*Continued from page* 46)

structure, and explains decoding and arrangement of the initial information (logical scheme and initial data) in the store of BESM. Part 2 presents programming algorithms for the construction of all types of operators from machine orders, and includes consideration of optimization and the processing of information of parameters for the programming of loops.

Finally, Part 3 gives the complete structure of the whole programming program.

Selected Semiconductor Circuits Handbook

Edited by Seymour Schwartz. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. Price $12.00.

This handbook provides the electronic engineer with a reference of over 150 useable, well-designed, reliable semiconductor circuits representing the most recent advanced engineering techniques as well as design theory information. The latest type IRE standards are generally used to provide uniformity throughout the book.

Design philosophy sections comprise the first half of every chapter, preceding each group of selected circuits.

Besides being a practical handbook, it also functions as a text book containing design information for all classes of semiconductor circuits. All component values are given for the selected circuits.

Electron Tube Life Factors

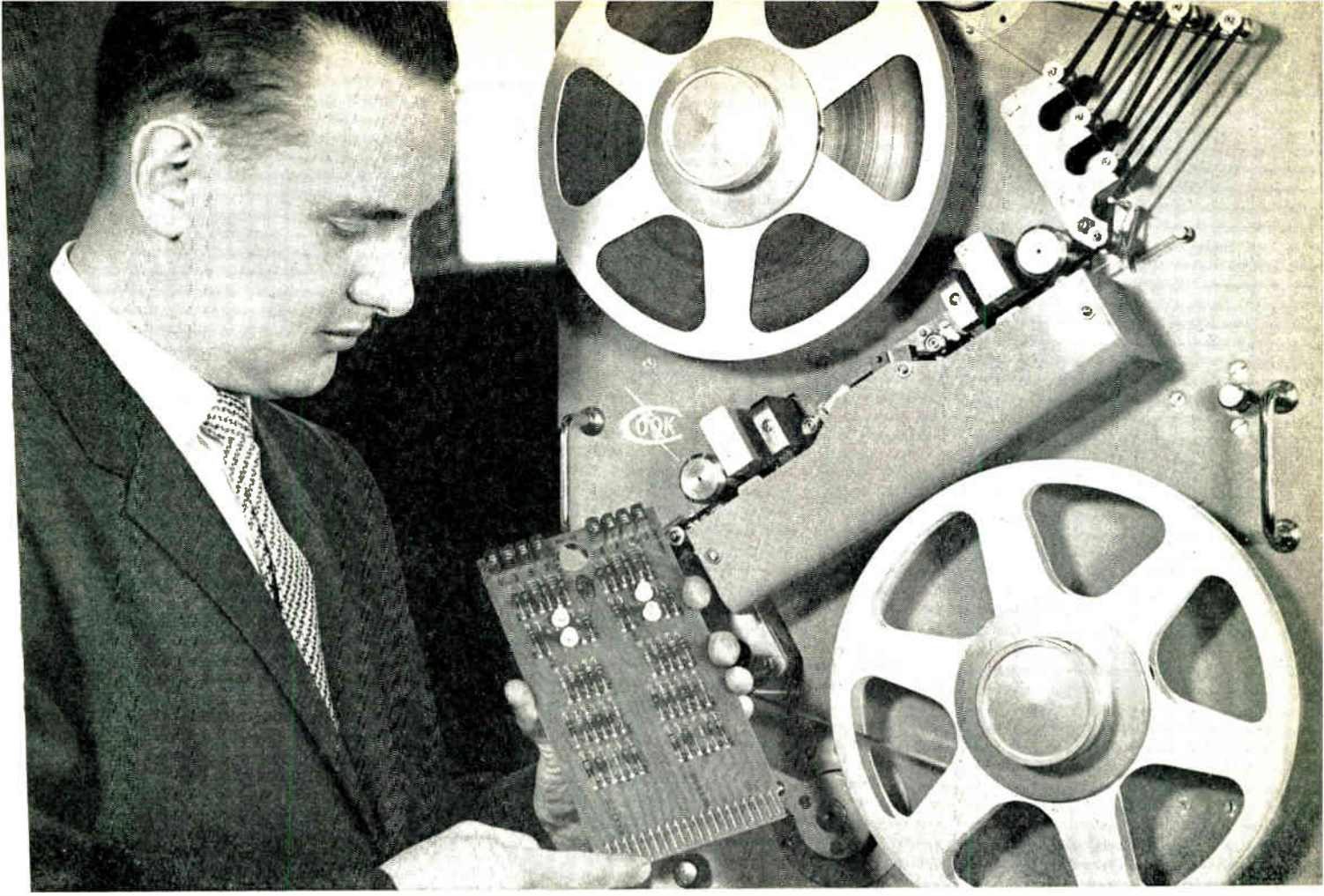
Edited by Craig Walsh and T. C. Tsao. Published 1960 by Engineeering Publishers, Elizabeth, N. J. 173 pages. Price $9.50.

This book contains a great deal of information in highly condensed form regarding the changes in the properties of electron tubes for periods of time up to 5000 hrs. of life under various environmental conditions. A series of charts and tables are given containing information digested from the data of more than 6 million electrical measurements. There is a wealth of engineering and statistical information which is convenient to use for specific types of tube applications.

Direct Conversion of Heat to Electricity

Edited by Joseph Kaye and John A. Welsh. Published 1960 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. Price $8.75.

This volume is an edited collection of papers which have been prepared by principal persons in the new technology of direct conversions. It includes fundamental discussions in thermoelectric energy conversion (the



Tung-Sol transistors handle critical switching in COOK ELECTRIC high speed tape transport

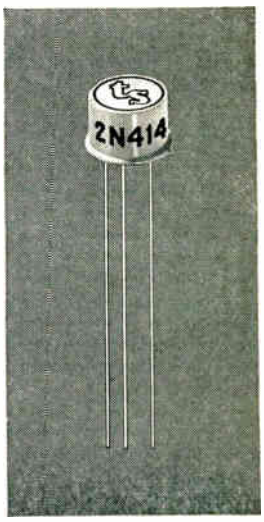
Cook Electric's Model 59 Digital Tape Transport embodies the design know-how gathered by Cook during its 12 years of active participation in missile programs which include the Atlas, Polaris and Titan missiles. It was built to fulfill the demands of modern industry for reliable, high-speed data processing and storage equipment. This tape transport is a direct adaptation of the equipment originally developed to provide unattended, 45-day documentation of the Polaris Missile system.

Gratified with the superior performance demonstrated by Tung-Sol switching transistors in the Polaris version, Cook assigned Tung-Sol units to these critical tasks in the industrial model. Tung-Sol's 2N414 germanium high-speed switching transistors serve in the flip-flop and logic circuits. Here's how Cook engineers evaluated the Tung-Sol semiconductors: "Tung-Sol transistors meet our exacting demands for performance and reliability"

There are many reasons for the superlative performance of all Tung-Sol components. Consider just three: Tung-Sol's exclusive concentration on the technology of component manufacture . . . strict adherence to the highest manufacturing standards . . . a quality control network that's unsurpassed.

If your design requires tubes or semiconductors, or both, specify Tung-Sol. There are many Tung-Sol components for virtually every military and industrial requirement ready to perform with full-life reliability. Our applications engineers will be glad to help you select the components that'll do the best job for you. Tung-Sol Electric Inc., Newark 4, N. J. TWX:NK193.

Technical assistance is available through the following sales offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Texas; Denver, Colo.; Detroit, Mich.; Irvington, N. J.; Melrose Park, Ill.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Toronto, Ont.



TUNG-SOL®

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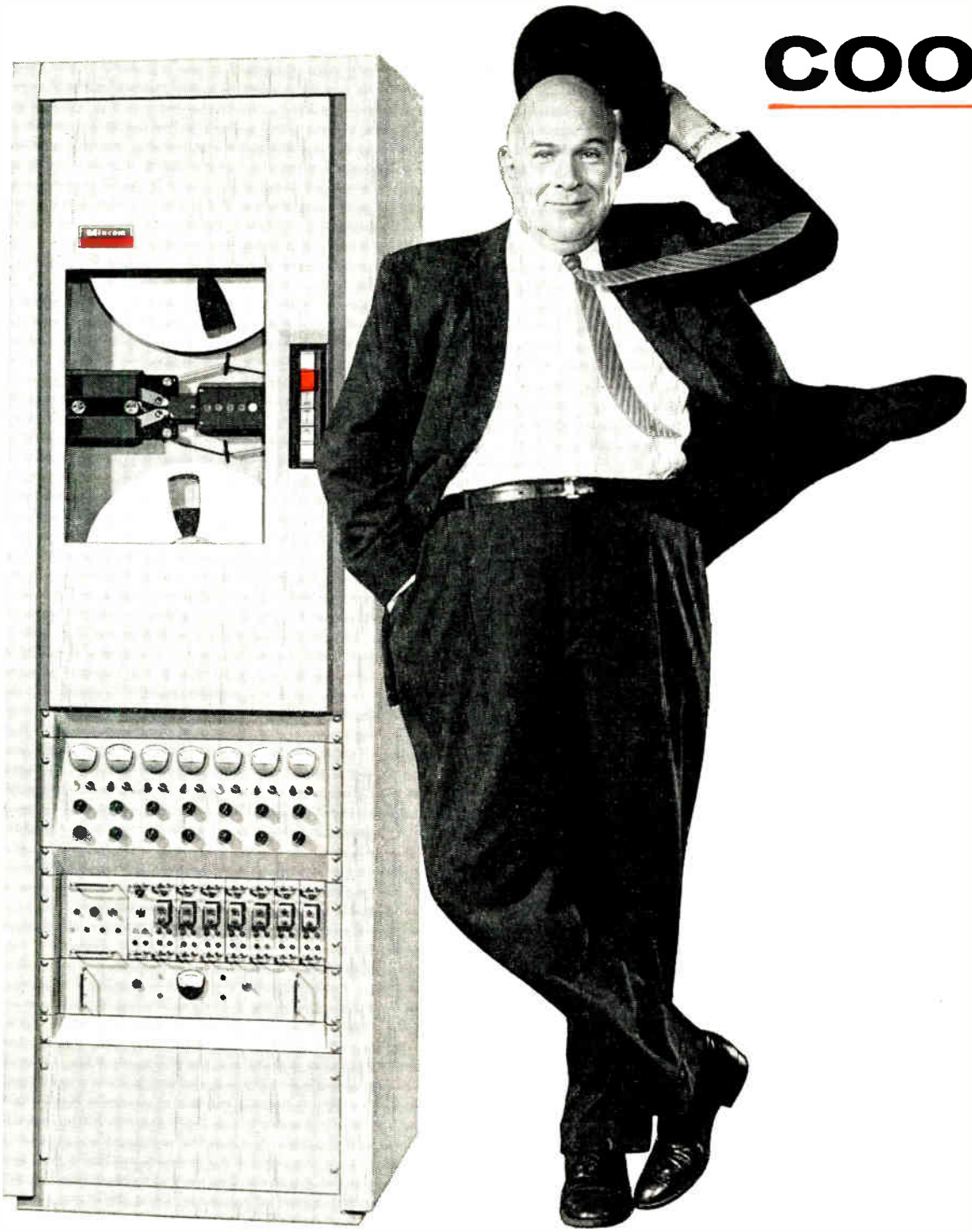
COOL



Standby time is no problem with the new, cool (all-transistorized) Mincom C-100. No blowers necessary — and the new Mincom Model C-100 Instrumentation Recorder/Reproducer is particularly new in its simplicity and reliability. Six speeds record frequencies from 50 cps to 100 kc. Only 500 watts input for 14-track system. No mechanical brakes. Only 0.1% flutter and wow. Instant push-button speed control, no belt changes. Interested? Write Mincom for specifications today.

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MINCOM DIVISION MINNESOTA MINING AND MANUFACTURING COMPANY

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Letters to the Editor

"The Challenge of Space"

Ed: In response to this article, some 21 letters were received from Senators and Congressmen commenting on its important contribution to the understanding of the missile-space procurement picture. Reprinted below are seven of those letters:

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You may be sure that I am grateful to you for enclosing the article, "The Challenge of Space," and I am pleased to have the copy for future reference.

I welcome this occasion to send you and your staff my very best wishes.

Richard Nixon
Vice-President

Office of the Vice-President,
Washington, D. C.

"My thanks to you for your letter of May 17 and your thoughtfulness in sending me a copy of the publication "Electronic Industries." The publication is jam-packed with information that a layman seldom sees. Congratulations on the article "The Challenge of Space."

With kindest regards,

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"I am pleased that you called my attention to the article, "The Challenge of Space." I have found this and all of the other material in Electronic Industries to be most interesting. The article, "The Challenge of Space," should be an eye opener to those who read it.

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Leonard G. Wolf,
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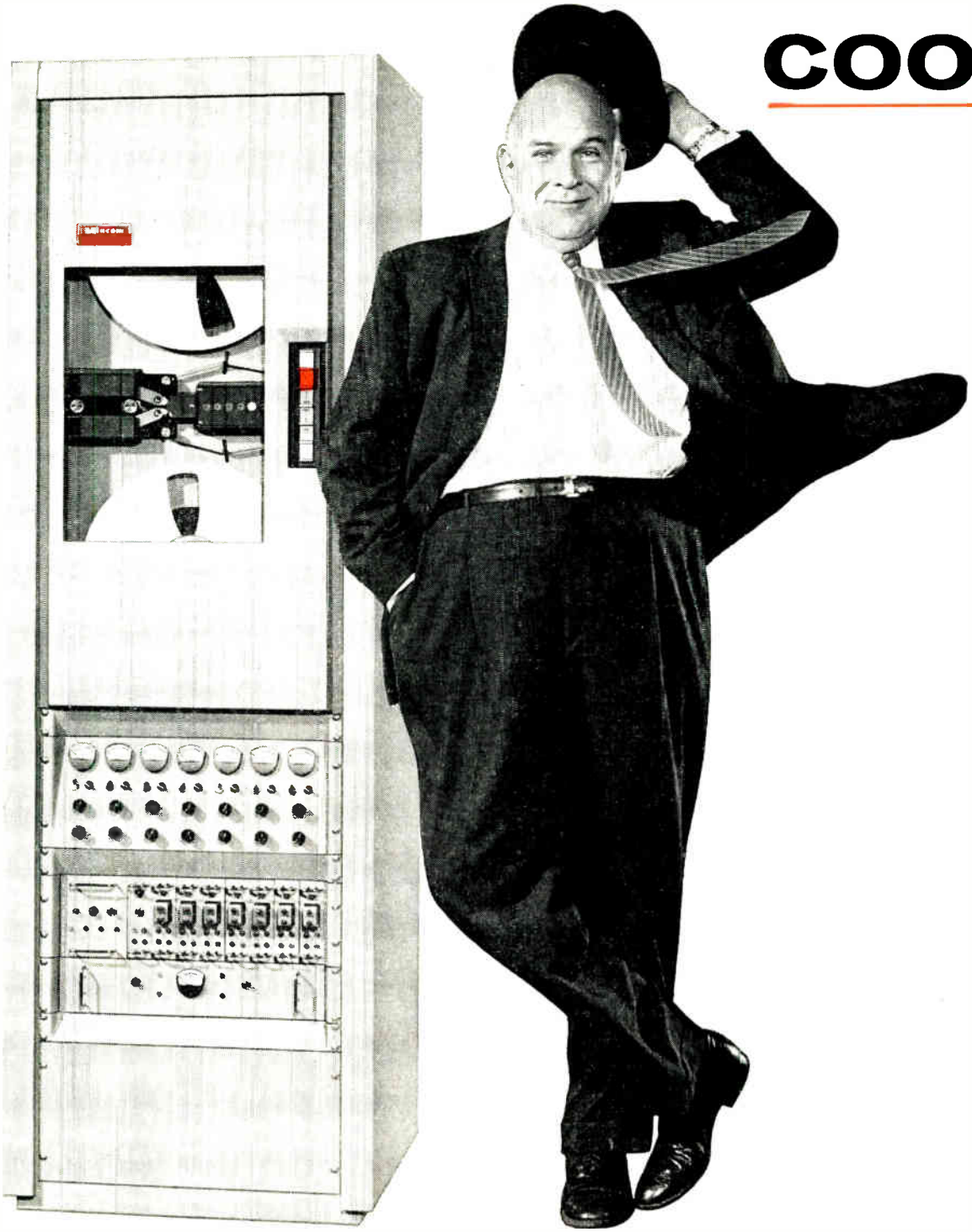
(*Continued on page* 64)

COOL



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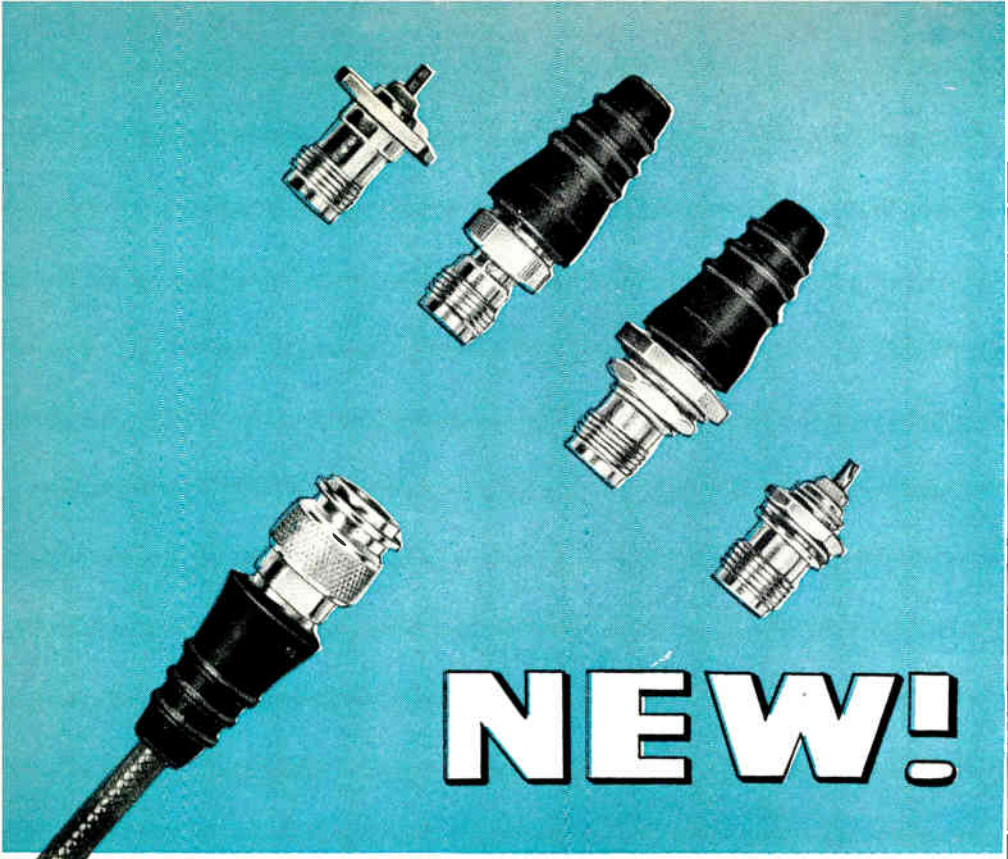

Quick-Crimp TNC* CONNECTORS

Two big advantages—vibration-resistant TNC coupling and fast, reliable *Quick-Crimp* assembly—are combined for the first time in a new RF connector family, AMPHENOL *Quick-Crimp* TNC connectors. The TNC threaded coupling design, developed primarily for missile and aircraft applications eliminates the "rock" inherent in bayonet coupled connectors, such as BNC. AMPHENOL's *Quick-Crimp* principle applied to the basic TNC design allows improved electrical and mechanical performance, and extremely fast, reliable assembly.

If you now are using either BNC or ordinary TNC designs, AMPHENOL Quick-Crimp *TNC's are highly recommended as replacement. Send now for cataloging!*

*U.S. PATS. PEND.

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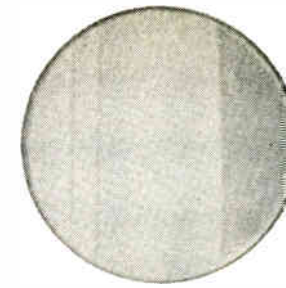
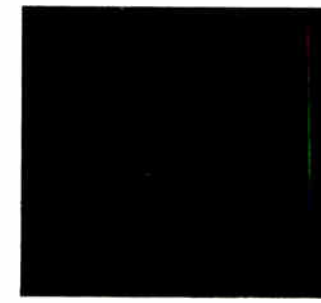
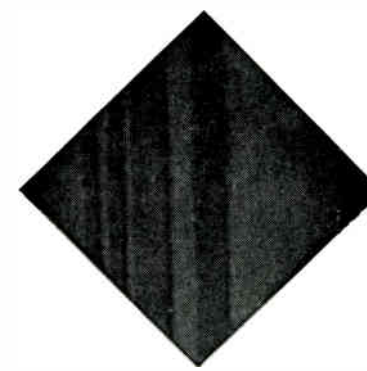
AMPHENOL CONNECTOR DIVISION
1830 SOUTH 54TH AVENUE, CHICAGO, ILLINOIS
Amphenol-Borg Electronics Corporation



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.

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LABORATORIES, INC.

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Centralab

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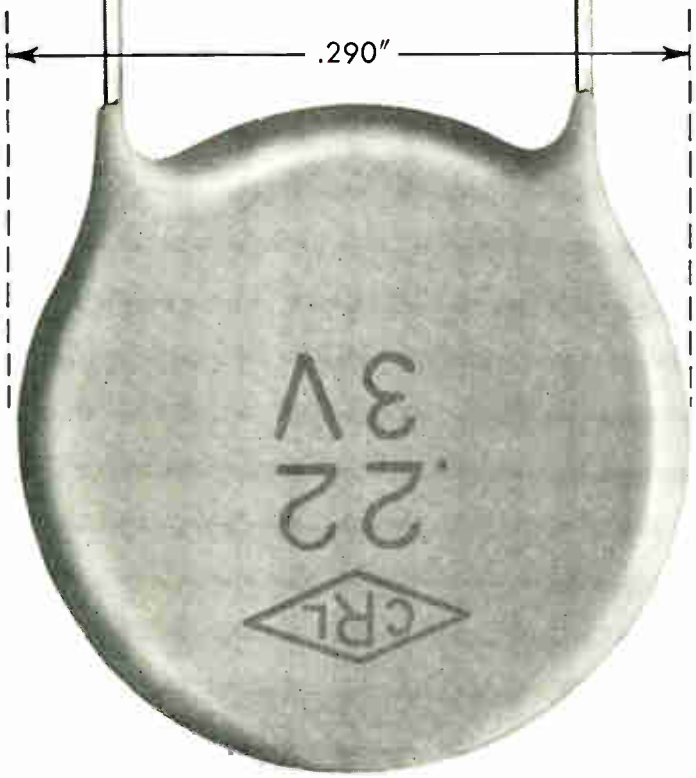
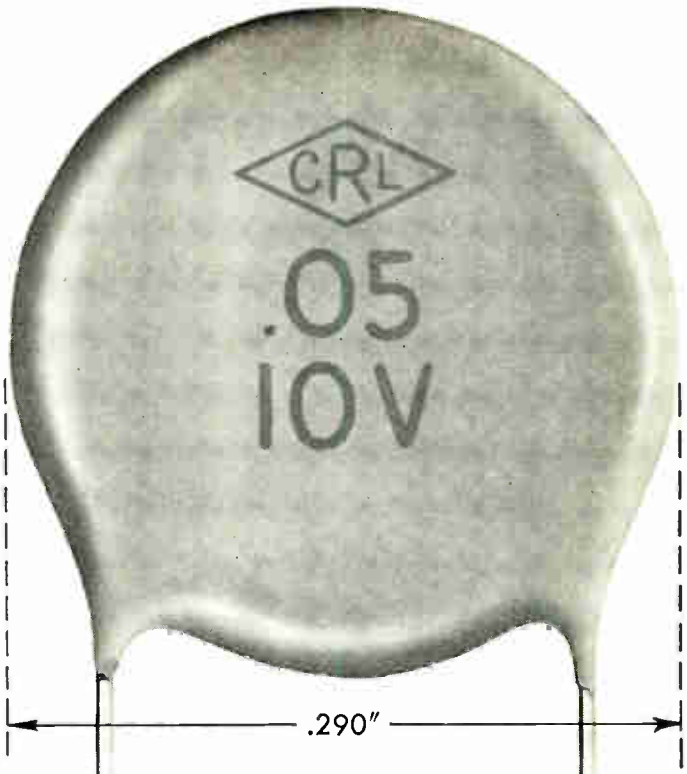
COST UP TO 40% LESS THAN PAPERS OR ELECTROLYTICS





These are Ultra-Kaps*—ultra-miniature ceramic capacitors for any low voltage use requiring extremely high capacities, low power factor and small size.

Ultra-Kaps have excellent stability from −55°C to +85°C . . . and there has *never* been a case of electrical failure among the millions of them now in the field.

SPECIFICATIONS

10 VDCW Ultra-Kaps

Capacitance Range	.05 to .47 mfd.
Sizes	.290″ to .840″ diam.
Thickness	.156″
Power Factor at 1 KC	10%

3 VDCW Ultra-Kaps

Capacitance Range	.02 to 2.2 mfd.
Sizes	.125″ to .840″ diam.
Thickness	.156″
Power Factor at 1 KC	3%

For complete technical data and price, write us or see your CENTRALAB Sales representative. Ultra-Kaps* are also available in industrial quantities for immediate delivery at factory prices through your local CENTRALAB distributor.

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The Electronics Div. of Globe-Union Inc.
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In Canada: P. O. Box 400, Ajax, Ontario

*Trademark

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Letters to the Editor

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Vice-President

Office of the Vice-President,
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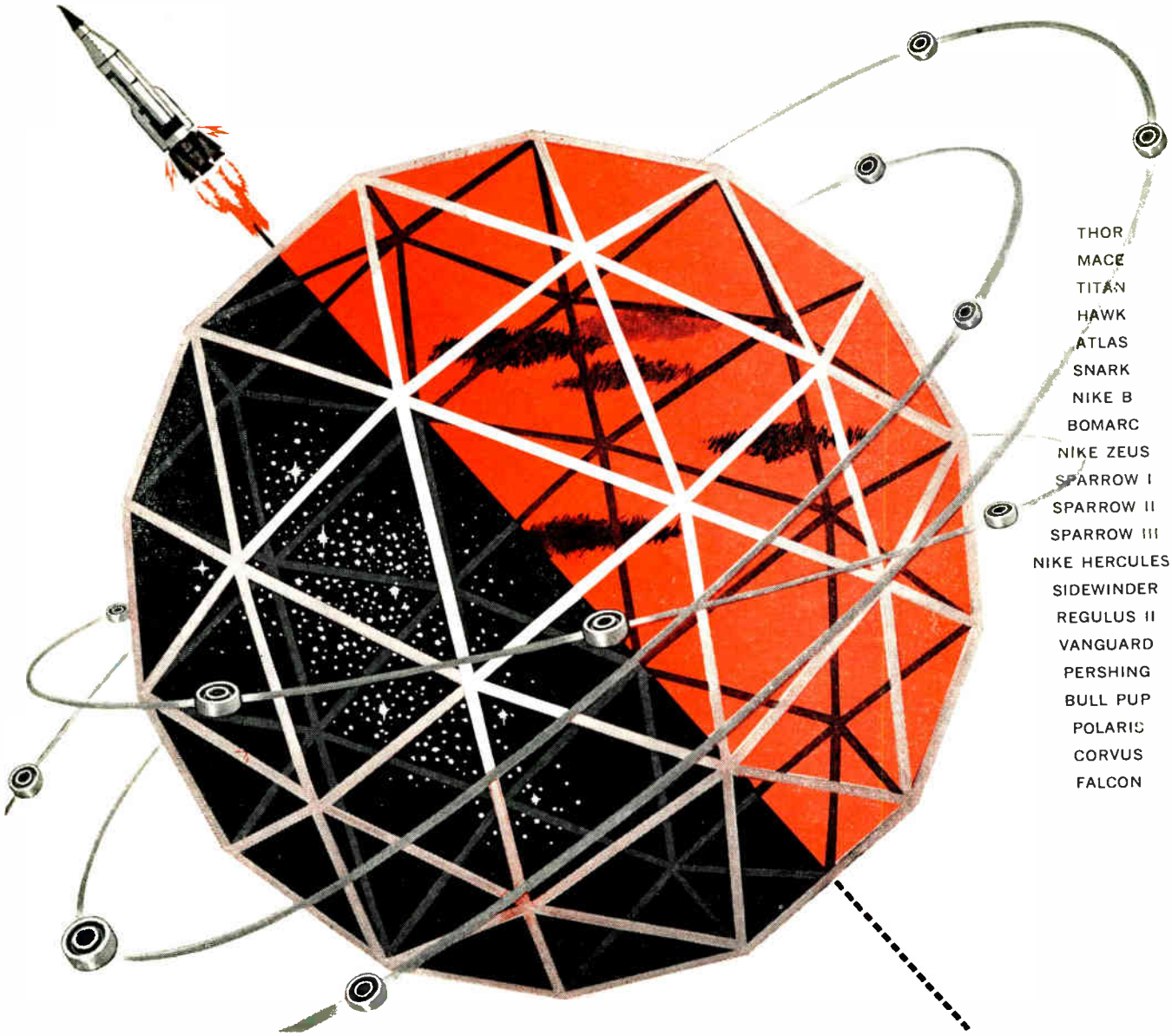
(Continued on page 64)



New ND Processes Improve Instrument Sensitivity!

In delicately-precise instrumentation, parts must react to relatively small rotive forces. Here . . . bearing torque is the highly critical factor. Separator selection, bearing finish and clinically clean assembly areas are extremely important.

It's here that New Departure is setting new industry standards! Special dies and in-process gauging of separators assure ball retention with improved torque and vibration characteristics. In addition, new N.D. honing processes and Talyrond gauging deliver uniform accuracy to millionths of an inch. Moreover, having originated the first bearing industry "white room", followed by continuous experience, New Departure's present day, modern assembly areas approach fantastic levels of cleanliness.

An everyday example of N.D.'s contribution to improved instrument sensitivity can be found in the Smithsonian Institution-selected Micro Clocks. These vitally important instruments are accurately tracking both U.S. and foreign satellite movements in time determinations of 1 milli-second . . . and better!

For new *performance* and *reliability* in your precision instruments, ask your N.D. Miniature/Instrument Bearing *Specialist* to sit in on early design level discussions. For further information call or write Department L.S., New Departure Division, General Motors Corp., Bristol, Conn.

NEW DEPARTURE

MINIATURE & INSTRUMENT BALL BEARINGS

proved reliability you can build around

Circle 44 on Inquiry Card

Letters to the Editor

(*Continued from page* 62)

dustries," recently.

I found this publication to be interesting, informative and valuable in providing me with a better understanding of our space-age endeavors.

James C. Oliver,
Member of Congress (Maine)

"The most explicit and factual article entitled "The Challenge of Space" is most timely and surely of interest to every member of Congress. You are to be complimented for making this information available to us.

Odin Langen,
Member of Congress (Minn.)

"I was very pleased to have the opportunity of reading "The Challenge of Space." It emphasizes the complexity of our weapons systems and the fact that costs will inevitably rise.

Thank you for your consideration in sending a copy of the article to me.

John E. Moss,
Member of Congress (Calif.)

Editor, ELECTRONIC INDUSTRIES:

Your article in the April issue entitled "The Challenge of Space" is very interesting and I'm sure would be of interest to others in our organization. May I please have ten reprints.

L. R. Zimov,
Vice-president
Ordnance Operations

Crosley Division,
Avco Corporation,
Cincinnati, O.

Editor, ELECTRONIC INDUSTRIES:

I would like to receive fifteen copies (if possible) of your article entitled "The Challenge of Space."

I am enrolled in a Purchasing class at the Univ. of California at Los Angeles. The article is so very well written that it would be a real benefit to all members of my class.

R. L. Scott,
Standards Engineer

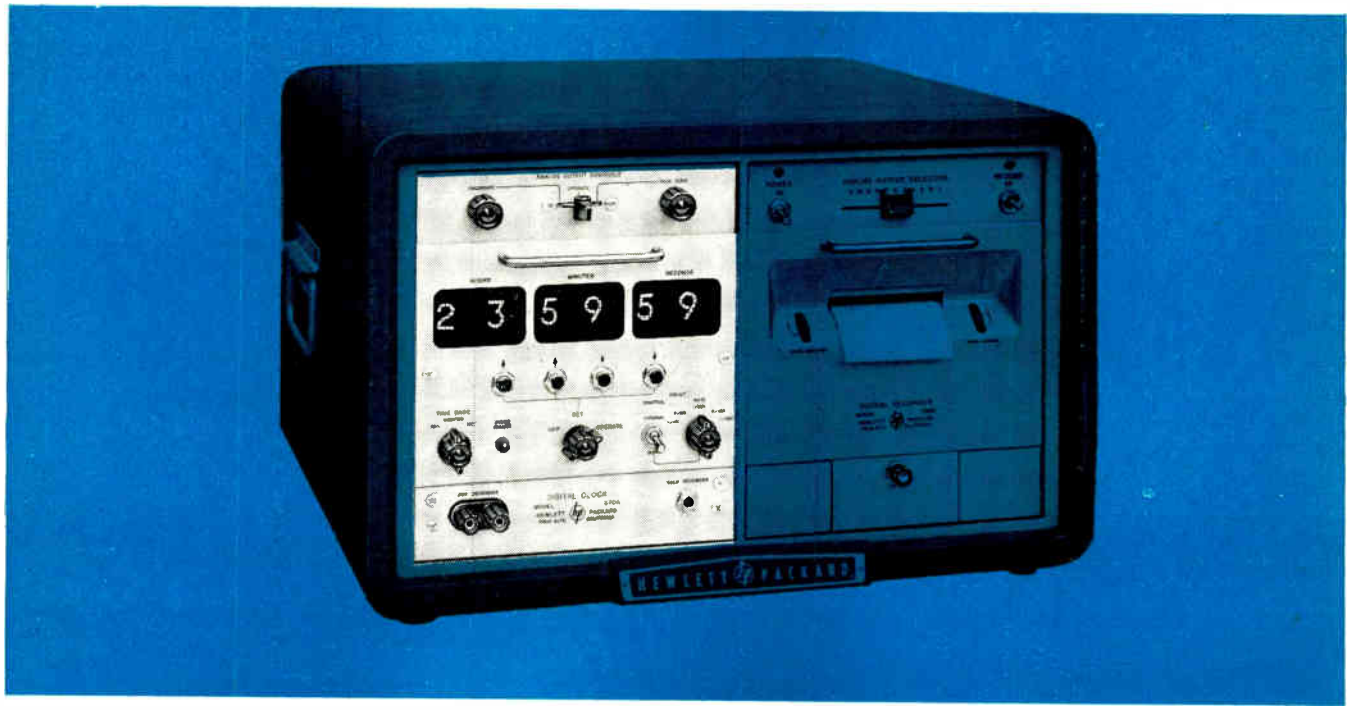
Hughes Aircraft Co.,
Fullerton, Calif.

Editor, ELECTRONIC INDUSTRIES:

The article, "The Challenge of Space," in your April issue was very interesting and I would appreciate

(*Continued on page* 66)

NEW CLOCKS FOR hp DIGITAL RECORDERS



add time-of-day to recorded data
control taking of readings
fit in Digital Recorder cabinet
available for field installation

New hp 570A and 571B Digital Clocks mount in the left-hand side of hp 560A and 561B Digital Recorders, respectively. The clocks may be installed in the field, and fit either in cabinet arrangement, as shown, or into a combined Recorder-Clock rack mount arrangement only 10½" high.

Time appears as a 23 hour, 59 minute, 59 second presentation (12-hour clocks are available on special order). Display is by long-life, in-line indicator tubes. All time digits are available for printing.

Two operating modes provide utmost usefulness. In the first mode, hp or Dymec Digital Counters, Digital Voltmeters or other external equipment control print rate; time being printed simultaneously with other data. In the second mode, for tests where less frequent readings are desired, the Digital Clocks control the timing of readings. A front panel control selects reading rates of 1 per second, 6 per minute, 1 per minute, 6 per hour or 1 per hour.

SPECIFICATIONS

Indication: Six in-line long-life digital display tubes. Indication to 23 hrs., 59 min., 59 sec.

Time Base: Ac line, 1 pps from counter, or external 1 pps.

Accuracy: Time base accuracy + 0, — 1 second.

Print Control: Front panel control selects CLOCK or EXTERNAL control mode. PRINT RATE of 1 sec., 6/min., 1/min., 6/hr., 1/hr. also chosen on front panel control.

Output: Six time digits for time recording. Holdoff signals for hp, Dymec counters.

Power Interruption Alarm: Front panel warning light.

Analog Output: 570A retains analog output of 560A.

Prices: hp 570A (fits hp 560A/AR) $1,050.00; hp 571B (fits hp 561B/BR) $950.00.

Data subject to change without notice.
Prices f.o.b. factory.

HEWLETT-PACKARD COMPANY
1029B Page Mill Road, Palo Alto, California, U.S.A.
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Rue du Vieux Billard No. 1, Geneva, Switzerland
Cable "HEWPACKSA" Tel. No. (022) 26. 43. 36

Call your hp representative for demonstration

Letters to the Editor

receiving six (6) reprints if this is possible.

It was one of the most interesting write-ups covering our allied businesses that I have ever seen.

B. J. Pratt
Industrial Engineering

Sylvania Electronic Systems,
A Division of Sylvania
Electric Products, Inc.,
175 Great Arrow Avenue,
Buffalo 7, N. Y.

"Airborne TACAN"

Editor, ELECTRONIC INDUSTRIES:

Please be advised that the statement pertaining to the TACAN system appearing under "Electronic Shorts," page 8, in the May 1960 issue of Electronic Industries, is erroneous.

You state that the system "allows two aircraft . . . . to take continual bearings on each other," whereas, the system actually provides continual range information.

Harry Vantine, Jr.,
Sup't Radio Division
Aeronautical Electronic & Electrical
Laboratory,
U. S. Naval Air Development Center,
Johnsville, Penna.

"The Case for DC Restoration"

After reading the extremely interesting and well-written article, "The Case For DC Restoration," by Robert J. Nissen, I sent a request to a leading TV manufacturer for assistance in incorporating a D.C. restorer in my set.

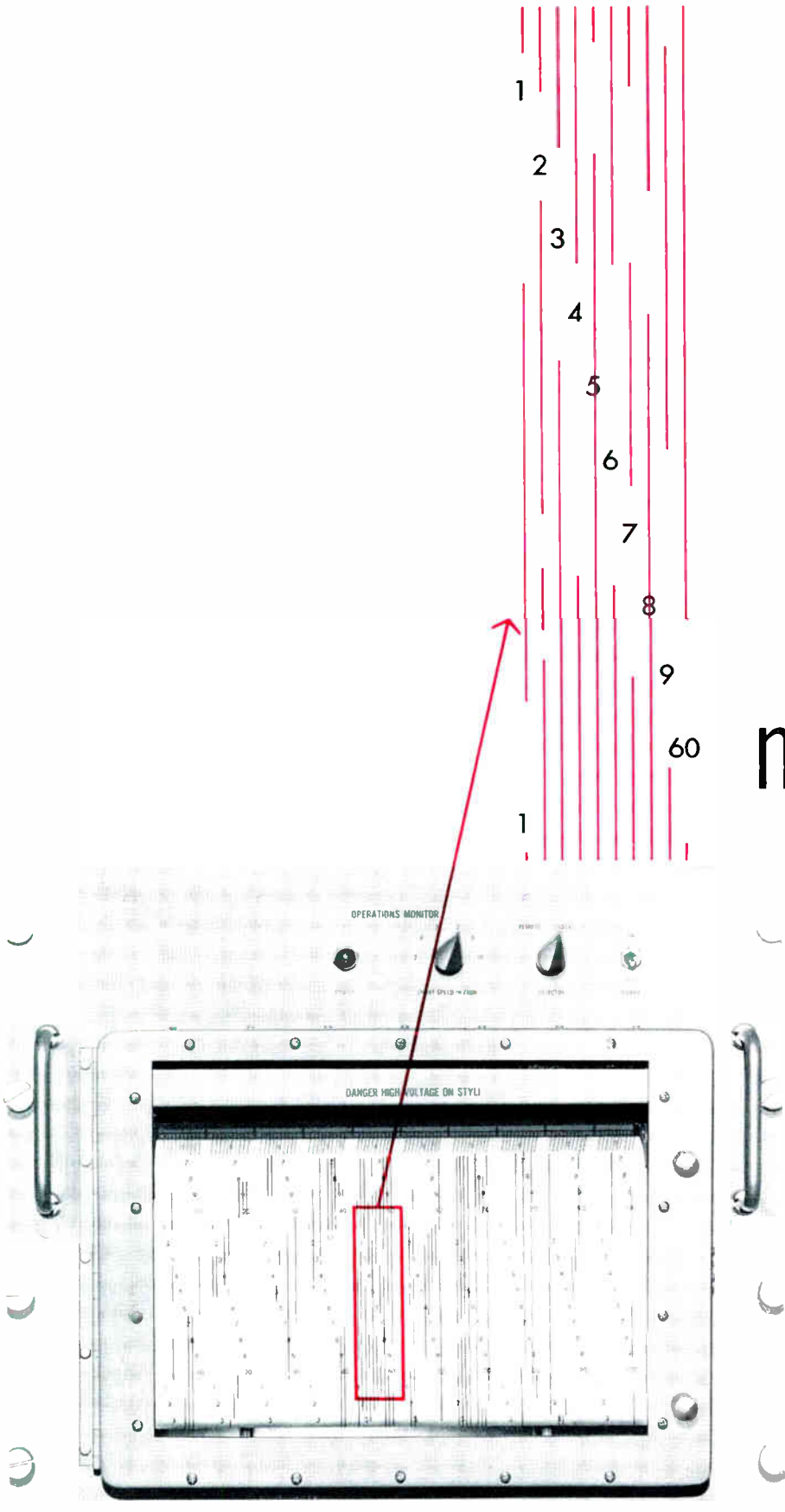
In reply I was told that . . . "we do not stock the item but you should be able to procure an inverter through a local distributor."

The equating of a D.C. restorer with an inverter by this TV manufacturer has clinched the case against the restoration of D.C. restoration. I'm afraid, Mr. Nissen, that your statement "In the last few years it has all but been forgotten by the manufacturer" is all too true and probably beyond recall.

R.I.P.?

Harry Barkan,
Production Manager,
Plant 5

Loral Electronics Corp.,
825 Bronx River Ave.,
New York 72, N. Y.



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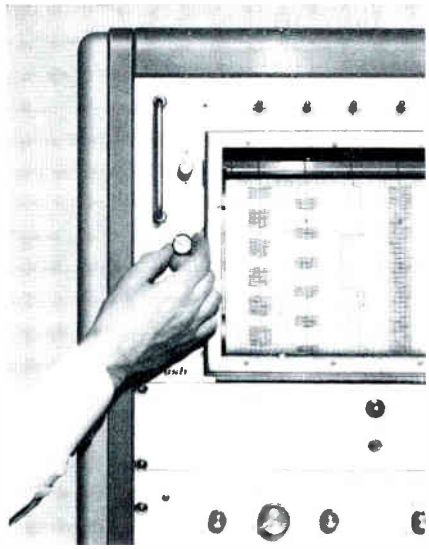

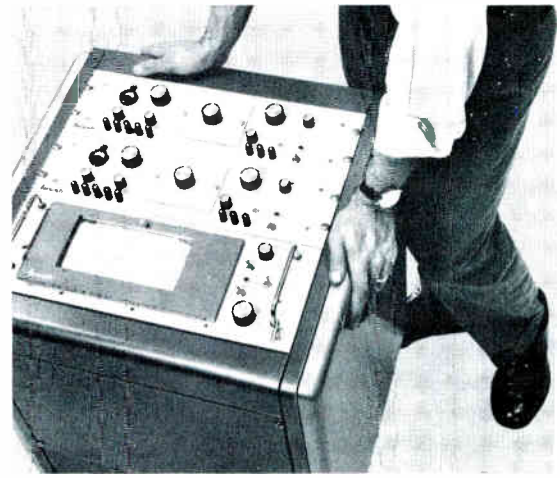

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Avoid a "second best" choice. Get exactly what you need. Only Brush permits selection of . . . **Writing Method** . . . ink, electric or thermal . . . **Trace Presentation** . . . curvilinear or rectilinear . . . **Configuration** . . . vertical or horizontal, rack mounted or portable models. Also . . . chart speeds from 50″/sec to 10″/day . . . functionally designed control panels . . . readily accessible components for fast inspection, simple adjustment . . . complete, easy to understand operating manuals. Get the industry's most advanced design concepts. You never need compromise when you specify Brush. Complete information at your request.

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Next month

Ninth Consecutive

- **ELECTRONIC INDUSTRIES' ANNUAL WESTERN ISSUE**

featuring

WESCON—1960 Western Electronic Show & Convention

Published for your year-round reading and reference use, this issue contains:

- **Annual West Coast Directory of Electronic Manufacturers**

  Names, addresses, telephone numbers and major products of more than 1200 component and equipment producers

- **Timely Technical Western Papers**

  Reporting latest outstanding developments in such fields as semiconductors, microwaves, reliability, electronic circuitry, etc.

- **What's New in the Electronic West**

  Summaries of new western electronic products, technical literature, plant news and the latest activities of electronic personalities

- **WESCON 1960**

  Complete up-to-the-minute review of the program. Technical papers, meeting announcements, show highlights, etc.

Another Electronic Industries staff study:

- **ELECTRONICS IN AGRICULTURE**

  Another in the series of studies prepared to aid manufacturers in finding new markets for their electronic products. Starting at the farm, the complete story of how electronic components and equipment contribute and are expected to contribute to the production, processing and marketing of food is told. From the thermistor used in chick brooder control and ultrasonics for determining meat quality to automatic photospectrometric measurement of fruit and vegetable maturity the field is covered. Equipment control in production and computer use in marketing are also treated.

Watch for these coming issues

*NOVEMBER	*JANUARY	*MARCH
Microwave Issue	Industry Review	Annual IRE Issue

Matching networks are used between source and load to obtain maximum energy transfer and to eliminate reflection losses. They also provide selectivity. Values obtained from the Smith Chart are inaccurate when the impedances are located close to the rim of the chart. A technique is described to calculate the bandwith. The correction factor for loss of the inductor is also presented.

Calculating Bandwidths for . . .

Matching Networks

By H. B. YIN

Engineering Dept.
Radio Corporation of America
Cherry Hill, New Jersey

IT is often required to use a matching network between the source and load such as antenna and r-f amplifier, interstage between amplifiers, etc., for obtaining maximum energy transfer and eliminating reflection losses. A matching network also provides the required selectivity. Impedance matching between two resistances (source and load) can be accomplished using reactive elements which can be readily evaluated with formulae or by using the Smith Chart.[1, 2] However, the phase shift introduced by the matching network is involved in the calculation of the elements from formulae. Also, the value obtained from the Smith Chart is not accurate when the impedances are located close to the rim of the Chart. Therefore, a new set of formulae for 2 (L)-, 3(T or π)-, and 4-element matching networks has been developed.

Development of New Formulae

Matching networks for two terminating resistances are usually composed of two, three, four, or more reactive elements. For the two-element network such as shown in Fig. 1, the values of the inductance (L) and capacitor (C) can be derived as follows:

At terminals A-A' of Fig. 1(a) the impedances looking into the left and right are Z and Z' respectively. When the network is matched, Z and Z' are complex conjugate to each other or equal to the same resistive value at the matched frequency ω_o. Then

$$Z = Z'^* = \frac{R_1}{1 + \omega_0^2 C_1^2 R_1^2} - j\frac{\omega_0 C_1 R_1^2}{1 + \omega_0^2 C_1^2 R_1^2} = R_2 - j\omega L \quad (1)$$

where Z'^* is the complex conjugate of Z'. By equating reals and imaginaries, we obtain

$$\omega_0 C = \frac{1}{R_1}\sqrt{\frac{R_1}{R_2} - 1}$$
$$\omega_0 L = R_2\sqrt{\frac{R_1}{R_2} - 1}. \quad (2)$$

The values of L' and C' of Fig. 1(b) can be obtained in a similar manner, or

$$\omega_0 C' = \frac{1}{R_2\sqrt{\frac{R_1}{R_2} - 1}}$$
$$\omega_0 L' = \frac{R_1}{\sqrt{\frac{R_1}{R_2} - 1}} \quad (3)$$

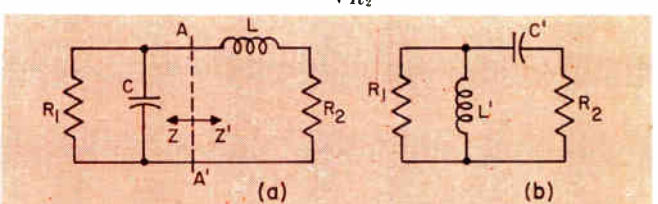


Fig. 1: Two-element matching networks.

Fig. 2: Three-element π matching network.

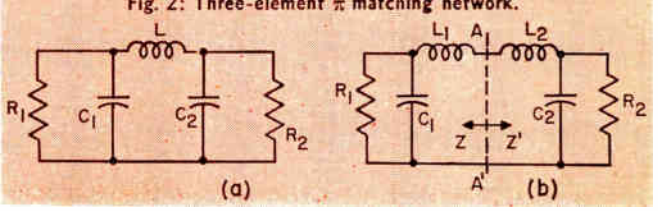
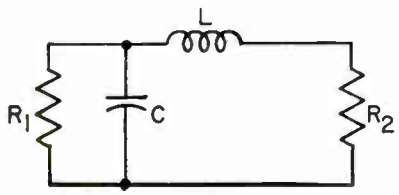


Table 1

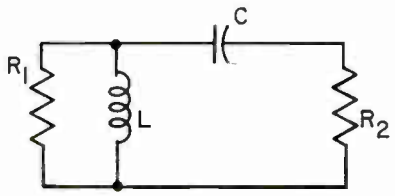
Practical Matching Networks

(a): Two Elements (L-section) ($R_1 > R_2$)



$$\omega_0 L = R_2 \sqrt{\frac{R_1}{R_2} - 1}$$

$$\omega_0 C = \frac{1}{R_1} \sqrt{\frac{R_1}{R_2} - 1}$$

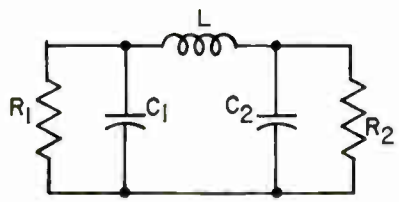


$$\omega_0 L = \frac{R_1}{\sqrt{\frac{R_1}{R_2} - 1}}$$

$$\omega_0 C = \frac{1}{R_2 \sqrt{\frac{R_1}{R_2} - 1}}$$

(b) Three Elements (T and π section)

π-section ($R_1 > R_2 > R_0$)

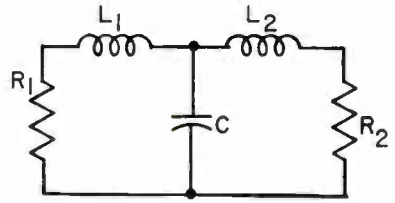


$$\omega_0 C_1 = \frac{1}{R_1} \sqrt{\frac{R_1}{R_0} - 1}$$

$$\omega_0 C_2 = \frac{1}{R_2} \sqrt{\frac{R_2}{R_0} - 1}$$

$$\omega_0 L = R_0 \left(\sqrt{\frac{R_1}{R_0} - 1} + \sqrt{\frac{R_2}{R_0} - 1} \right)$$

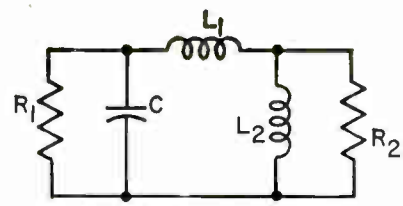
T-section ($R_0 > R_1 > R_2$)



$$\omega_0 L_1 = R_1 \sqrt{\frac{R_0}{R_1} - 1}$$

$$\omega_0 L_2 = R_2 \sqrt{\frac{R_0}{R_2} - 1}$$

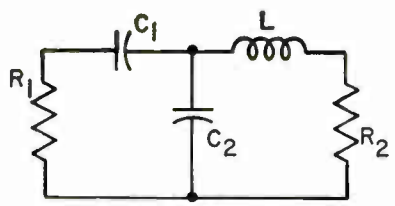
$$\omega_0 C = \frac{1}{R_0} \left(\sqrt{\frac{R_0}{R_1} - 1} + \sqrt{\frac{R_0}{R_2} - 1} \right)$$



$$\omega_0 C = \frac{1}{R_1} \sqrt{\frac{R_1}{R_0} - 1}$$

$$\omega_0 L_1 = R_0 \left(\sqrt{\frac{R_1}{R_0} - 1} - \sqrt{\frac{R_2}{R_0} - 1} \right)$$

$$\omega_0 L_2 = \frac{R_2}{\sqrt{\frac{R_2}{R_0} - 1}}$$

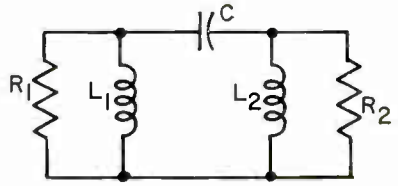


$$\omega_0 C_1 = \frac{1}{R_1 \sqrt{\frac{R_0}{R_1} - 1}}$$

$$\omega_0 C_2 = \frac{1}{R_0} \left(\sqrt{\frac{R_0}{R_2} - 1} - \sqrt{\frac{R_0}{R_1} - 1} \right)$$

$$\omega_0 L = R_2 \sqrt{\frac{R_0}{R_2} - 1}$$

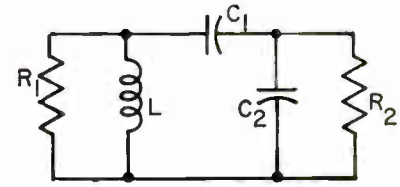
π-section ($R_1 > R_2 > R_0$)



$$\omega_0 L_1 = \frac{R_1}{\sqrt{\frac{R_1}{R_0} - 1}}$$

$$\omega_0 C = \frac{1}{R_0 \left(\sqrt{\frac{R_1}{R_0} - 1} + \sqrt{\frac{R_2}{R_0} - 1} \right)}$$

$$\omega_0 L_2 = \frac{R_2}{\sqrt{\frac{R_2}{R_0} - 1}}$$

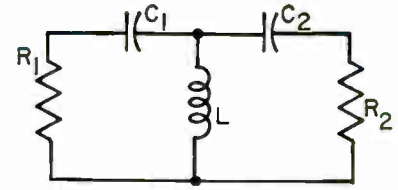


$$\omega_0 L = \frac{R_1}{\sqrt{\frac{R_1}{R_0} - 1}}$$

$$\omega_0 C_1 = \frac{1}{R_0 \left(\sqrt{\frac{R_1}{R_0} - 1} - \sqrt{\frac{R_2}{R_0} - 1} \right)}$$

$$\omega C_2 = \frac{1}{R_2} \sqrt{\frac{R_2}{R_0} - 1}$$

T-section ($R_0 > R_1 > R_2$)



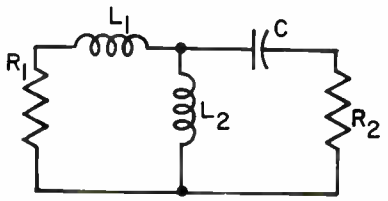
$$\omega_0 C_1 = \frac{1}{R_1 \sqrt{\frac{R_0}{R_1} - 1}}$$

$$\omega_0 C_2 = \frac{1}{R_2 \sqrt{\frac{R_0}{R_1} - 1}}$$

$$\omega_0 L = \frac{R_0}{\sqrt{\frac{R_0}{R_1} - 1} + \sqrt{\frac{R_0}{R_2} - 1}}$$

Table I (Continued)
Practical Matching Networks

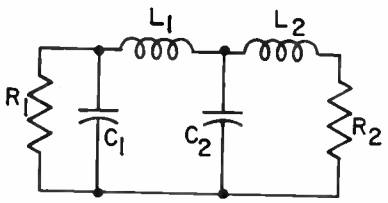
(c) Four Elements ($R_1 > R_0 > R_2$)



$$\omega_0 L_1 = R_1 \sqrt{\frac{R_0}{R_1} - 1}$$

$$\omega_0 L_2 = \frac{R_0}{\sqrt{\frac{R_0}{R_2} - 1} - \sqrt{\frac{R_0}{R_1} - 1}}$$

$$\omega_0 C = \frac{1}{R_2 \sqrt{\frac{R_0}{R_2} - 1}}$$

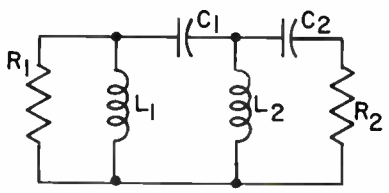


$$\omega_0 C_1 = \frac{1}{R_1} \sqrt{\frac{R_1}{R_0} - 1}$$

$$\omega_0 L_1 = R_0 \sqrt{\frac{R_1}{R_0} - 1}$$

$$\omega_0 C_2 = \frac{1}{R_0} \sqrt{\frac{R_0}{R_2} - 1}$$

$$\omega_0 L_2 = R_2 \sqrt{\frac{R_0}{R_2} - 1}$$



$$\omega_0 L_1 = \frac{R_1}{\sqrt{\frac{R_1}{R_0} - 1}}$$

$$\omega_0 C_1 = \frac{1}{R_0 \sqrt{\frac{R_1}{R_0} - 1}}$$

$$\omega_0 L_2 = \frac{R_0}{\sqrt{\frac{R_2}{R_0} - 1}}$$

$$\omega_0 C_2 = \frac{1}{R_2 \sqrt{\frac{R_0}{R_2} - 1}}$$

Matching Networks *(Continued)*

Eqs. (2) and (3) are valid when $R_1 > R_2$. It is noticed that the circuit of Fig. 1(a) can be deduced into the circuit of Fig. 1(b) because of the existing relations

$$\omega_0 C = \frac{1}{\omega_0 L'} \qquad \omega_0 C'' = \frac{1}{\omega_0 L} \tag{4}$$

Any matching network other than the two-element can be considered as a cascade of several two-element networks. For instance, Fig. 2(a) indicates a three-element or π matching network.

Somewhere along the inductance the impedances looking into the left (Z) and right (Z') of the terminals A-A' of Fig. 2(b) are the same and equal to R_0 at the matched frequency (ω_0). If so, the π-section becomes two L-sections and the elements are given either by Eq. (2) or (3). L_1 and L_2 are in series; the sum of L_1 and L_2 thus gives the value of L. By using Eq. (2) for Fig. 2(b), we obtain

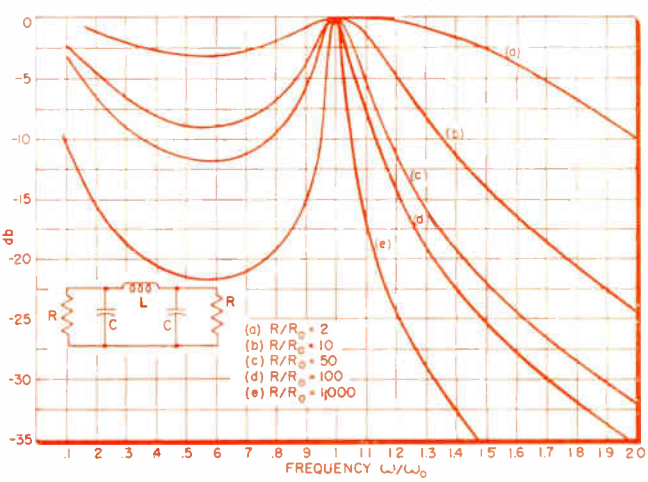
$$\omega_0 C_1 = \frac{1}{R_1} \sqrt{\frac{R_1}{R_0} - 1} \qquad \omega_0 C_2 = \frac{1}{R_2} \sqrt{\frac{R_2}{R_0} - 1} \tag{5}$$

$$\omega_0 L = \omega_0 L_1 + \omega_0 L_2 = R_0 \left(\sqrt{\frac{R_1}{R_0} - 1} + \sqrt{\frac{R_2}{R_0} - 1} \right)$$

where R_0 is any real number, provided $R_0 < R_2$ and $R_0 < R_1$ for the validity of Eq. (5). Choice of R_0 depends upon the selectivity and will be discussed in a later section.

It is noticed that the equations are simple and a high degree of accuracy can easily be secured for the matching network between antenna and r-f amplifier or the interstage between amplifiers of some receivers where the phase shift is of no importance. It is further noted that the values of any number of reactive elements of a matching network can be developed in this similar fashion. A summary of the most practical matching networks is tabulated in Table 1.

Fig. 3: Use of a matching network to provide appropriate selectivity for a three-element network with equal terminations.



Bandwidth Considerations

When the matching network is used as the r-f input or interstage circuitry, it must provide the required selectiviy as well as maximum energy transfer. It is a laborious work to evaluate the frequency response characteristics from the loop equations. However, the selectivity can be obtained from the mismatch loss consideration. Take the circuit as shown in Fig. 2(b); the network is matched only at the frequency ω_o. Therefore, the mismatch loss at the terminal A-A' due to the difference in impedances Z and Z' is given by:[3]

$$\text{Mismatch Loss in db} = 10 \log \frac{(Z + Z^*)(Z' + Z'^*)}{(Z + Z')^2} \quad (6)$$

$$\text{or} = 10 \log \frac{4RR'}{(R + R')^2 + (x + x')^2}$$

where $Z = R + jx$ and $Z' = R' + jx'$. At $\omega = \omega_o$, $Z = Z' = R = R' = R_o$. The use of a matching network to provide the appropriate selectivity is illustrated in Fig. 3 for a three-element network with equal terminations. It is obvious that the higher that ratio R/R_o, the more selective the circuit becomes. For unequal terminations, the three-element network again gives a perfect match at $\omega/\omega_o = 1$ and provides the selectivity such as indicated in Fig. 4. It is again noticed that R_o must be small as compared to the terminating resistances in order to secure a narrow passband.

When an even number of reactive elements are used such as 2-, 4-, or 6-element, usually a nearly maximally flat response about the matched frequency can be realized.[4]

In practice, the inductance does not have infinite Q, thus introducing some insertion loss. The effect of the loss of an inductor upon the response characteristics can again be derived from Eq. (6). Consider the circuit of Fig. 2(b) and redraw it as shown in Fig. 5 which includes the losses of the inductors. The Q of the coil is defined as

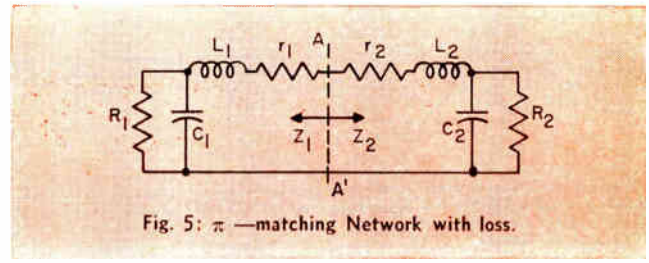


Fig. 5: π —matching Network with loss.

$$Z_1 = (R + r_1) + jx$$
$$Z_2 = (R' + r_2) + jx$$

$$Q = \frac{\omega_0 L}{r} = \frac{\omega_0 L_1 + \omega_0 L_2}{r_1 + r_2} \quad (7)$$

Under this condition, the mismatch loss becomes

$$\text{M. L.} = 10 \log \frac{4(R + r_1)(R' + r_2)}{(R + R' + r_1 + r_2)^2 + (x + x')^2} \quad (8)$$

However, this will not give the selectivity because the power delivered to R_2 (load) from R_1 (source) has been changed due to the loss of the inductor. Thus a loss factor derived in the Appendix is given as

$$\text{L. F. (loss factor)} = 10 \log \frac{(R + R')^2 + (x + x')^2}{(r_1 + r_2 + R + R')^2 + (x + x')^2} \quad (9)$$

At $\omega = \omega_0$, $R = R' = R_0$ and $x = x' = 0$. Then Eq. (9) becomes:

$$\text{L. F.} = 10 \log \frac{4R_0^2}{\left(2R_0 + \frac{\omega_0 L}{Q}\right)^2} = 10 \log \frac{1}{\left(1 + \frac{\omega_0 L}{Q} \cdot \frac{1}{2R_0}\right)^2} \quad (10)$$

$$= 10 \log \frac{1}{\left(1 + \frac{\sqrt{R_1/R_0 - 1} + \sqrt{R_2/R_0 - 1}}{2Q}\right)^2}$$

Fig. 4: For unequal terminations, the three-element network again gives a perfect match at $w/w_o = 1$.

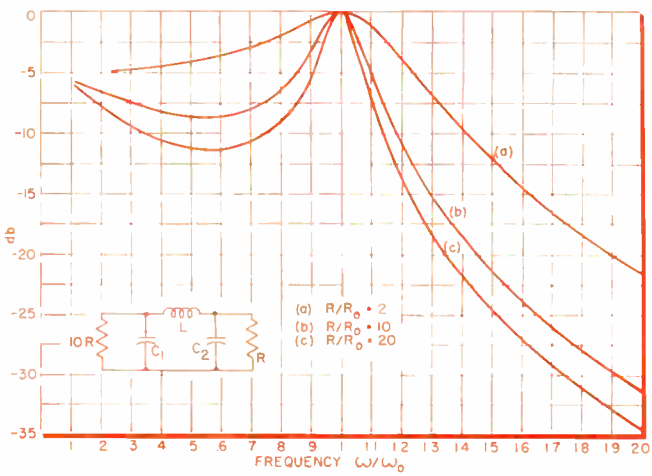
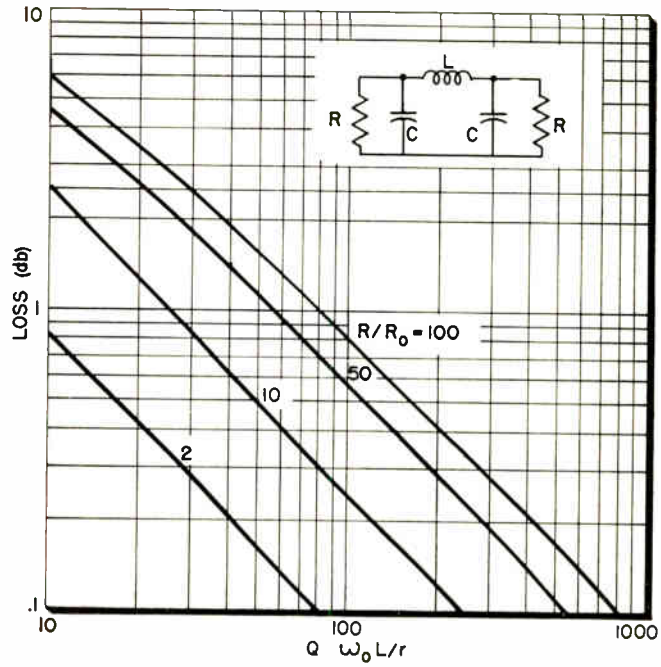


Fig. 6: Loss at matched frequency—equal terminations.



Matching Networks *(Continued)*

Plots of this insertion loss at $\omega = \omega_o$ for equal and unequal terminations are shown in Fig. 6 and 7 respectively as a function of the Q of the coil. The loss is also dependent upon the value of R_o. For equal Q, the loss increases approximately as the square root of the decrease in value of R_o.

New Formulae

A set of new formulae has been derived for evaluating matching networks. These formulae are concise and easy to use. To provide the required selectivity, it is important to select the right value of R_o for the matching network; R_o has to be small in the π-section case and large in the T-section case as compared to the terminating resistances. However, the insertion loss increases as the matching network becomes more selective. High Q elements are therefore preferred.

Appendix

Derivation of Eq. (9)—Let us redraw the circuit of Fig. 5 as shown in Fig 8 which includes a generator and consider R_1 and R_2 as source and load resistances respectively.

$$Z_1 = r_1 + Z = (r_1 + R) + jx$$
$$Z_2 = r_2 + Z' = (r_2 + R') + jx'$$

Available power from the equivalent circuit at AA' is

$$P_a = \frac{|e_s|^2}{4\,(R + r_1)} . \tag{11}$$

With no loss

$$P_a' = \frac{|e_s|^2}{4R} . \tag{12}$$

The loss factor at terminal A-A' towards left is then

$$L_L = \frac{\dfrac{|e_s|^2}{4\,(R + r_1)}}{\dfrac{e_s^2}{4R}} = \frac{R}{R + r_1} \tag{13}$$

By the same reason, the loss factor towards right at terminal A-A' is

$$L_R = \frac{R'}{R' + r_2} \tag{14}$$

The mismatch loss at terminal A-A' is

$$\text{M. L.} = \frac{4\,(r_1 + R)\,(r_2 + R')}{(r_1 + r_2 + R + R')^2 + (x + x')^2} \tag{15}$$

By multiplying Eqs. (13), (14), and (15), it gives power gain

$$G = \frac{4\,RR'}{(r_1 + r_2 + R + R')^2\,(x + x')^2} \tag{16}$$

at the lead R_2. When $r_1 = r_2 = 0$, the power gain at the load R_2 is given by Eq. (6). By comparing Eqs. (6) and (16), we obtain a loss factor

$$\text{L. F.} = \frac{(R + R')^2 + (x + x')^2}{(r_1 + r_2 + R + R')^2 + (x + x')^2}$$

or in db

$$\text{L. F. db} = 10 \log \frac{(R + R')^2 + (x + x')^2}{(r_1 + r_2 + R + R')^2 + (x + x')^2} .$$

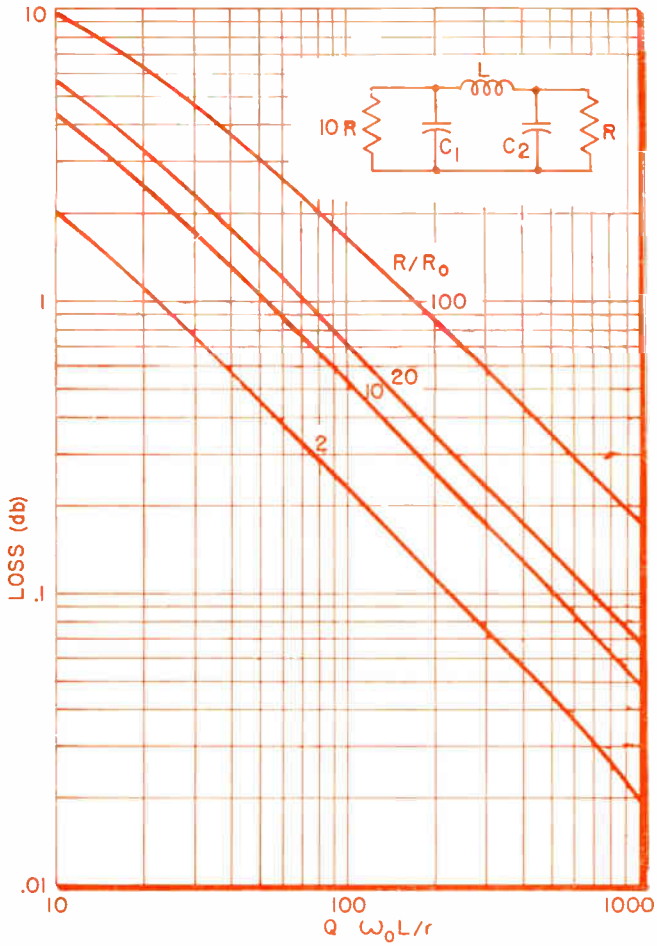


Fig. 7: Loss at matched frequency—unequal terminations.

Acknowledgment

The author wishes to thank Mr. H. M. Wasson for his many valuable suggestions.

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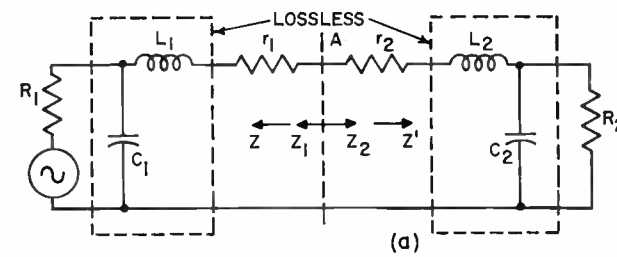

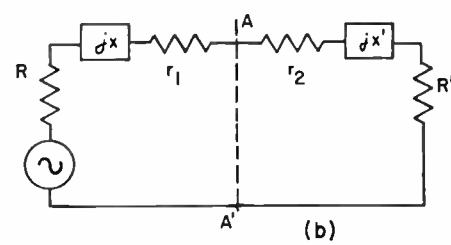

Fig. 8: π —matching network and its equivalent.

The degree of stability of systems with time delay depends on the location of the zeros of the characteristic equation on the complex plane. A numerical procedure is outlined which produces accurate location by replacing the exponential in the characteristic equation with an approximation and solving polynomials.

How to

Analyze Control Systems With Time Lag

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IN many processes a physical quantity subject to random variation is to be kept as nearly constant as possible by the actuation of some controlling mechanism. In such a system, there may be a delay between the time a black box emits a decision (output) and the time it receives information (input) upon which the decision is based. Thus the output at time t is not a function of the input at time t, but a function of the input at an earlier time $(t-\tau)$. Here τ is the time delay.

Common Procedure

From a model previously studied, [1, 2, 3] consider the equations:

$$\frac{d^2x(t)}{dt^2} = f(t),\ 0 < t \leq \tau. \tag{1}$$

$$\frac{d^2x(t)}{dt^2} + g\frac{dx(t-\tau)}{dt} + kx(t-\tau) = f(t),\ t > \tau, \tag{2}$$

where the system is quiescent for negative values of t. Here g and k are constants. To solve (1), (2), the common procedure is to take the Laplace transform, find the zeros of the characteristics equation, and then invert the transform. If $\bar{F}(p)$ is the Laplace transform of $F(t)$, then

$$\bar{F}(p) = \int_0^\infty e^{-pt}F(t)dt \tag{3}$$

and the characteristic equation takes the form

$$p^2 + e^{-p}(gp + k) = 0. \tag{4}$$

Stability

An important consideration of time delay systems is stability. A system is stable if the zeros of the charteristic equation has negative real parts, that is the zeros lie in the left half plane. If both g and k are positive, and if no time delay is present, (4) is stable. However, with the presence of a time delay, to insure stability it is not enough to require that g and k are positive (see later example). Systems of the type (4) are known as exponential polynomials. Stability criteria are known,[4] but they are qualitative in nature and not quantitative. In practical applications, the degree of stability is important and precise knowledge of the zeros is required. Further, more work is usually needed to apply the stability criteria than is necessary for the determination of the zeros.

Time Lag *(Continued)*

TABLE 1

Early Zeros of Equation (4) for Various Values of the Parameters

(k/g = 0.3)		
g = 1.0	g = 1.32	g = 1.33
−0.41275	−0.37239	−0.37160
−0.17218 ± 1.16962j	−0.00021 ± 1.35233j	+0.00465 ± 1.35678j
−2.06709 ± 7.54940j	−1.78362 ± 7.58524j	−1.77593 ± 7.58622j
−2.65550 ± 13.9279j	−2.37531 ± 13.9475j	−2.36770 ± 13.94804j

TABLE 2

Zeros of Equation (12) for Various Values of the Parameters

(k/g = 0.3)		
g = 1.0	g = 1.32	g = 1.33
n = 2		
−0.41275	−0.37244	−0.37160
−0.17498 ± 1.16950j	−0.00388 ± 1.35593j	+0.00128 ± 1.36052j
−6.23730	−6.93979	−6.96095
n = 3		
−0.41275	−0.37239	−0.37160
−0.17221 ± 1.16961j	−0.00026 ± 1.35238j	+0.00461 ± 1.35683j
−5.12141 ± 6.01462j	−5.15355 ± 6.57360j	−5.15381 ± 6.58987j
n = 4		
−0.41275	−0.37239	−0.37160
−0.17218 ± 1.16962j	−0.00021 ± 1.35233j	+0.00465 ± 1.35678j
−2.86796 ± 7.21097j	−2.61513 ± 7.43741j	−2.60781 ± 7.44361j
−14.50697	−15.71692	−15.75208

A Numerical Procedure

Illustrated here is a numerical procedure to find the roots of (4). The idea is to replace the exponential in (4) by a suitable rational approximation and then locate the important zeros by solving polynomials. At this point we detour to consider a useful approximation for e^{-z}. Utilizing some results obtained in previous studies [3, 5], let:

$$e_n^{-z} = \frac{G_n(-z)}{G_n(z)}, \quad G_n(z) = \sum_{k=0}^{n} \frac{(2n-k)!z^k}{k!(n-k)!}. \tag{5}$$

Then:

$$e^{-z} = e_n^{-z} + R_n(z), \tag{6}$$

$$R_n(z) = -\frac{(-1)^n e^{-z}(z/2)^{2n+1}(\pi/n)^{1/2}}{(2n)!}\left[1 + 0\left(\frac{1}{n}\right)\right]. \tag{7}$$

Fix z; Then:

$$\lim_{n \to \infty} R_n(z) = 0, \tag{8}$$

so that the sequence e_n^{-z} converges to e^{-z}. Thus e_n^{-z} is an approximation to e^{-z} and $R_n(z)$ is the remainder. Omitting 0 $(1/n)$, (7) is pragmatic as it gives realistic values of the error for small n, say $n = 3$ or 4. The approximates e_n^{-z} are known as the main diagonal elements of the Padé table. They are quite powerful and afford a simple highly accurate method for the evaluation of the exponential and circular functions. Indeed for any reasonable accuracy, e_n^{-z} is considerably more accurate than $(n+1)$ terms of the Taylor series expansion for e^{-z}.

An Illustration

To illustrate, suppose $z = 1$. Let $n = 4$. Then: $e^{-1} = 0.36787\ 9441$, $e_4^{-1} = 0.36787\ 9456$, $R_4(1) = -0.15 \cdot 10^{-7}$.

The approximate value of $R_4(1)$ derived from (7) is $-0.16 \cdot 10^{-7}$. About eleven terms of the Taylor series expansion are needed to achieve the same accuracy. Again, if $z = i = \sqrt{-1}$, then

$$e^{-i} = \cos 1 - i \sin 1 = 0.54030\ 2306 - 0.84147\ 0985i,$$
$$e_4^{-i} = 0.54030\ 2338 - 0.84147\ 0964i,$$
$$R_4(i) = -0.32 \cdot 10^{-7} - 0.21 \cdot 10^{-7}i.$$

The approximate value of $R_4(i)$ obtained from (7) is $-0.36 \cdot 10^{-7} - 0.23 \cdot 10^{-7}i$.

To simplify evaluation of $e_n(z)$, z real, one should group the terms of $G_n(z)$ into an even series and an odd series. Then $G_n(z)$ is the sum of the even and odd parts while $G_n(-z)$ is the difference of the even and odd parts except possibly for sign. Thus only a single polynomial essentially need be computed. Similar economy can be achieved on the pure imaginary axis. The polynomials $G_n(z)$ have a number of interesting properties. Three formulas useful for computational and check purposes are

$$G_{n+1}(z) = 2(2n+1)G_n(z) + z^2 G_{n-1}(z), \tag{9}$$

$$2\frac{dG_n(z)}{dz} = G_n(z) - z\,G_{n-1}(z), \tag{10}$$

$$z\frac{d^2G_n(z)}{dz^2} - (z+2n)\frac{dG_n(z)}{dz} + nG_n(z) = 0. \tag{11}$$

General Electric's I. D. Daniels holds two of the Company's newly developed compactrons. Multifunction tubes are smaller and may decrease costs.

New series of multifunction tubes for consumer applications introduced by General Electric. Possibilities for substantial size-reductions and manufacturing economies reported

"Compactrons"

A NEW electronic device, called "compactron," will make it possible for manufacturers of radios, televisions, high-fidelity sets and electronic organs to achieve, in the near future, significant size reductions in their products. Essentially "compactrons" involve the incorporation of several tube or tube and semiconductor functions in one envelope.

The General Electric Co., Owensboro, Ky., recently displayed and operated a mock-up of a two-compactron radio 2½ in. high, 2½ in. deep and 10½ in. wide—the width being dictated by the size of the speaker employed.

Potential electronic device advances now possible with the use of compactrons are:

A television receiver with 10 compactrons, replacing present TV set circuits that require 15 tubes and three diodes, or 24 transistors and 11 diodes; a two-compactron 12-volt automobile radio that could obsolete the present four-tube car radio design; and monaural high-fidelity equipment using four compactrons rather than either six tubes or 11 transistors.

Developmental models of compactron now include the following, compared to the tubes they displace (in parenthesis).

For table radios:

1. Combined oscillator, converter and intermediate frequency amplifier. (12BA6, 12BE6)
2. Combined second detector, audio amplifier, audio power output amplifier and rectifier. (35W4, 50C5 and 12AV6)

For Television:

1. Horizontal oscillator and automatic frequency control. (6CG7 and 6AL5)
2. Horizontal damping diode (single diode). (6AX4GTB)
3. Vertical deflection amplifier and oscillator. (6DN7)
4. Horizontal deflection amplifier. (6DQ6B)

General Electric's plans for broadening the compactron line include the introduction, in the next 12 months, of approximately nine more types. Long-range plans for integrating a wide variety of functions into one unit indicate that the line eventually will comprise from 75 to 100 types.

C. D. McCool, manager of product design at Owensboro, said that compactrons now scheduled for production use 12-pin connections in a circle 0.750-in. in diameter and a dome-shaped envelope exhausted from the bottom. They are about 1⅛ in. in diameter and vary in seated height from 1 to 2¾ in.

Twelve connections were chosen to accommodate multi-function elements within the unit. They are spaced to provide latitude in lead separation, with a minimum of interaction at the base. The design avoids undue clustering of associated components, and the large 12-pin circle adapts better to the larger 1½-in.-diameter designs of high power output.

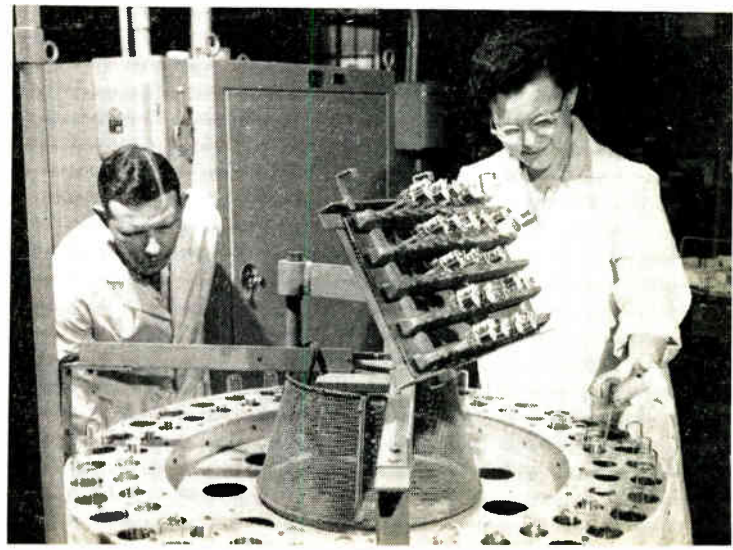
New metallurgical developments, leading to improved thermal efficiencies, provide important contributions to compactron design and operation.

Included in these, he said, is a new anode material developed by General Electric and one of its suppliers that reduces by as much as 40% the heater power required by the cathode. Another development is a clad material that improves both the hot strength and thermal efficiency of cathode elements.

The large-diameter circle of the 12 connector pins, also adapts the compactron well to printed circuitry,

(*Continued on page* 202)

New compactrons are exhausted and stem-sealed and then annealed on the rotating wheel in pilot production operation at GE's Owensboro, Ky., plant.



By GERALD LUECKE
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Part Two of Two Parts

Switching With Transistors

In Part One, most of the steady-state characteristics were treated. Part Two completes the discussion of those characteristics; treats transient characteristics; and, concludes with parameters and circuit performance.

Input Requirements

To drive the transistor from point A to point B in Fig. 2, I_B must equal 800 μa. A plot of I_B *vs.* the base-to-emitter voltage, V_{BE}, is shown in Fig. 5. The operating point of the transistor was moved along the load line in Fig. 2 while recording the data for Fig. 5.

Little base current will flow until V_{BE} is increased to a value greater than point 1. Then only a small increase in V_{BE} is required to arrive at point 2, which corresponds to the I_B required to drive the transistor to the saturated ON condition, point B in Fig. 2. This is similar to the familiar forward-current, forward-voltage curve for a P-N semiconductor junction. For silicon, point 1 is usually 0.6 to 0.7 volt; for germanium, it is usually 0.2 to 0.3 volt. For silicon, point 2 might be from 1 volt for low-power units to 8 volts for power units; for germanium, it might be 0.2 volt for the milliwatt alloy units and up to 3 volts for the power units. The base current at point 2, divided into the V_{BE} required, determines the d-c input resistance of the transistor at point 2.

The I_B at point 3 in Fig. 5 is not sufficient to saturate the collector current and therefore produces a collector current equal to point C in Fig. 2. I_C results from I_B and is related to I_B by the common-emitter forward current transfer ratio, h_{FE}, Eq. 5. Increasing the current, I_B, from point 1 to point 2 in Fig. 5

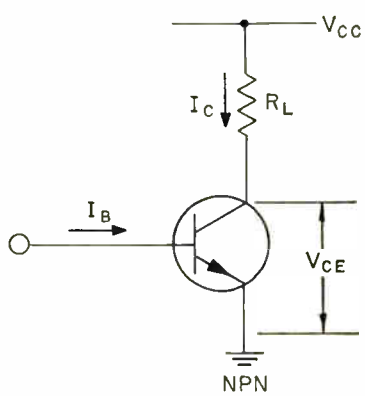


Fig. 8 (left): This circuit may be used for determining switching times between the ON and OFF points of a saturated switch.

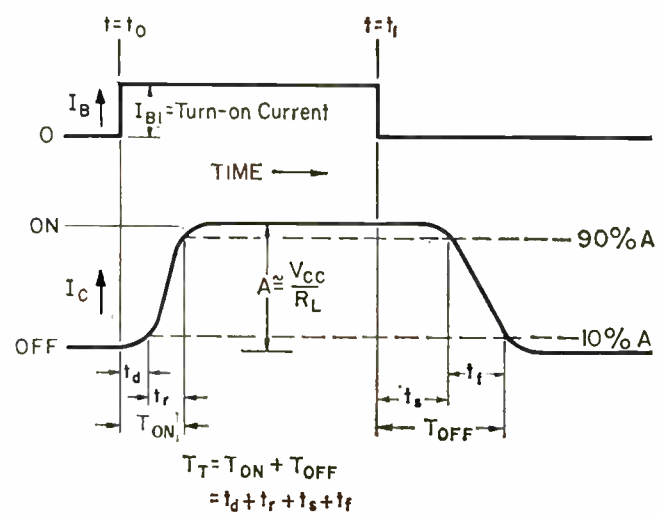


Fig. 9 (right): Switching time of a saturated transistor.

increases the collector current from point A to point B in Fig. 2. A very small change in V_{BE} produces a large change in collector current. However, the collector current is largely determined by the load resistor, R_L, because the collector current saturates and the R_{CS} is small compared to R_L.

Because the I_B produced by a given V_{BE} on Fig. 5 will vary for given production units, *a constant current source is used to set I_B in a saturating switching circuit.* As illustrated in Fig. 6, the source is usually a high voltage in series with a large resistor. Under these conditions, the I_B and I_C ON levels of the saturating switch are set by circuit values and are relatively independent of transistor parameters. Of course, I_B must be of a value that causes saturation when $h_{FE(min)}$ of a production spread is encountered.

When the transistor collector current does not saturate, point C in Fig. 2, then the base current required for the ON operating point will vary as the h_{FE} of the transistor varies. Because some transistor types show a wide production distribution of h_{FE} and, in addition a variation over the operating temperature range, *non-saturating transistor circuits set the magnitude of collector current by controlling emitter current.* That is, V_{BE} is generally used for control, instead of constant I_B. The magnitude of V_{BE} must be greater than the value necessary to produce the I_B to satisfy $I_B = I_C/h_{FE(min)}$. Non-saturated switches are operated in what is essentially a common-base configuration. This type of switching, called current-mode switching, will be discussed later.

Dissipation

Saturated Switch

At the OFF point A, Fig. 2, V_{CE} is large and I_C is a small leakage value. For the typical silicon unit at 25°C, $I_C = 0.1$ μa when $V_{CE} = 15$ volts. This is a low dissipation of 1.5 μw. A typical germanium unit might have $I_C = 5$ μa at $V_{CE} = 20$ volts, or a dissipation of 0.2 mw. As temperature increases, the leakage current, if it is all due to I_{CO}, will double for every 10°C rise in junction temperature. By this rule, at a junction temperature of 100°C, the silicon unit leakage current is 20 μa at $V_{CE} = 15$ volts, dissipating 0.3 mw. Likewise at 65°C, the leakage current of the germanium unit is 80 μa at $V_{CE} = 20$ volts, dissipating 1.6 mw.

The above examples illustrate one characteristic advantage of the low I_{CO} of silicon transistors at high temperatures. Also, grown-junction and diffused small-signal transistors can be 5:1 better in I_{CO} than alloy units. This is true for germanium as well as silicon.

Note that the dissipation figures used take into account *only* the collector dissipation. The total dissipation must include the power to the base-emitter junction. For reasons of clarity, we have neglected this small additional power, but it cannot be neglected for a power transistor in many circuit applications.

At the ON point B, $V_{CE(sat)}$ is small and I_C is large. $V_{CE(sat)}$ is in the order of 1.5 volts at $I_C = 10$ ma for a silicon transistor and 0.5 volt at $I_C = 5$ ma for a germanium transistor. The dissipations are 15 mw and 2.5 mw, respectively. Both are grown-junction

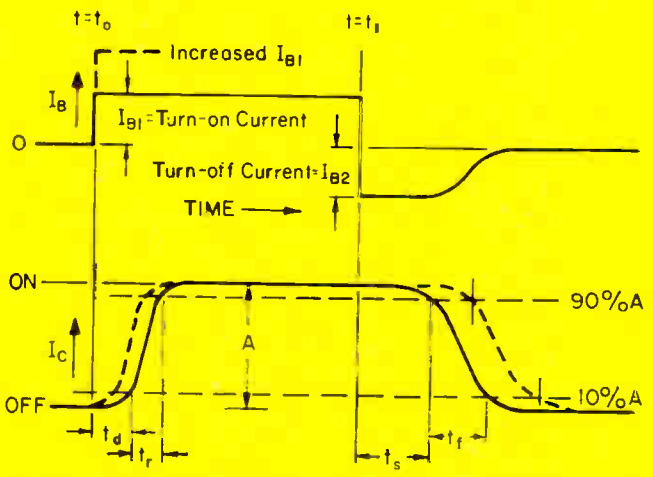


Fig. 10 (above): Effects of increased turn-on current with turn-off current present. The latter is a transient, present only while the transistor is in storage. It is not a steady-state value of current.

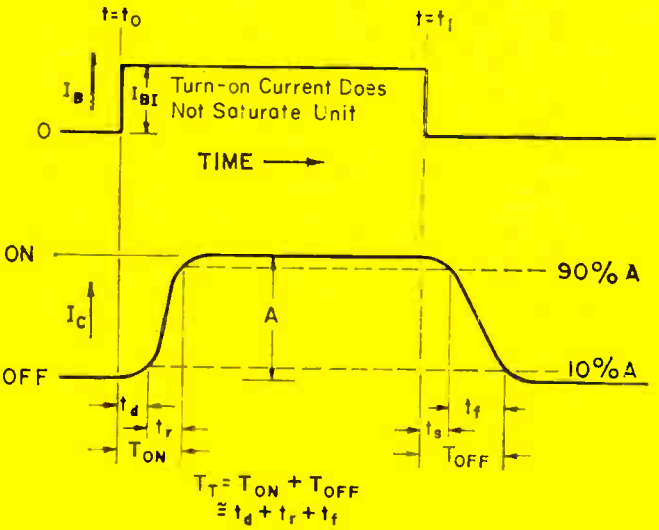
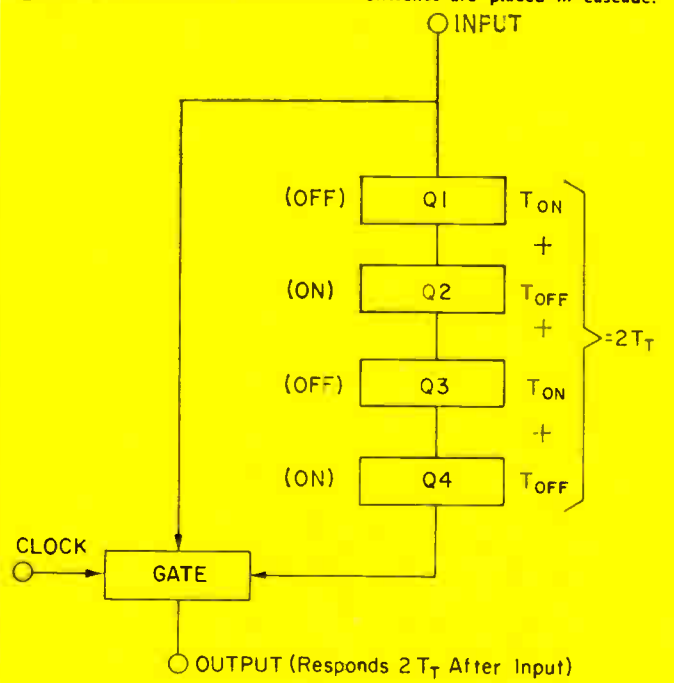


Fig. 11 (above): For a non-saturated transistor, rise and fall shapes are same as for a saturated unit but storage time is very small.

Fig. 12 (below): Importance of propagation time is shown in this diagram where four identical transistor switches are placed in cascade.



Transistor Switches *(Continued)*

units with an R_{CS} of 150 ohms and 100 ohms, respectively. A typical germanium alloy transistor might have a $V_{CE(sat)} = 0.1$ volt at $I_C = 100$ ma, giving a dissipation at the ON point of 10 mw and an R_{CS} of 1 ohm. Grown-junction and diffused units have a low R_{CS}, and alloy-junction units have an R_{CS} that is much lower—by a factor of 10. *This shows the advantage of using the transistor as a saturated switch, namely, there is low dissipation at both the ON and OFF points.*

The dotted lines on Fig. 2 join the points where the product of V_{CE} and I_C equals 50 mw and 150 mw. The dissipation in the transistor is close to these constant dissipation lines (really exceeds the 50 mw dissipation) only when it switches from point A to point B and back again. *It has high dissipation only while crossing the active region.* This is illustrated in Fig. 7 where the V_{CE}, I_C, and power dissipated in the transistor of Fig. 2 are plotted for each instant of time as the transistor is switched from point A to point B and back again. The drive current into the base is plotted as a time reference.

The average dissipation is much less than the peak dissipation. *Because the average dissipation is low, much larger currents and voltages can be handled by saturated transistors without exceeding the rated dissipation.* However, the voltage should be limited to a safe value below the breakdown voltage, while the current must stay within the maximum current specified for the transistor. At all times, average dissipation must be below the rated dissipation at the maximum ambient temperature—obtained from the power derating curve for the transistor.

Non-Saturated Switch

Dissipation at OFF point A will be the same as for the saturated switch. However, the ON point is now point C in Fig. 2. For the transistor used in Fig. 2, $V_{CE} = 6$ volts, $I_C = 12$ ma, and $P_D = 72$ mw. This dissipation is much larger than the ON point B of the saturated switch. *Because the ON point of non-saturated transistors used as switches is in the active region, they have higher dissipation at this point than saturated transistors.* A transistor which is always in the active region (between point A and point B on the load line) will have a higher average dissipation than either of the switching circuits. A video amplifier or an emitter-follower are good examples of applications where the operating point is always in the active region.

Power Switches

In many applications, a transistor is used to switch large amounts of power and to remain ON for long periods of time. The ON dissipation is then $I_C V_{CE(sat)}$, watts obtained when using the transistor in the saturated mode. This must not exceed the rating of the transistor at the maximum ambient temperature. Obviously, low R_{CS} is essential. The maximum I_C rating and the ratio of R_{CS} to generator impedance must also be considered when designing a circuit. The breakdown voltages and leakage currents determine the ratings that apply at the OFF point.

It is significant that the power controlled or switched can be as much as 40,000 times the power required to control the switch.

Transient Characteristics

Saturated Switches

Switching times between the ON and OFF points of a saturated switch are determined in a circuit such as shown in Fig. 8. Since the collector current level is the information carrier, we are interested in the response of the collector current to a pulse of base current, plotted in Fig. 9.

At $t < t_o$ in Fig. 9, $I_B = 0$ and I_C is at the steady-state OFF level. At $t = t_o$, I_B is suddenly increased to I_{B1}, the turn-on current large enough to saturate the I_C of the transistor. At $t = t_o$, I_C does not respond immediately. The time from $t = t_o$ to the point where I_C is 10% of its final value is the delay time, t_d. The time from the 10% level to the point where I_C is 90% of its final value is t_r, the rise time, $t_d + t_r = T_{ON}$, the turn-on time. The final value of I_C will be the steady-state ON level. The ON level is approximately V_{CC}/R_L for a transistor which has a low collector-emitter saturation voltage.

When I_B is suddenly returned to zero at $t = t_1$, I_C does not drop to zero immediately. It remains unchanged for a period of time due to minority carrier storage in the base region. This storage time, t_s, is measured from the end of the base current pulse to the time that the collector current has reduced to its 90% value. The fall time, t_f, is the time required for the collector current to reduce from its 90% value to its 10% value. $t_s + t_f = T_{OFF}$, the turn-off time.

Fig. 13: Since most parameters were measured originally in the common-base configuration, this equivalent circuit became popular.

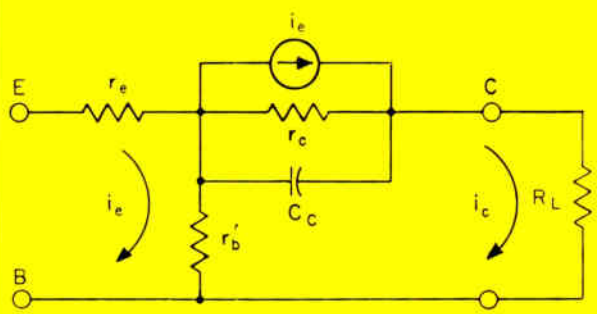
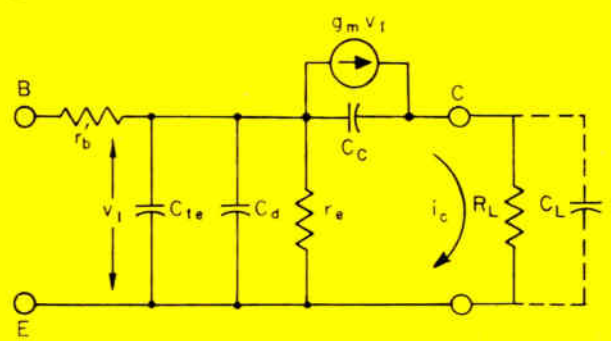


Fig. 14: When the transistor is operated in the common-emitter configuration, this equivalent circuit is found to be very useful.



In switching circuits that propagate information from one point to another as current or voltage levels, both the ON time and the OFF time are important. *The total switching time $T_T = T_{ON} + T_{OFF}$ becomes a figure of merit. The smallest T_T represents the best switch.* For each application, both transistor and circuit parameters determine the magnitude of each of the switching time components.

The delay time is due to three factors:

(1) Since a reliable transistor switch should be reverse-biased to hold it OFF, the base-emitter junction capacitance will have a voltage across it. It takes time to discharge this capacitor and charge it to the forward voltage. The larger the reverse bias, the longer the delay.

(2) Time is required for the emitter current to diffuse across the base region. This is represented by a base charge, which must be supplied by the input circuit.

(3) At low emitter currents, the current amplification and frequency response are low. An acceptable level of emitter current must be reached before the collector will have its maximum response, necessitating a delay.

The rise time, which indicates the transistor frequency response, is a function of the alpha-cutoff frequency, or bandwidth of the transistor. It is also a function of the turn-on current; the higher the turn-on current, the shorter the rise time, Fig. 10.

The collector current is saturated when the collector voltage falls below the base voltage and thereby applies a forward bias to the collector-base junction. This causes the collector to inject a stored charge into the base region just like the emitter does. The collector current will not decrease until these stored charges are swept from the base region. The more stored carriers in the base region, the longer the storage time. Storage time is a function of h_{FE} and of the turn-on and turn-off drive currents. The higher the h_{FE} and the larger the turn-on drive, the longer the storage time; the larger the turn-off drive, the shorter the storage time.

The fall time is also indicative of the transistor frequency response. It will, like t_r, be a function of overdrive—in this case, a turn-off drive. The larger the turn-off drive, the shorter the fall time.

A turn-off current, I_{B2}, in the opposite direction to the turn-on current can be provided to remove the stored carriers from the base region and reduce storage time. Storage time decreases as I_{B2} is increased. Fig. 10. *I_{B2} is a transient current and is present only while the transistor is in storage. It is not a steady-state value of current.*

Increasing I_{B1}, the turn-on current, decreases rise time and delay time; however, this increases storage time by placing more charge in the base. To reduce the storage time, more I_{B2} is required. I_{B2} will also decrease fall time because it represents an over-drive to turn the transistor OFF.

The way to produce short switching times then is to provide large I_{B1} and I_{B2} currents. However, since both currents must be supplied from the driving source, the sum of I_{B1} and I_{B2} is the drive current required and the circuit h_{FE} of the device is reduced accordingly.

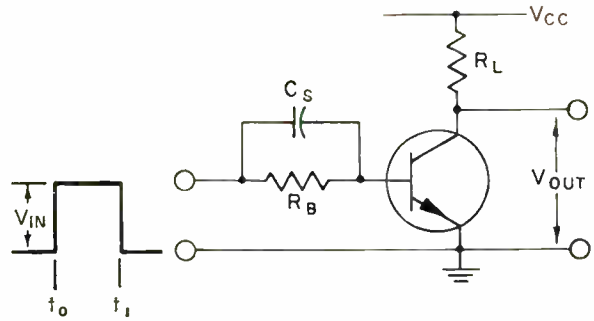


Fig. 15: This saturated switching circuit has a "speed-up" capacitor across the large resistor in series with the base. The capacitor tends to reduce the total switching time considerably.

To further complicate the design problem, storage time is a function of the h_{FE} of the transistor. For example, given a transistor with a 3:1 production spread of h_{FE} at 25°C, the circuit designer wants all units to saturate with a short T_{ON} time, so he provides three to four times the minimum I_{B1} necessary to produce a saturated I_C. Assuming a 3:1 h_{FE} variation over the temperature range, the designer will have a 9:1 variation in h_{FE}. This shows the large variation in storage time that must be accommodated. The amount of turn-off current, I_{B2}, that can be provided is limited by the h_{FE} needed for the circuit. In most cases the value of the circuit h_{FE} must be greater than five.

Overdrive Factor

A saturated transistor switch may have I_{B1} larger than necessary so that t_r will be reduced. The overdrive factor is a measure of the extra I_{B1} that has been provided to reduce t_r. The I_B required to just saturate I_C is:

$$I_B = \frac{I_C}{h_{FE\,(min)}} \tag{14}$$

The actual I_{B1} may be several times I_B. The ratio of I_{B1} to I_B is the overdrive factor and can be expressed as:

$$O.F. = \frac{h_{FE\,(min)}\, I_{B1}}{I_C} \tag{15}$$

$h_{FE(min)}$ should be measured at the approximate I_C operating level, just out of saturation.

The overdrive factor, defined another way, is the ratio of the collector current that would be obtained if the transistor did not saturate to that obtained in normal, saturated, operation. This assumes that $h_{FE(min)}$ remains constant.

Non-Saturated Switches

As previously stated, the non-saturated switch has its ON I_C level in the active region. Its OFF level of I_C is the same as for saturated switches.

Fig. 11 is another plot against time of the I_C response to a step of I_B. The I_{B1} turn-on current *is not* large enough to saturate the I_C of the transistor. The rise time, t_r, and the fall time, t_f, will have the same shape as for the saturated transistor; but the *storage time, t_s, will now be very small because the transistor is not saturated.*

Since t_s is negligible, $T_T = t_d + t_r + t_f$ giving a total switching time much smaller than for a satu-

Transistor Switches *(Continued)*

rated switch. Also, not as much variation in total switching times due to h_{FE} variations need be expected with a non-saturated switch. Therefore, *bits of information can be propagated faster by non-saturated switches than by saturated switches.* This is the main reason for using non-saturated switches. For the increase in speed we sacrifice power loss in the device because, as pointed out in the discussion on steady-state characteristics, more power is dissipated in the non-saturated switch at the ON point.

Importance of Propagation Time

The importance of propagation time is illustrated by Fig. 12, where four identical transistor switches are placed in cascade.

Stages 1 and 3 are OFF; stages 2 and 4 are ON. If the input changes stage 1 to ON, the other stages likewise are changed. The output from 4 will not occur until a time equal to 2 T_T after the input is applied to stage 1. If the output of stage 4 were to be coincident in a gate with the input to stage 1, the gate must be held ON to accommodate the large time difference of 2 T_T. Thus, the speed at which information can be propagated is limited by T_T. T_T for present saturated transistors is usually 100-150 mμsec.

To improve T_T, if all stages were non-saturated stages, transistors with a higher frequency response could be substituted. This would cause both t_r and t_f to decrease and T_T accordingly. However, if all the stages are saturated switches, it is not sufficient to merely substitute transistors with higher frequency response. Even though t_r and t_f would be reduced, T_T may not be appreciably reduced because the storage time is still quite long. *High-frequency transistors must also have lower storage time to significantly reduce* T_T. A good figure of merit to compare saturated switching transistors is the T_T obtained when the transistor is used in a given saturating circuit where I_{B1}, I_{B2} and I_C are set values in the circuit. Note that $V_{BE(OFF)}$ should also be constant to keep t_d variations at a minimum.

Parameters and Circuit Performance

Importance of C_{ob}, r_b, C_{te}, C_d, and C_L

When the transistor was first introduced, most of the parameters were measured in the common-base configuration. As a result, the equivalent circuit shown in Fig. 13 became popular.

The current generator, α, was assumed to be

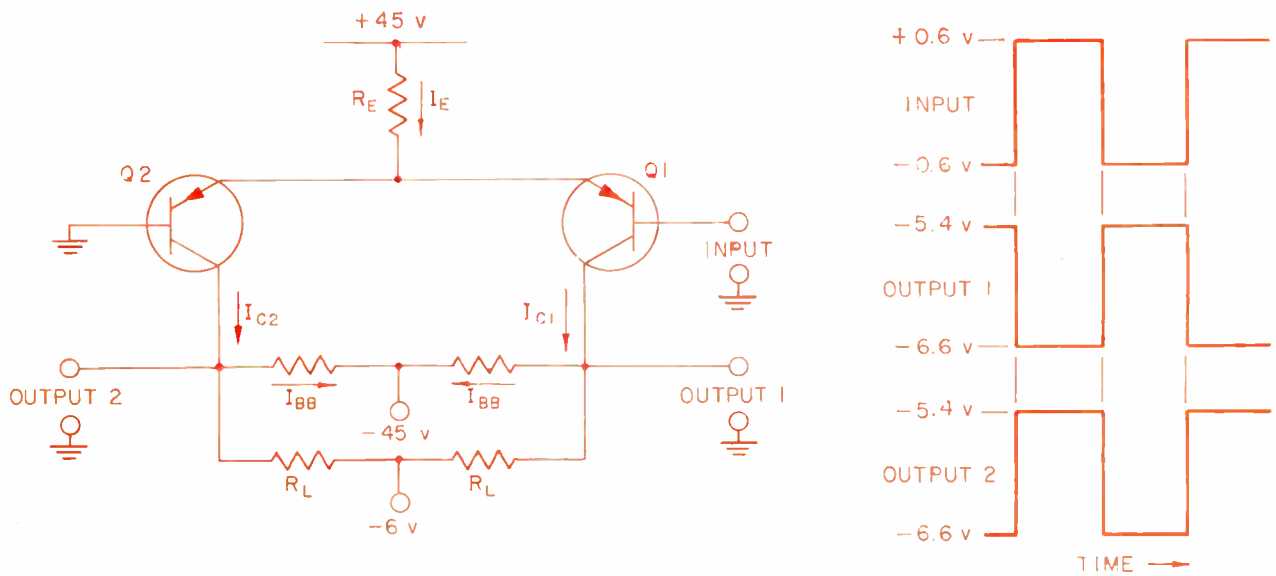
$$\alpha = \frac{\alpha_N}{1 + \frac{j\omega}{\omega_N}} \qquad (16)$$

where α_N is the small-signal common-base forward current transfer ratio at a low frequency and ω_N is the radian frequency at which $\alpha = 0.707\ \alpha_N$. That is, $\omega_N = 2\pi f\alpha$ where $f\alpha$ is the α-cutoff frequency.

The two important time constants in the response of i_c are $1/\omega_N$ and $(r'_b + R_L)C_c$. The $1/\omega_N$ time constant and the $r'_b C_c$ portion of the second time constant are associated only with the device; the $R_L C_c$ portion is a time constant associated with the circuit. r'_b, the base spreading resistance, is a difficult parameter to measure. Fig. 13 represents it in its simplest form. The $r'_b C_c$ time constant decreases as r'_b and/or C_c decreases; the $1/\omega_N$ time constant decreases as the α-cutoff frequency increases. Accordingly, a figure of merit for high-frequency response has been developed by forming the ratio $\omega_N/r'_b C_c$. The better high-frequency device will have ω_N large and $r'_b C_c$ small. ω_N and r_b are both related to the base width, W. r'_b varies inversely with W and ω_N varies inversely with W^2. The values of ω_N, r'_b, and C_c also vary widely with the dc conditions at the operating point. C_c of most transistors varies inversely as the ⅓ to ½ power of the voltage across the collector junction. C_{tc}, another designation for C_c, is called the collector transition capacity. Measured at the header terminals, C_{tc} becomes C_{ob} because the header capacity is included.

When the transistor is operated in the common-emitter configuration the equivalent circuit in Fig. 14 is useful. The response of i_c from the current generator, $g_m\ v_1$, again depends on the time constant $R_L C_c$

Fig. 16: Non-saturated transistors are used in this circuit as current-mode switches.



and the time constant ω_N contained in the frequency dependence of g_m. However, in the case of the common-emitter configuration, the C_c reflected to the output is $C_c/(1-\alpha)$ which is a much larger capacity. Also, a time constant associated with the input circuit is now apparent. The build-up of v_1 and consequently i_c, is dependent on the charge on C_{te} and C_d. C_{te} is the transition capacity of the emitter-to-base junction and varies in a similar fashion to C_c with reverse voltage. C_d is a capacity which represents the number of carriers in the base region. Both of these capacitors delay the response of i_c, since v_1 appears across them. r_e, the resistance in parallel with C_{te} and C_d, is inversely proportional to the magnitude of emitter current. Little input current flows into the large r_e when I_E is small. Rather, it is shunted into capacitors C_{te} and C_d. The current through r_e generates i_c. Therefore, the response of i_c is not as fast while I_E is a low value.

Most common-emitter saturated switches are driven with a constant current. Therefore, there is a large resistor in series with r'_b, and $(R_b + r'_b)$ determines the charging time constant of C_{te} and C_d. For this reason r'_b is not important. However, when a voltage drive is used r'_b is again important because it, along with the generator impedance, determines the delay.

When the common-emitter switch is reverse-biased there is a voltage across C_{te}. The larger this voltage, the longer the time required to discharge C_{te} and charge it to the forward voltage, v_1. This explains why the delay time of i_c *varies with* $V_{BE(OFF)}$.

If the time constant $R_L C_c$ is to have a negligible effect on the response of i_c, a comparison must be made between

$$\frac{1}{\omega_N (1 - \alpha_N)} \text{ and } \frac{R_L C_c}{1 - \alpha_N}.$$

That is, $R_L C_c$ should be much less than $1/\omega_N$, or $\omega_N R_L C_c \ll 1$ to prevent $(R_L C_c)/(1-\alpha_N)$ from contributing significantly to the transient response in a specific device.

C_L represents the stray wiring capacity of the external circuitry. Since C_L is in parallel with R_L, it may contribute significantly to the $R_L C_c$ time constant. *In fact, using conventional component connections, the response of circuits using future "ultra-fast" transistors will probably be limited by* C_L *alone.*

Importance of the Type of Drive

If a step of voltage is applied to the base-emitter input, Fig. 14, from a generator with source resistance R_g, v_1 is present immediately, restricted only by r'_b and R_g, and i_c responds quickly. The amount of overdrive is determined by v_1. If the same type of voltage drive is now used to turn-off the transistor, the minority carriers stored in the base are swept out quickly and i_c again responds quickly. The fastest response is obtained from a switching transistor by using low-impedance voltage-drive generators.

The saturated switching circuit shown in Fig. 15 has a "speed-up" capacitor across the large resistor in series with the base. The circuit applies constant current drive to the transistor during the steady-state operation, but during the switching transient, the capacitor is essentially a low impedance and the drive is really a voltage drive. The speed-up capacitor reduces the total switching time considerably.

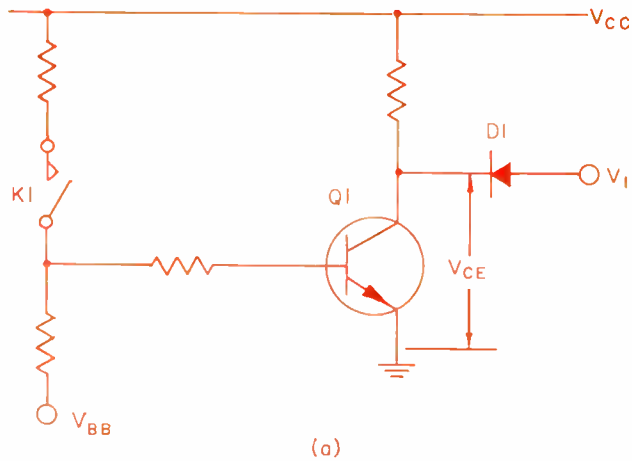
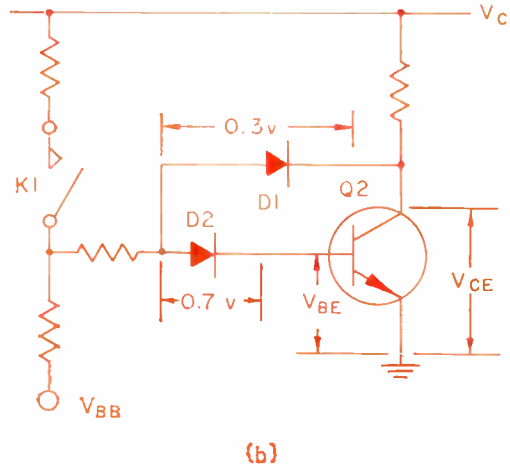


Fig. 17: Examples of non-saturated switches with current drive.



As stated previously, non-saturated transistors are used as current-mode switches. This type circuit is illustrated in Fig. 16. When the input voltage is positive, the constant current set by V_{EE} and R_E flows through Q2 to form I_{C2}. Changing the input voltage to a negative value switches the I_E current from Q2 to Q1 and forms I_{C1}. V_{BB}, which is a larger negative voltage than V_{CC}, provides a bias current I_{BB} to set the output potentials. In this circuit the ON collector current levels are determined by the constant current I_E; therefore, h_{FE} variations are not important. Since the drive on the base is a voltage drive, it need only be above and below a given value. The outputs are derived from the collectors of Q1 and Q2. The lowest T_T, in the order of 20 mμsec with present-day devices. is obtained in a switching circuit of this type.

The fastest non-saturated circuits use voltage drive, but some circuits are current-driven, Fig. 17. Transistor Q1 in Fig. 17a is ON when K1 contacts are closed. However, Q1 never saturates because D1 provides a very low collector load resistance when V_{CE} drops below V_1.

In Fig. 17b, Q2 is ON when K1 contacts are closed. D1 is a germanium diode; D2 is a silicon diode. D2 has a +0.7-volt drop across it when Q2 is ON. Therefore, when V_{CE} drops below the level equal to (V_{BE} +0.4 volt), D1 conducts and holds Q2 out of saturation. This circuit is known as the "Baker Clamp".

What's New . . .

Filter Calculations Made Easy

THE three-element section is the cornerstone of modern filter practice. Various methods can be used to aid the mechanics of filter attenuation calibration.

One method is to represent the attenuation graphically and obtain answers from the resulting curves. Graphical calculation, however, has an important drawback: there must always be some distance between two neighboring curves. This not only makes it impractical to draw curves for all possible combinations of band-pass conditions, but it also amplifies the possible error.

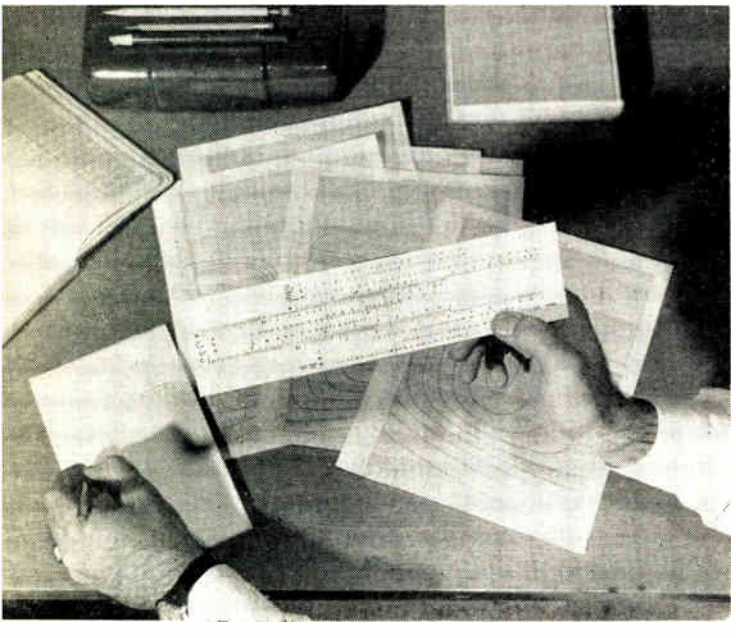
A second method is far quicker and more accurate: information required for any filter calculation can be set up on a slide rule having special scales and the solution then read directly from the slide rule. Such rules have been constructed by their designers — Anatol I. Zverev and Herman J. Blinchikoff, Manager and Engineer, respectively, in the Network Synthesis Section, Electronics Div., Westinghouse Electric Corp., Baltimore, Md.

As well as special scales, the filter slide rule incorporates the conventional A, B, C, and D scales found on every standard slide rule. These four scales enable the engineer to evaluable both the inductance-capacitance elements of the filter network and the various frequency ratios used in determining attenuation characteristics.

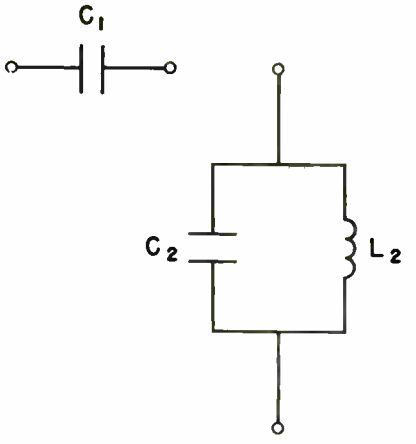
Results of calculation with the filter slide rule have been compared with similar results obtained by an IBM electronic computer. Fixed frequencies were these: $f_0 = 140$ KC, $f_1 = 135$ KC, and $f_2 = 145$ KC. These results are compiled in the table.

Thus it is clear that the accuracy of this slide rule is more than sufficient for most filter problems. It is an extremely useful tool for the design of high quality filter networks.

Westinghouse has a small supply of these scales available and will supply them gratis to filter engineers until the supply is exhausted. Requests must be made on company letterhead.



New slide rule eliminates need for graphs and tables in filter calculations. Combination of special and conventional scales permit answers to all filter calculations to be read directly from the rule.



The accuracy test calculations were made for this type of three-element section.

TABLE I

Calculated Attenuation (db)

Frequency (KC)	IBM 650	Filter Slide Rule
111	24.264	24.3
130	12.315	12.3
132	9.766	9.5
147	7.208	7.1
150	10.696	10.8
169	18.843	18.6

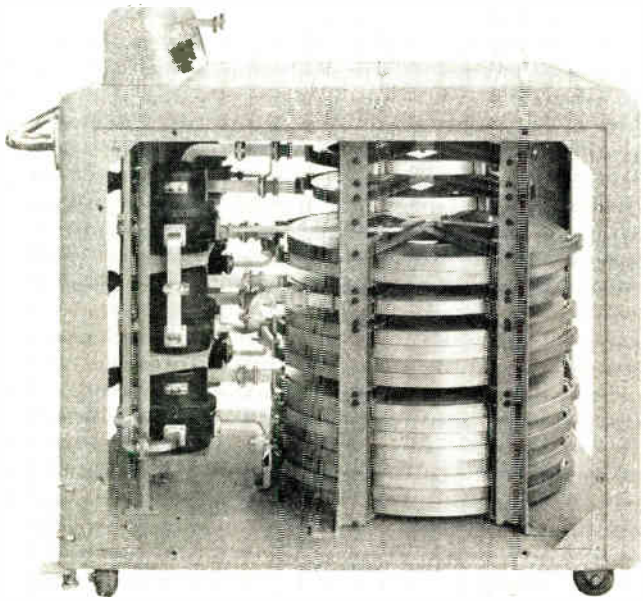
Zone Refining Refractories

IMPURITIES in refractory rods, e.g., molybdenum, tungsten, tantalum, vanadium, and columbium, are either vaporized into a high vacuum chamber or concentrated at both ends of the rod and subsequently cut off when a new zone refining technique is used.

Ductility of these materials is proportional to their purity. Temperatures as high as 3500° to 6500°F are required for purification. In the Electron Beam Floating Zone Apparatus (EBZ-93) made by MRC Mfg. Corp., 47 Buena Vista Ave., Yonkers, N. Y., accelerated electrons are bombarded in concentration on a thin zone of the rod. Once melted, the zone travels up the rod, corresponding with the electron gun movement. At all times only a thin strip of the rod is in the molten state.

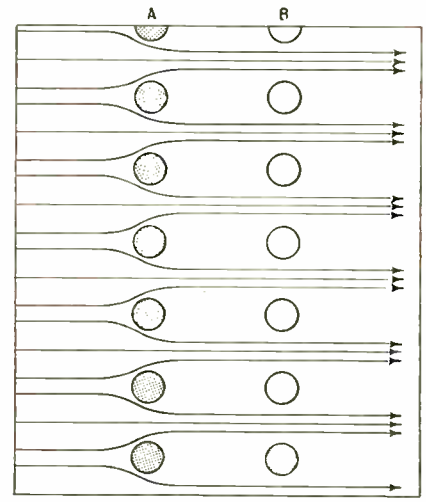
Purified ⅛ in. tungsten rod can be hairpin bent at room temperature; molybdenum, in liquid nitrogen, at —196°C.

Portable Delay Lines for Testing



Set-ups can be tested on 64 ranges with this new portable microwave delay line. Capable of lengths from 13 ft. to 1228 ft., it is variable in short steps by the simple flick of a switch. Manufactured by Turbo Machine Co., Lansdale, Pa., it cuts testing time from two days to 15 minutes. Cooperating with Diamond Ordnance Fuze Labs., the organization which developed the coiled waveguide technique in 1956, the firm has continuously improved the bending operation and the coupling of coils in the test assembly.

Football and the Electron Tube

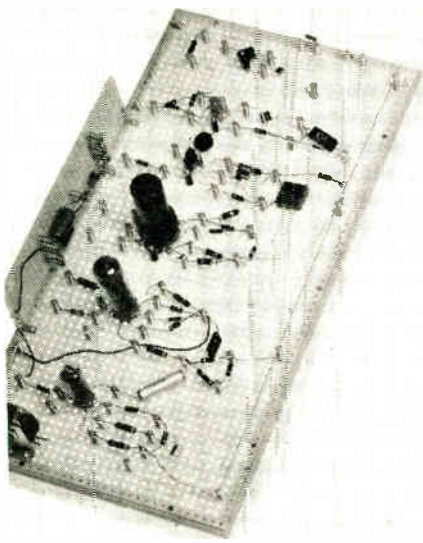


The "blocking back" concept is used by General Electric's new 6FG5. An "extra" shadow grid (A) diverts electron flow around screen grid (B) thus drastically reducing screen current. With this design, the screen grid can be tied directly to the plate voltage, eliminating dropping resistors and by-pass capacitors. Reduction of screen current also permits exceptionally low-noise pentode operation.

Faster Breadboarding

COMPONENTS may now be changed as often as desired on breadboards—without soldering. A new terminal which fits into the usual pegboard is springloaded in such a way that wire leads are held rigidly in place without soldering. Contact resistance is less than 0.002 ohms.

With the springloaded terminal circuits may be tried and changed much more rapidly because soldering is eliminated. Several of the terminals are mounted on this board.



The device, manufactured by Vector Electronic Co., Inc., 1100 Flower St., Glendale 1, Calif., is known as the Solderless Springclip. Though originally designed for breadboards, it is being used in many permanent applications where soldering is undesirable.

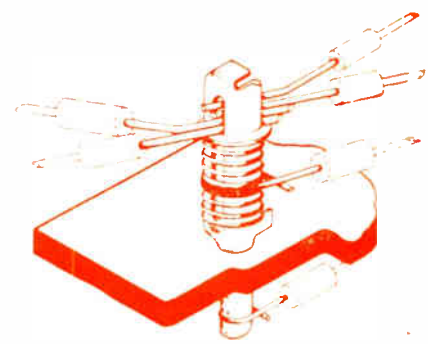
Expensive components such as transistors may be used over and over by merely pulling the leads out of a slot where they have been held tightly. The slot starts at the top of the new terminal and extends practically to the base. A spring and washer arrangement is used to hold from 1 to 6 leads, up to 0.05 in. diameter, firmly against the top of the slot.

Because components are not soldered, there is no danger of "burning up" sensitive, and expensive, transistors and diodes with excessive heat.

Their initial low cost and indefinite re-use make Springclips an extremely economical fastening device. They can be re-used indefinitely because they are not staked to the pegboard but rather held in place by action of a spring.

The new terminal is also featured in an Experimental Chassis Kit, 25X, which the company manufactures. The kit contains a pegboard and the usual mechanical parts in addition to the new Springclips.

Leads may be inserted into the slot or held in place by the coils of the spring. An extra lead may be connected below the board, but this usually requires soldering.



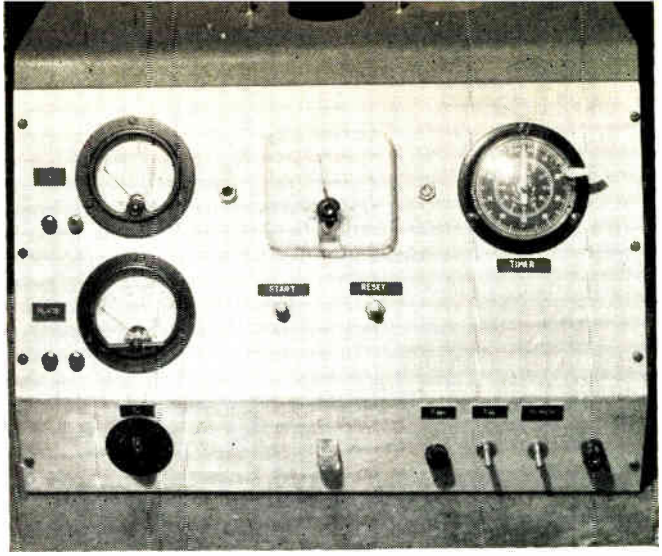


Fig. 1: Front of the cathode warm-up test set gives some hint of its capability. Text tells how to construct it for labo use.

In tube design one of the objects is to have fast cathode warm-up time. This will reduce arcing and transients, thereby improving tube life and reliability. Complete information is given to permit construction of a laboratory type test set.

A Test Set for

Determining Cathode Warm-Up Time

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Lansdale Div., Philco Corp.
Lansdale, Pa.

DURING the first sixty seconds of operation of a piece of electronic equipment using vacuum tubes, there are many transient conditions. In some applications, such as rectifier or horizontal deflection circuits, the condition could be critical due to tube arcing which may be caused by a cold cathode. The object in most tube applications is to have a fast cathode warm-up-time. This will reduce the arcing and transients, thereby improving the life and reliability of the tube.

Cathode warm-up-time, generally known as Operation Time, is the time after simultaneous application of all electrode voltages for a current to reach a stated fraction of its final value. Conventionally, the final value is taken as that reached after a specified length of time. All electrode voltages are to remain constant during measurement. The tube elements must be at room temperature at the start of the test.[1]

This article describes a test set (Fig. 1) constructed for a specific tube type and contains power supplies, meters and other components which will perform the testing of warm-up-time with reasonable accuracy. The Unit is an electromechanical device. The design is based largely upon the use of an 0-100 microampere contact meter relay and a motor driven timer.

The contact meter relay (CMR) uses a 100 microampere movement and has a high limit adjustable single contact arrangement. The motor driven timer, a Cramer Time Totalizer, type 690-ET, is a highly accurate electrically operated stop clock with a 60 sec. time range and scale divisions of 0.01 sec.

This equipment was originally designed for a development type double triode which required a warm-up-time of 5 sec. or less under the following conditions: 10 v. applied to the heater, 100 v. to the plate, zero bias voltage. Each triode section is to be tested separately at a plate current of 4 ma.

A 100 ohm precision resistor in the cathode of a single triode section formed the basis of the warm-up-time circuit, making use of the voltage drop across the resistor and applying it to a sensitive meter and control circuit. (Figure 2)

1. I.R.E. Standards on Electron Tubes and Definitions of Terms, 1957.

Since 4 ma. was the established value of the warm-up-time plate current, a contact meter relay of 0-100 microamp. was used in conjunction with a calibration potentiometer to provide a variable range of 0-10 ma. This gave an adjustment of 4 ma. well within the range of the meter scale. The calibration potentiometer, plus the mechanical contact calibration of the meter, provided reasonable accuracy and reproducibility of readings on the same set of standard tubes over a long test period.

When calibrating the meter, the fixed Pointer (Red) is moved up scale beyond the point of calibration, which in this case is 4 ma. By use of a load resistor and the plate supply set to the required 100 v., the meter is adjusted (Black Pointer) to the 4 ma. by the calibration potentiometer. When the 4 ma. point is calibrated on the dial, the Red Pointer is then moved into position where it remains until further calibration is desired, or the current is changed to another value. Provisions for plugging in a standard meter for comparison are made by a normally closed phone jack.

The filament supply consists of a transformer having a secondary of 11.5 v. at 11.5 a. adjusted to 10 v. by means of a Variac in the 117 v. primary. Short, heavy wiring is used in the secondary to keep initial switching transients to a minimum. A voltage regulated power supply is used to furnish 100 vdc to the plate circuit. The relay used with the CMR requires a dc supply for its operation and is a standard selenium rectifier circuit (Fig. 2) for use with the above mentioned relay and meter.

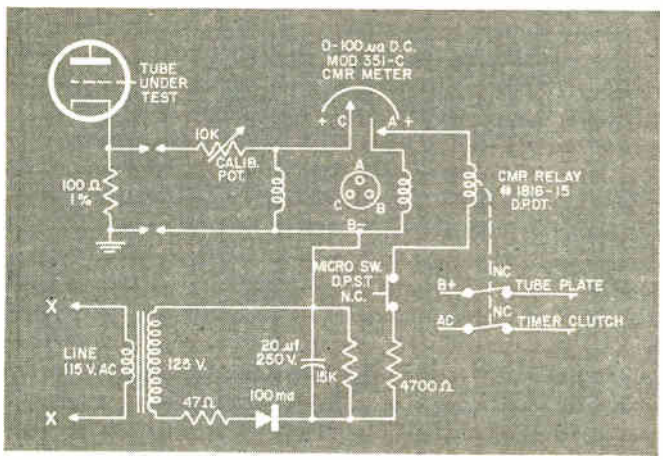
The tube socket is mounted on the top of an 18 x 12 x 12 in. sloping panel cabinet along with two switches, which switch from one side of the triode to the other. The socket and switches are mounted on a piece of bakelite 4 x 8 in. and the assembly is mounted under the top of the cabinet with the components going through pre-drilled holes in the cabinet top. This assembly is removable from the cabinet with the front panel and chassis assembly (Fig. 3). Control switches and meters are mounted on the sloping panel of the cabinet, while the plate power supply (Fig. 4) and the relays are mounted on a 10 x 17 x 3 in. chassis which is attached to the panel.

Mechanical construction and parts layout is not critical and standard arrangement of meters and switches for convenience and outside appearance have been followed. Generally, a test position or socket is in the most convenient place for ease of use and speeding up the test procedure. Switches are arranged according to frequency of use and convenience. Meters are arranged in a logical order and are grouped in relation to the appropriate switches or controls, if any. Electrical wiring is not critical, but the filament wiring should be heavy #10 and short to cut down any possible initial drop in voltage.

When the main power switch (Fig. 5) is on, the regulated plate supply CMR relay supply, filament transformer primary and the time clock motor are in operation. The plate switch (Fig. 5-B) applies the adjusted voltage as read on the 0-250 vdc plate meter to the tube socket. The plate supply is adjusted to the required voltage by a potentiometer.

The filament voltage is adjusted by a Variac (Fig. 5-C) and the voltage as read at the transformer secondary is observed on the 0-15 vac filament meter.

Fig. 2: Simplified, partial schematic shows CMR's dc supply



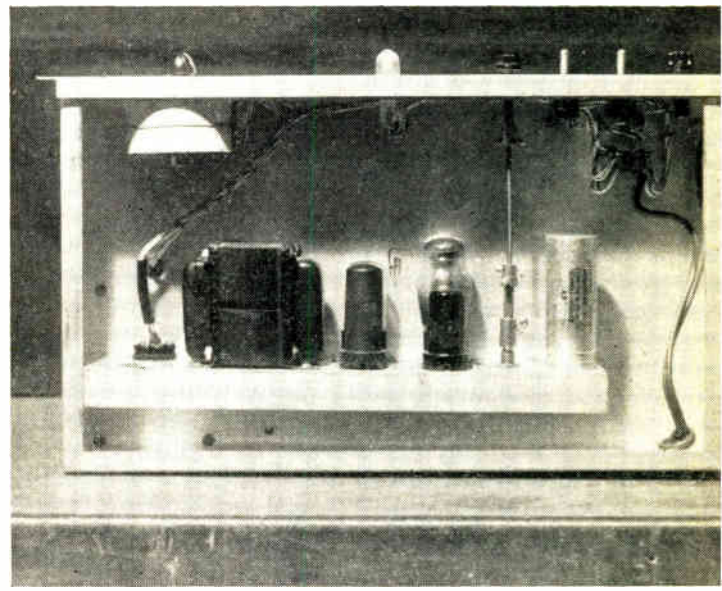
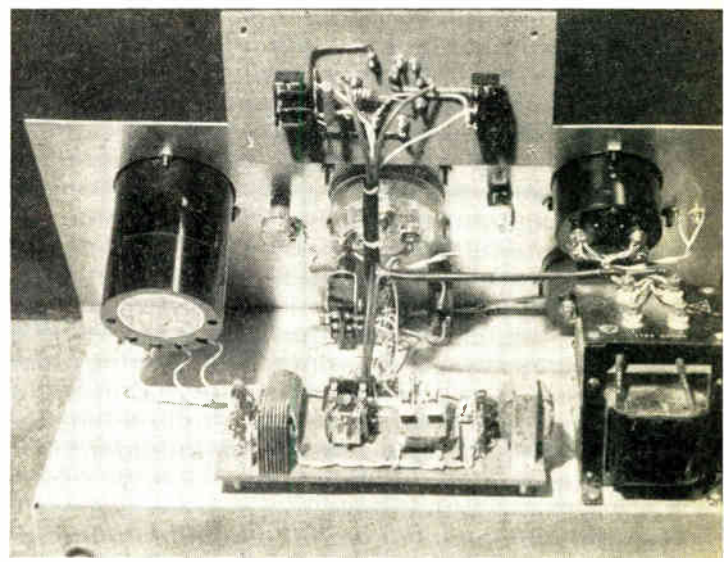


Fig. 3: Meters and switches are mounted on test set front panel. CMR dc supply is mounted on small phenolic strip with relays.

Fig. 4: Regulated plate power supply is mounted under the chassis shown in Fig. 3. Shaft adjusts voltage from front panel



Test Set *(Concluded)*

When the tube under test is first plugged into the socket, only the plate voltage will be applied to the tube.

Depressing the normally open Start switch (D1) closes the power relay (RY-1) completing circuits which will apply heater voltage to the tube socket with simultaneous operation of the timer clutch. which releases the timer mechanism and pointers for timing.

As the tube under test warms up and starts to draw current, the CMR meter (E) will indicate. Since the CMR meter has been adjusted to 4 ma.. contacts in the meter relay complete a circuit (RY-2) which simultaneously stops the timer and pointers, and opens the plate circuit (F) to prevent further tube conduction. The tube is then removed from the test socket.

Depressing the normally closed Re-set switch (G) opens the power relay and meter relay circuits simultaneously. The CMR meter pointer (Black) returns to zero. The plate voltage is applied to the tube socket. The filament voltage is removed from the socket. The timer clutch is in the hold position. The Timer (H) hands are reset by means of a reset lever protruding from the Timer. A tube under test must be removed before depressing the Re-set switch, because the hot tube will have plate current and resetting of equipment cannot be accomplished.

Generally one side of a group of tubes is tested before switching the tube element switches from side one to side two.

This test set has been in considerable use and has made available valuable information regarding the improvement of Warm-up-time on this tube type. It can be readily modified for use on other tube types with a cathode-warm-up problem.

PARTS LIST

1	CMR meter Mod. 351-C 0-100 microamp. dc, locking type contact single contact—upper limit	Assembly Products, Inc.
1	Cramer, type 690(ET), time totalizer 60 sec. time range, scale division 0.01 sec. 11 ov. 60 cycles	R. W. Cramer Co., Inc.
1	DPDT relay (RY_2) #1816-15	Assembly Products, Inc.
1	DPDT relay (RY_1) KA11A	Potter & Brumfield
1	Meter, O-15 vac., 3-inch, round, bakelite	Weston
1	Meter, O-250 vdc., 3-inch, round, bakelite	Weston
1	Cabinet, #SF-504,12x18x12 in.	Par-Metal Prod. Corp.
1	Chassis, #AC-416, 10x17x3 in.	Bud Radio, Inc.
1	Powerstat, Type-10	The Superior Elec. Co.
1	SPST, Micro-switch, normally open	Micro-Switch Div. Minneapolis-Honeywell
1	DPST, Micro-switch, normally closed	Micro-Switch Div. Minneapolis-Honeywell
2	SPST, Bat handle, toggle switch	A-H & H Co.
2	SPST, Bat handle, toggle switch	A-H & H Co.
1	Post-Lite No. 105	Drake Mfg. Co.
1	Fuseholder, 3AG, Type #302003	Littelfuse, Inc.
1	Socket, Octal, Production	Sylvania Elec. Prod. Co.
1	Rectifier, 100 ma. selenium Type 5M1	Radio Receptor Co., Inc.
1	Capacitor, 20 mfd, 250v; Cat. No. BR-2025	C-D Electric Corp.
1	Resistor, 47 ohm, 2w, 10%, Type BW-2	Ohmite Mfg. Co.
1	Resistor, 15,000 ohm, 2w, 10%, Type BW-2	Ohmite Mfg. Co.
1	Resistor, 4700 ohm, 1w, 10%, Type BTA	I.R.C.
2	Resistor, 470K ohm, 1w, 10%, Type BTA	I.R.C.
1	Resistor, 100 ohm, 1w, 1%, Type DCF	International Resistance Co.
1	Potentiometer, 10,000 ohm, Type CU 1031	Ohmite Mfg. Co.
1	Power Cord and Plug Assembly, 3-wire	
1	Transformer, 11.5v sec/11.5 A, Cat. No. 68G 117	General Elec. Co.
1	Power Supply Regulated, down to 100 vdc.	Penna. Test Lab.
1	Transformer, 125v, sec./50 ma.	

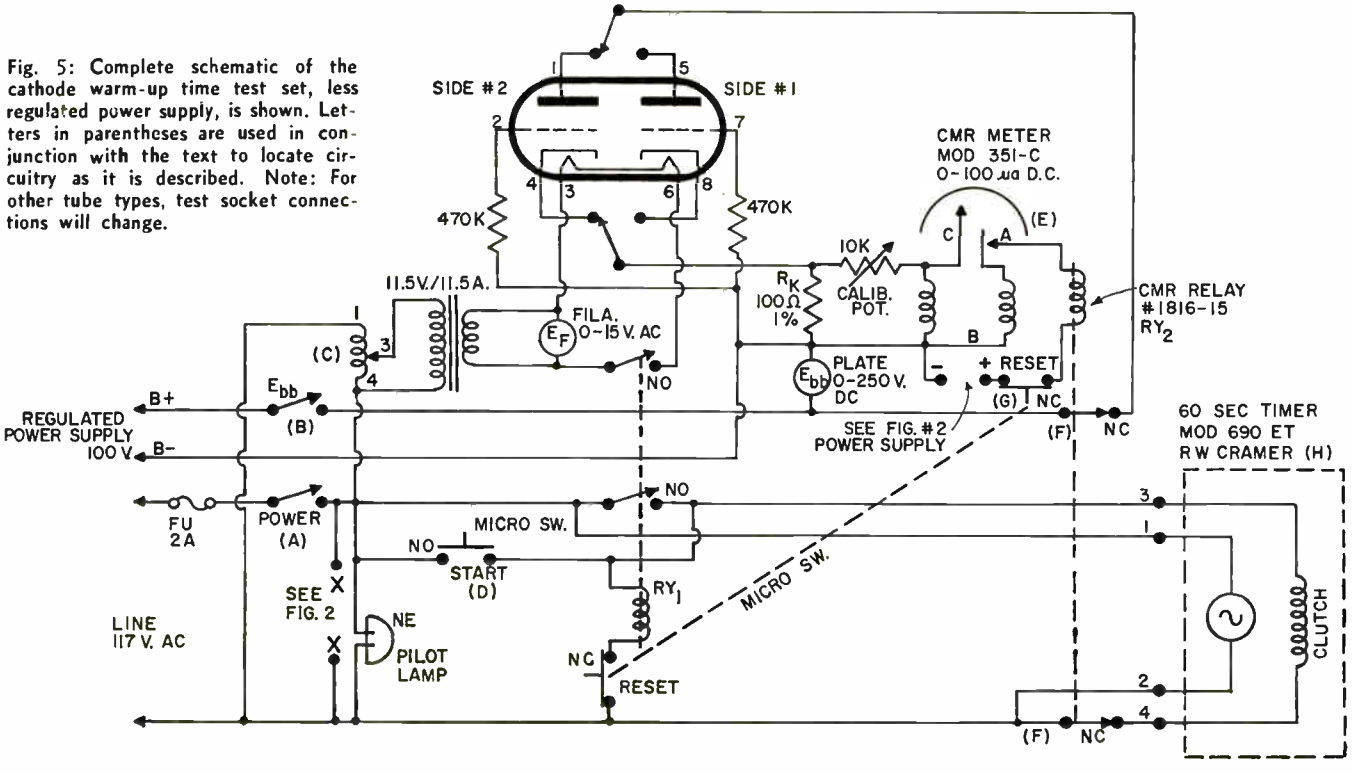


Fig. 5: Complete schematic of the cathode warm-up time test set, less regulated power supply, is shown. Letters in parentheses are used in conjunction with the text to locate circuitry as it is described. Note: For other tube types, test socket connections will change.

This is the sixth in a planned series of editorial features on Radio Frequency Interference arranged for by the editors of ELECTRONIC INDUSTRIES

In designing and installing transmission lines it is necessary to consider the role played by RFI. The basic considerations are given here. Included are the physical characteristics which are associated with the analysis or control of interference situations. The mathematical techniques used are demonstrated step-by-step.

Analysis of

RFI in Transmission Lines and Filters

By **DELMER C. PORTS,**
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THE physical connection between a radio frequency generator or receptor and an antenna frequently takes the form of a transmission line or waveguide and therefore cannot be considered a direct connection in the usual sense of the term. Distributed impedance parameters are present at all frequencies and a special study of the system from an interference viewpoint is required. In an interference situation a definite chain of events is observed. This chain starts at the generator with the formation of spurious r-f power. This power then passes through the coupling mechanism to the radiator, thence by radiation or by direct coupling and propagation mechanisms to the receiving location, and on to the receiver where it appears in combination with the desired signal.

This article discusses the transmission line as a complex, frequency dependent, coupling mechanism introduced between the antenna and transmitter. It outlines the basic factors associated with transmission line effects, their characteristic nature, and the extent of their influence. The general physical characteristics of transmission lines and filters which are associated with the analysis or control of interference situations are also presented. Particular attention is afforded the unpredictability of certain of these characteristics and their significance in terms of the deviations observed in measured spectrum signatures. Such unpredictability must be considered in any approach to a usable interference solution.

The analysis of an electronic complex presents many challenging problems to the interference engineer. His function differs from that of the design engineer in that he must understand and describe the complex much more completely. He is interested not only in the output of a given system within its designed frequency range, but also in its output at all other frequencies. Unlike the design engineer he cannot choose his mode of operation nor can he pick convenient component values. The methods of analysis that he must use involve much more detail since he is not in a position to make many of the simplifying assumptions that are so often allowed in design work. In this connection he must study the system in its nonlinear form over broad frequency ranges.

Generally speaking, the interference analysis of a communications system can be approached in three different ways, (1) the macroscopic approach, (2) the microscopic approach, and (3) the compromise approach. The basic characteristics of these approaches are outlined below.

1. The *macroscopic approach* is essentially a systems approach. The only parameters considered are overall

system parameters; no consideration is given the individual elements which comprise the overall parameters.

2. The *microscopic approach* considers each individual element of the system as an entity and the analysis process then takes account of the interaction of all of these elements.

3. The *compromise approach* combines aspects of both the first and second approach. The system is broken down into black boxes which represent, both theoretically and physically, logical divisions of the communications system. The parameters of these black boxes are then derived from a systems point of view where only the overall parameters of the black boxes are considered.

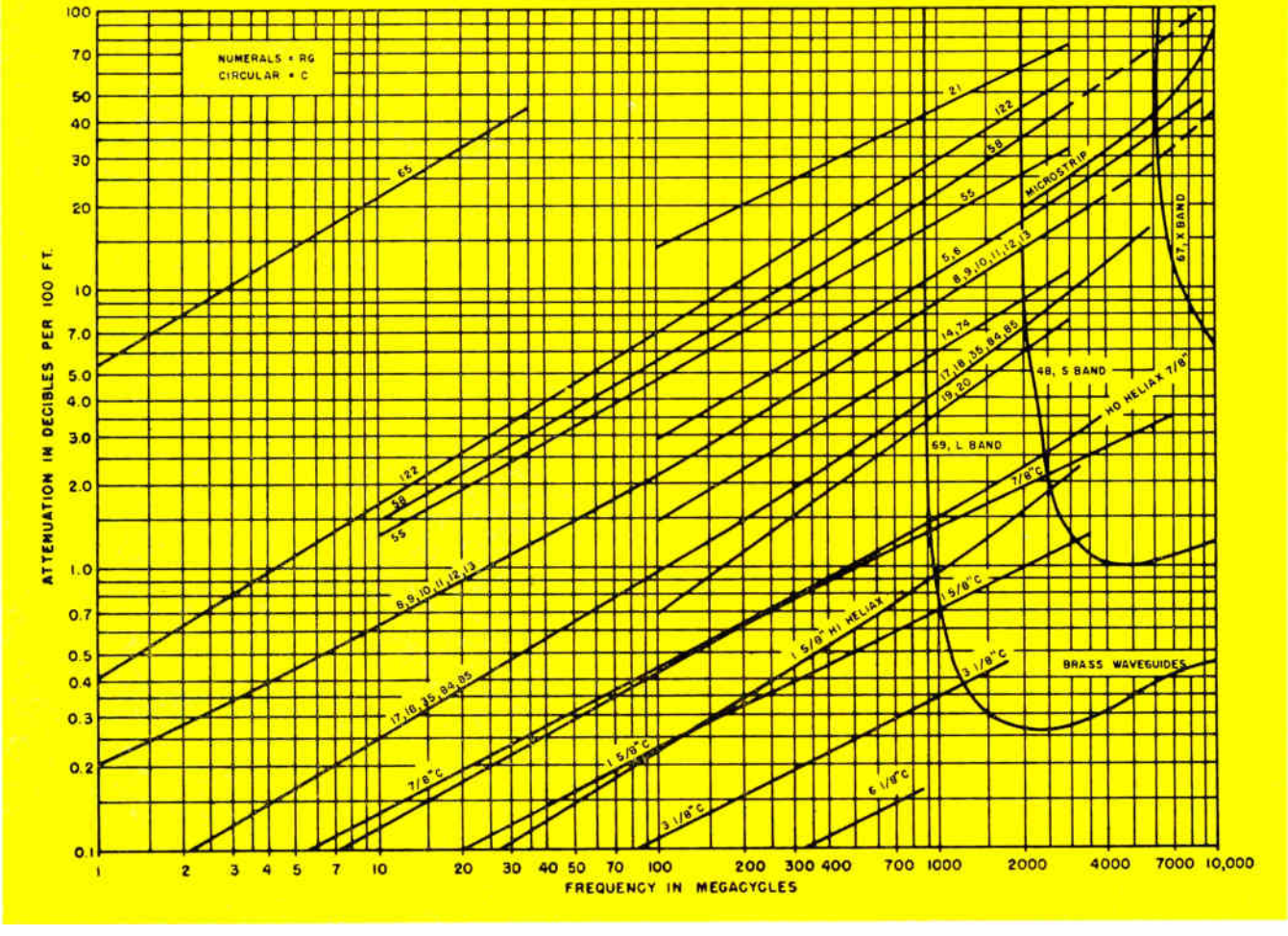
Of the above three, the first approach holds a clear-cut advantage from the analytical point of view. There are two reasons for this. First there are a minimum number of parameters to be considered and second these parameters represent overall system parameters and therefore give a direct indication of the performance of the system. The second and third methods have two apparent disadvantages. First, there are a large number of parameters to be considered and second these parameters have only an indirect effect, i.e., they must be combined properly in order to determine their effect on the overall performance of the communications system.

If it were necessary to consider only the ease of analytical treatment in this problem, the choice of approach would be obvious. However, the engineering aspects of the problem must also be considered. If the first approach were chosen because of its analytical simplicity, without first considering whether it were possible or practical to measure the overall system parameters, then this approach would be a very poor choice indeed.

From a measurement point of view, the second approach would be best, since the measurement of the properties of each of the elements in the system would not present any conceptual problem. The measurement of parameters for the third approach would not be quite as simple since it would involve frequency dependent measurements, but it would still be possible.

In the final analysis, the first method is of limited merit from a practical point of view. In order to measure the overall parameters of the system directly, it would be necessary to assemble the complete system. Once this was done, there would be no purpose in measuring individual system parameters since the spectrum signature of the system as such could be measured directly. This approach would defeat the whole purpose of interference analysis, since it would be necessary to assemble a complete system before any results could be obtained.

Fig. 1: The theoretical attenuation characteristics of typical transmission lines and waveguides are plotted.



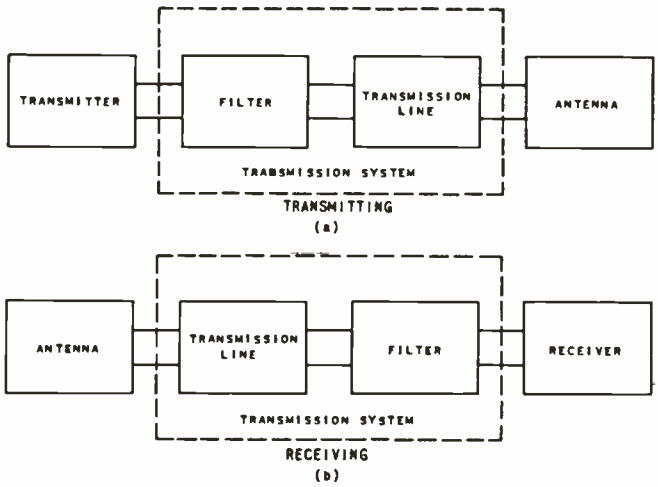


Fig. 2: Block diagram illustrates a typical communication system.

On the basis of the above discussion, the logical choice for an approach would seem to be the third or "compromise approach." This is the most logical choice because it combines a relatively simple analytical treatment with measurement requirements that are at the same time possible and practical. Therefore, this article is primarily concerned with the development of the compromise approach and its specific application to transmission lines and filters. Before presenting a detailed analysis of the problem some practical considerations which influence RFI in transmission systems will be discussed.

Transmission Lines

The first group of transmission mechanisms to be considered, i.e., the physical equipment that comprises the transmission system, will be of parallel-wire systems and coaxial lines. The parallel-wire system may be a two-wire system or a multi-wire system depending primarily on the power handling capacity required. Corona effects and arcing are the most important power limiting factors in the parallel-wire system, while arcing is the most important power limiting factor in coaxial line systems, particularly in pulsed systems. These factors are important because of the possibility of direct coupling to nearby systems. In parallel open-wire systems operating over reasonable distances, The possibility of objectionable direct coupling decreases as the number of wires employed increases. In general it may be said that parallel-wire systems exhibit less loss than equivalent coaxial lines. However, the coaxial lines do radiate less energy.

Corona effects and attenuation per unit length at a given frequency are of particular interest in interference considerations. It should be noted that the higher order harmonics and other spurious signals are not attenuated at the same rate. This phenomenon is illustrated in Fig. 1. The greater attenuation rate observed at the higher frequencies is not necessarily a desirable factor in braided-shield coaxial lines. Coaxial lines which use a braided shield radiate more readily through the shield as frequency increases, thus giving the appearance of greater attenuation. If, however, it is known that such leakage is very low, then the inherent low-pass characteristic of the line can be used to good advantage.

Flexible coaxial lines will radiate interference into space regardless of the termination of the line. As a result of leakage, currents flow on the outside of the shield. These currents cause the formation of standing waves along the cable which then affect the RFI situation. Filters are placed in the system just before the antenna in some applications. If this is the case, the filter will, of course, have no effect on the leakage of the transmission line and will only enhance the overall system as far as the antenna's radiation is concerned. The level of the radiation from the coaxial line is much greater than the indicated theoretical levels.

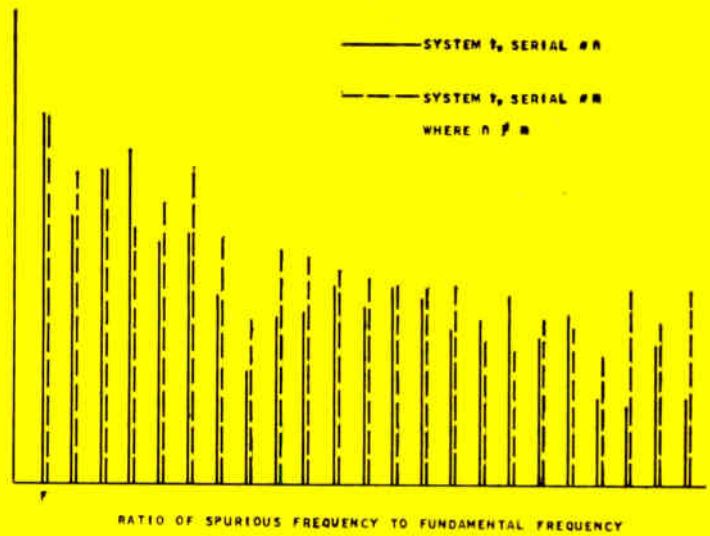
In systems that use flexible cable the use of double shielded cable will give on the order of 25 db improvement over a single shield of the same construction. Systems that do not require the use of flexible coaxial cable can use coaxial cables with a solid copper shield. These cables have negligible radiation. One intriguing factor in the leakage by braided shield cable is that the electro-magnetic leakage fields are not always concentric about the coaxial line.

Another source of leakage originates from the connectors of the system. Quick-disconnect/connect connectors introduce impedance discontinuities. These discontinuities enhance leakage. It should be emphasized that when an impedance match is made at one point there is no reason to presume that the junction is matched over broad frequency ranges. Proper installation of connectors will greatly reduce the leakage from connectors. Points to be aware of in these considerations are:

1. A good bond between the cable shield and the shell of the connector.
2. Elimination of all air gaps in the connector.
3. Use of connectors built to close mechanical tolerances.
4. Capping of all panel-mounted connectors not in use.

The attenuation of the r-f energy at the shield is due to two distinct effects. These effects are the re-

Fig. 3: Typical output spectrum for two transmitting systems.



flection of the energy at the shield boundary and the absorption of the wave as it passes through the shield. The combined effect of reflection and absorption losses is termed the "attenuation" of the cable.

Transmission Line Filters

In addition to the actual transmission line used in a transmission system, impedance-matching networks and filters may also be employed. The filters frequently used with transmission lines are the familiar constant-K and M-derived filter sections. Design considerations for these filters are found in most electrical engineering handbooks.

Ideal filters can be conveniently classified in two groups: (1) reflection types and (2) absorption types. The reflection type, as the name implies, reflects the filtered signal back into the generator. The generator in turn passes the filtered signal to the surrounding environment in the form of heat. The absorption filter passes the filtered signal directly to the environment again in the form of heat.

In many low frequency systems which employ impedance-matching networks at the antenna or at other points in the transmission system, the inherent low-pass characteristics of phase lagging transformation networks may be used to advantage.

Other design considerations for filters and impedance-matching networks that must not be ignored from an interference point of view are those dealing with circulating currents and those concerned with shielding. Filters must be designed so that if circulating currents do occur at frequencies removed from the pass band, the system will be capable of handling them. Adequate shielding is important, for if the device is not adequately shielded it may become an efficient radiator of the very component that it was designed to suppress. Many h-f systems do not require the use of impedance-matching networks. However, if filtering is required in these cases, filters as such must be added to the system.

Waveguides

Waveguides form the second major group of transmission mechanisms to be considered (transmission lines and filters forming the first). Waveguides take various cross-sectional configurations — rectangular, square, and circular being the most common. The attenuation per unit length in a waveguide is not constant for all frequencies. In fact, at a given frequency the attenuation varies depending upon the mode of operation in the waveguide.

Some waveguide attenuation characteristics are shown in Fig. 1 which illustrates the high-pass characteristics of a few typical waveguides. As noted above, the power handling capabilities of a waveguide are determined after consideration of the measured arcing level and the theoretical power level required. Either of these two factors may be the limiting factor in a particular case. The critical value of electric field above which breakdown occurs in waveguide systems depends upon a number of interdependent factors:

1. The composition and pressure of the air or other gas filling the device.[1]
2. The signal frequency.
3. The size and shape of the region over which the electric field approaches its maximum concentration.
4. The presence of nearby conducting surfaces, their shapes, and their spacing.
5. The pulse length, shape, and repetition frequency.

Leakage from joints and from "leaky" filters, present the possibility of direct coupling to nearby systems. If breakdown occurs for periodic portions of time, additional spurious products and cross-modulation products must be considered in RFI studies.

The greater the number of joints and bends that a system has, the greater is its capacity for supporting different transmission modes. Unless the amplitude of a given signal in a given mode is known, it is difficult to determine the attenuation per unit length. In fact a detailed analysis of waveguides is very complex. The standard techniques used for waveguide analysis do not predict many of the observed phenomena any more than do the standard transmission line techniques predict many of the phenomena observed for transmission lines. No adequate waveguide techniques have been developed to date which can be applied in the prediction of RFI effects.

1. E. M. T. Jones, S. B. Cohn, and E. D. Sharp, "Investigations of High Power Filter Techniques," Stanford Research Institute, Menlo Park, California, Mar. 1960.

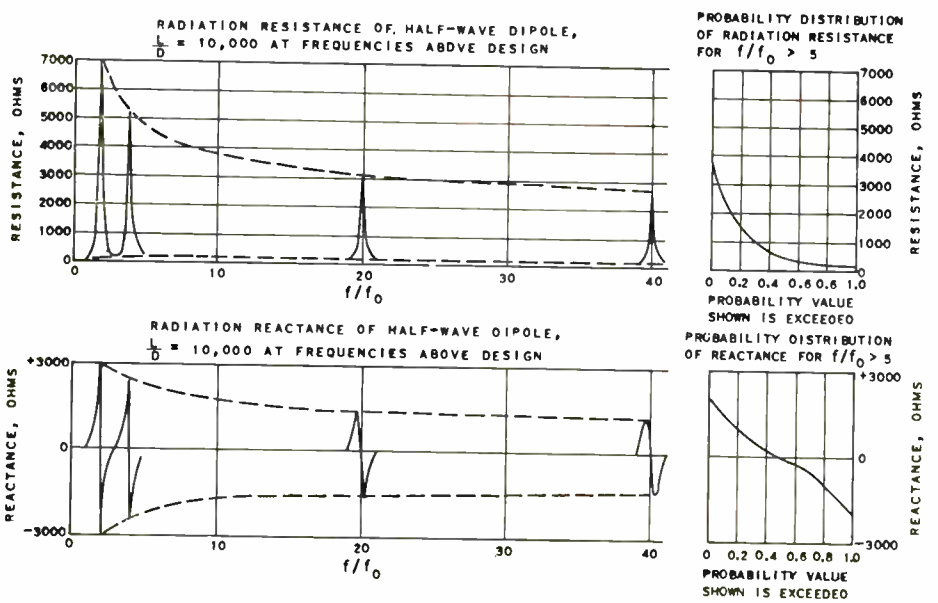


Fig. 4: Characterization of typical antenna input impedance as a function of frequency.

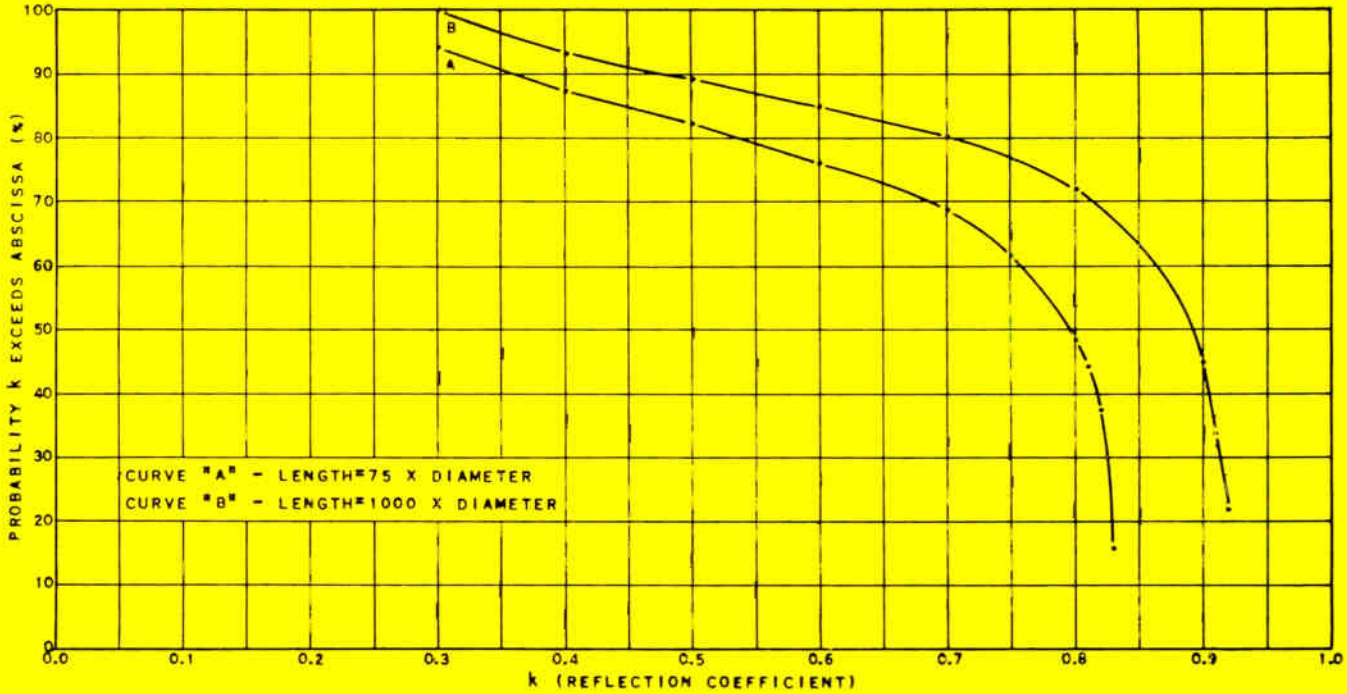


Fig. 5: Probability distribution of reflection coefficient for a long thin center-fed wire matched to transmission line at lowest resonant frequency.

Waveguide Filters

The inherent high-pass characteristic of the waveguide was illustrated in Fig. 1. It is possible to obtain a band-pass type of filter through the addition to the system of the proper low-pass filter. A waveguide filter whose function is to reduce spurious radiation should have the following characteristics:

1. In the pass band, the VSWR and insertion loss must be low.

2. In the stop bands, the insertion loss must be sufficiently high over a given frequency range to reduce the undesired signals to a reasonable level.

3. The filters must have sufficient power handling capacity to fulfill system requirements.

Waveguide filters may be classified in the following four groups: 1. Coupled waveguide filters; 2. Directional filters; 3. Direct coupled filters; 4. Leaky waveguide filters. Classes 1, 2, and 3 are reflection type filters. Class 4 is an absorption type.

Isolators are sometimes used in microwave systems to keep reflections from the antenna from interfering with the operation of the generator. Absorption type filters offer an advantage over reflection types in such systems in that these greatly reduce reflection in the real (i.e., practical) case.

If reflections are permitted to run freely through the system, it is possible for them to present additional low attenuation circuits for some of the higher order spurious signals generated in the transmitter. The enhancement mechanism for these spurious signals usually exhibits sharply resonant features. To avoid this, the number of bends and joints should be kept to a minimum. Careful alignment of all waveguide pieces will also help to reduce reflections. In addition to misalignment, reflections may be caused by minute imperfections in the walls of the waveguide and by burrs at the joints. All of these factors must be carefully controlled.

The development of new waveguide filters is one of the most rapidly advancing areas in microwave electronics. Today the newer waveguide filters utilize techniques which involve the use of Tchebyscheff polynomials. The difference between the theoretical or ideal case and the actual case increases as frequency advances. At higher frequencies the equal-ripple function (Tchebyscheff) becomes extremely useful.

Included in a current listing of waveguide filters one may find corrugated waveguide filters with longitudinal slots, dissipative filters with rectangular-side waveguides, offset dissipative-wall filters, serpentine leaky-wall circular dissipative-wall filters, dissipative filters with circular side waveguides, complete transfer coupler filters, and leaky-wall wire-grid filters.[2]

The Role of Statistics

Transmission lines, including waveguides, form one distinct portion of a communications system. Fig. 2 shows a typical system in block diagram form. A given communications system may or may not employ filters. However, the mathematical models of filters and transmission lines are essentially the same. Therefore, it is conceptually convenient to replace the separate blocks for the filter and the transmission line by one block representing the overall transmission system.

In many phases of communications system analysis of which an analysis of the transmission system is a major consideration, it is much easier to gain insight into the general problem by considering a particular example rather than attempting a broad general description of the problem. To illustrate one of the major problems in spectrum signature analysis, Fig. 3 shows a typical output spectrum for two transmitting systems. These two systems are for all intents and purposes alike. They differ only in the respect that no two physical systems can ever be

2. *Ibid.*

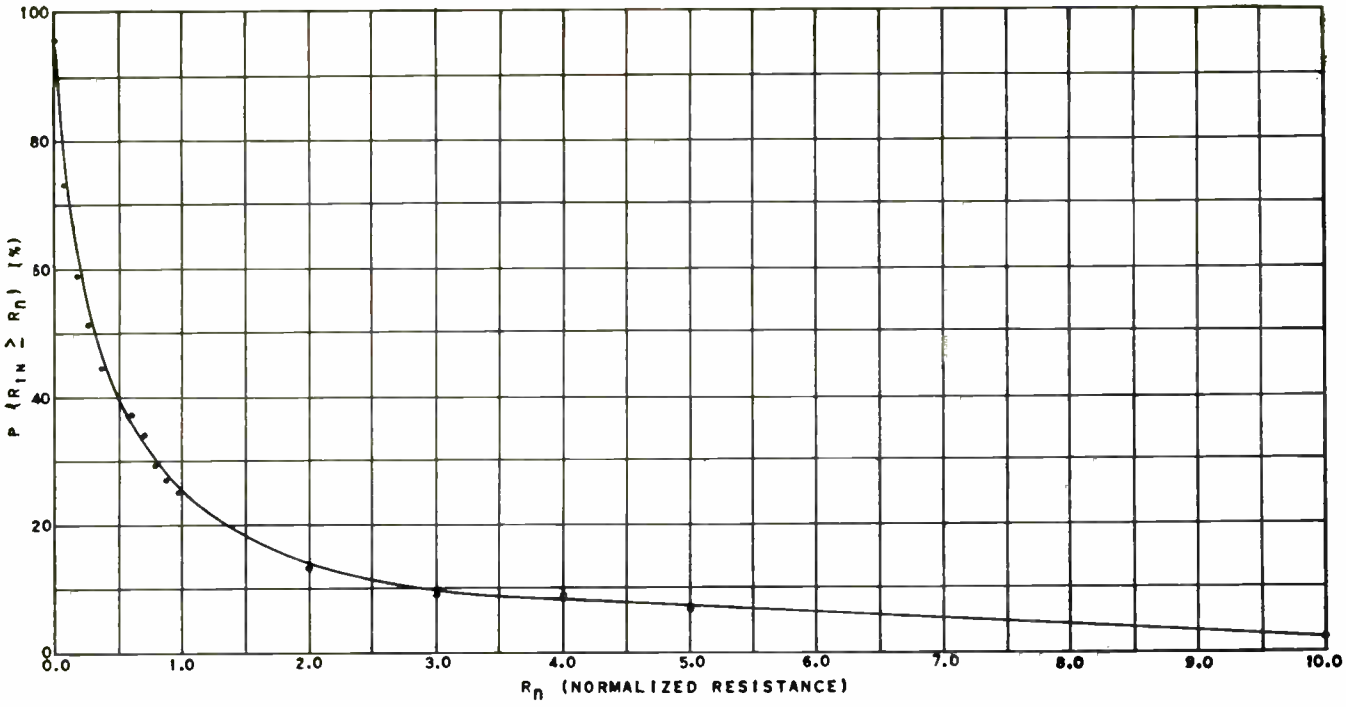


Fig. 6: Percent probability that real part of normalized input impedance exceeds R_n is plotted.

RFI Analysis *(Continued)*

exactly alike regardless of how much care is taken to make them identical. The difference between the two spectra arises from non-predictable factors associated with the system. Thus, in many phases of the analysis of system behavior, there are no precise numbers that can be applied to members of a class of systems. However, the use of statistical methods permits the description of the system in terms of the likelihood that a particular amplitude will not be exceeded.

The analysis techniques developed over the years have been slanted toward obtaining average numbers for such things as the attenuation per unit length of transmission line, connection losses, radiation losses, and phase shift per unit length. Deviations from these quantities will yield differences from these average values on the order of a few db. But, the variances shown in Fig. 3 are on the order of 20 to 50 db.

In order to account for these large variances, it is necessary to consider other factors. One such factor to be considered analytically here is the uncertainty in the length of transmission line, and its resultant effect on the power output spectrum of the system. Later it will be shown that this randomness will have a marked effect on the real part of the input impedance which the transmitter will see, and therefore on the power delivered by the transmitter.

In this connection it must be recognized that to make the analysis technique for a class of systems independent of any particular physical set-up, the concept of statistical probability has to be incorporated into the analysis. Thus, specifying unique values for the impedance parameters of a transmission system requires an exact knowledge of the physical arrangement of a specific system, and yields results which are valid only for that system. Through the use of statistical methods, values of general validity can be determined for these parameters on the basis of statistical probability and the statistically determined values can then be used in a general analysis.

Solution of a Typical Problem

In any of the standard transmission line analysis techniques, it is implied that the parameters of the system be unique for a particular type of line. However, as was stated above, this is an unrealistic assumption because of the randomness introduced by the uncertainty in the electrical length of the transmission line. In order to demonstrate the mathematical techniques which are used to incorporate this uncertainty in length into the problem, a treatment will now be carried out for a typical example.

A. Statement of the Problem

Given the probability distribution for the radiation resistance and reactance of an antenna (which will determine the probability distribution of its reflection coefficient when connected to a transmission line of known characteristic impedance Z_o), and assuming that the transmission line is lossless and its length is known only approximately, determine the most probable value of the impedance which any transmitter would see, independent of its operating frequency, looking into the system made up of the transmission line plus antenna.

The most probable value will be determined assuming that no information is available concerning the type of transmitter which is to used. Therefore, the most probable value will be a property of the transmission line and antenna, and will be independent of the particular transmitter which might be attached to the system.

The most probable value of the real part of the input impedance can then be used, together with the spectrum signature of whichever transmitter is to be used, to determine the probable power spectrum which the antenna will radiate. That is to say, spectrum signatures obtained by standard techniques can be adjusted to give more realistic spectrum signatures by taking into account the variations which will be shown to exist between the standard loads used and the actual loads the physical systems exhibit.

B. General Statistical Method

This section will be concerned with the formulation of the general techniques which will be used to treat the problem stated above.[3]

For convenience, let

$$Z_{in} = \frac{Z_1}{Z_o} \tag{1}$$

where Z_{in} is the input impedance of transmission line plus filter normalized to the characteristic impedance of the transmission line.

By standard techniques it can be shown that

$$Z_{in} = \frac{1 + k\cos\phi - j\,k\sin\phi}{1 - k\cos\phi + j\,k\sin\phi} \tag{2}$$

where k = the reflection coefficient of the antenna knowing the characteristic impedance of the transmission line to which it is attached

$\phi = 2\beta l$

β = the phase shift constant of the transmission line

l = the length of the transmission line.

The real part of the normalized input impedence, R_n, is found by taking the real part of Eq. 2. Thus

$$R_n = Re\,(Z_{in}) = \frac{1 - k^2}{1 - 2\,k\cos\phi + k^2} \tag{3}$$

Only the absolute value of k has been used in Eqs. 2 and 3. This can be done because of the assumption of random length. Because of this randomness of length, the initial angle of k would be of no importance since the phase shift introduced by the factor $2\beta l$ would be random and therefore the total phase angle could be any value within the range of zero to 2π.

The probability that R_{in} is equal to or greater than some value R will be a double integral of the form

$$P\,(R_{in} \geq R) = \int_{k_1(R)}^{k_2(R)} \int_{\phi_1(k,R)}^{\phi_2(k,R)} K\,(k)\,\Phi\,(\phi)\,d\,\phi\,d\,k \tag{4}$$

where $K\,(k)$ = probability density of $|k|$

$\Phi\,(\phi)$ = probability density of ϕ

and k_1, k_2, ϕ_1, ϕ_2 are limits of integration imposed by Eq. 3.

The probability density, $f(R)$, of R_{in} can be obtained from Eq. 4 and is given as

$$f\,(R) = \frac{d}{d\,R}\left[P\,(R_{in} \geq R)\right] \tag{5}$$

This is a result of the definition of probability density which is

$$P\,(R_{in} \geq R) = \int_{R}^{\infty} f\,(R)\,d\,R \tag{6}$$

Unfortunately, the cumulative probability integral, Eq. 4, cannot be used directly to determine the probability density for R_{in}. This is the result of two limitations, the first being a mathematical one and the second a practical one.

1. The limits k_1, k_2, ϕ_1, and ϕ_2 are not continuous functions of the parameter R. That is, for $R \leqslant 1$ the limits take one form, while for $R > 1$ the limits take another form.

2. The probability density for k will not usually be known as an analytic expression but rather will be known only in the form of experimental data.

The difficulty posed by (1) can be handled without any great difficulty by making a transformation of coordinates to a rectangular system. When this is done, the limits of integration become continuous functions of the parameter R. However, because of (2), it becomes necessary to evaluate Eqs. 4 and 5 by numerical methods. The integral of Eq. 4 is approximated by a discrete summation and the differentiation required by Eq. 5 is carried out by using a finite difference ratio $\Delta P/\Delta R$ rather than the limiting ratio $d\,P/d\,R$.

C. A Typical Result

In this section, results typical of the type obtained when the methods of Section B are applied to a problem of the type outlined in Section A will be presented.

A typical set of antenna input impedance curves are shown in Fig. 4. Fig. 5 shows the cumulative probability distribution for $|k|$ that is obtained from the curves of Fig. 6. The probability density function, $K(k)$, *for* $|k|$ can be obtained by graphical differentiation of the curves shown in Fig. 5. The probability density function, $\Phi(\phi)$, for ϕ is postulated from the assumption that the uncertainty in length of the line is completely random. Therefore, it is assumed that all values of ϕ from zero to 2π are equally probable.

Using these assumed forms of $K(k)$ and $\Phi(\phi)$, the cumulative probability distribution obtained for R_{in}, $P(R_{in} \geqslant R)$, is shown in Fig. 6 and the probability density obtained for R_{in}, $f(R)$, is shown in Fig. 7.

It can be seen that the most probable value of R_{in}, which is $R = 0.1$, is a sharp peak in the probability density function shown in Fig. 7. It was found that this curve could be fitted almost exactly by a log-normal distribution of the form

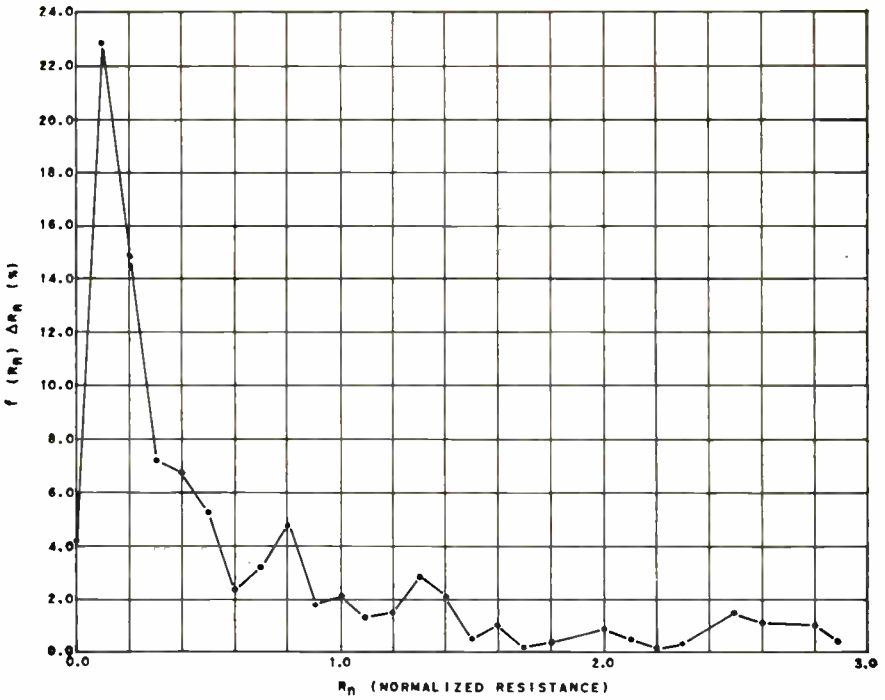
$$f\,(R) = a\,\epsilon^{-b\left(ln\,\frac{R}{R_o}\right)^2} \tag{7}$$

where R_o = the most probable value of R, which equals 0.1 for the example considered.

It must be emphasized at this point that this most probable value for R_{in} is valid only for frequencies removed from the fundamental. In particular, for this example, the curves shown in Figs. 4 and 5 are valid only for frequencies, f, such that f/f_o is greater than 5, where f_o is the lowest resonant frequency of the assumed antenna.

3. Jansky & Bailey, Inc., "Interference Prediction Study," Final Report, Vol. I, RADC-59-224, Jan. 1960, Contract Number AF 30(602)-1934.

Fig. 7: Percent probability that real part of normalized input impedance lies between R_n and $R_n + \Delta R_n$.



RFI Analysis

(Concluded)

The distribution, and the most probable value, for the reactive part of the input impedance of the transmission line plus antenna has been completely ignored in this treatment. The justification for this omission is the following. From the typical curves for antenna impedance shown in Fig. 4, it can be seen that it is equally probable that X_{in} will be positive or negative. Therefore, as a result of purely qualitative reasoning, it can be seen that the most probable value of X_{in} will be zero. That is to say, the most probable normalized input impedance will be purely real with a magnitude R_o.

D. The Significance of R_o

In the previous sections it has been shown, through some very simple statistical considerations, that the most probable value of the real part of the normalized input impedance is, $R_n = 0.1$. That is, for a system using a transmission line whose Z_n is the standard 50-ohm value, the most probable value of Z_n at spurious frequencies is 5 ohms. At this point in the discussion the reader may logically question the significance of this result.

The answer to this question is indeed quite simple. In interference control work, there is a concept which is commonly used to characterize transmitters. This concept is the so-called "spectrum signature." In the use of this term, it is always implied, if not actually stated, that it is possible to make measurements at the output terminals of a transmitter which will uniquely characterize this transmitter and its interference capabilities.

The standard method of determining this output spectrum is to attach a standard value (e.g., 50-ohm). purely resistive, dummy load to the output terminals of the transmitter and measure the frequency spectrum of the power delivered to this load. The justification for the validity of this method follows.

The antenna and associated filters in a transmitter system are designed such that at the fundamental frequency the impedance of the load is matched to the standard transmission line characteristic impedance of 50 ohms. Thus, at the fundamental frequency the transmitter will be operating into a purely resistive load of 50 ohms. It is therefore reasoned that if a 50-ohm dummy load is attached to the transmitter, a power density spectrum can be measured which will be a significant and valid characterization of the transmitter's interference capabilities.

However, it has been found, as stated earlier in this discussion, that measurements made on actual systems in operation yield output power spectrums, measured at the antenna, which vary as much as 20 to 50 db from the values predicted from the spectrum signature method. These large variances cannot be accounted for by the analysis techniques generally employed. However, they can be accounted for by the type of results obtained in the preceding sections.

These results show that the power delivered to a 50-ohm dummy load is not a realistic index of the power which a transmitter would deliver to an actual antenna at frequencies which are off fundamental. In fact, for the typical antenna characteristics considered in the preceding example, it was found that the most probable load would be 5 ohms purely resistive.

Thus, it can be seen that at off-frequencies, there is a 20 db likelihood of error in the standard load used to determine the spectrum signature. That is, the most probable value of the real load represents a 20 db variation from that of the standard load.

It should be noted that although 5 ohms is the most probable load, it is not the only possible load. There is a finite probability that the real part and the reactive part of the load impedance could be any value within a broad range.

Therefore, it should be recognized that the variations which are observed in measured spectrum signatures are not really so unaccountable as they may appear to be at first glance. It has been shown, in the quite simple example given here, that such wide variations in output power are not only possible but in reality they are very probable.

This then is the significance and justification of the statistical approach to this type of interference prediction problem.

This car is an insurance company's dream—it eliminates the driver. RCA demonstrated an electronic highway through which the driverless auto is controlled. In this case the lead car is initiating signals through the highway which control the second car.

By JOHN E. HICKEY, Jr.

Associate Editor
ELECTRONIC INDUSTRIES

First of a Series

Searching for

New Electronic Markets

What truck-fleet owners need in electronic equipment . . . Interesting electronic products that are opening new markets . . . Industrial problems ripe for electronic solutions.

WITH electronic companies diversification has become a watchword. This is because today the largest portion of the gross annual electronic business is dependent on the military dollar and under this condition the long-term stability of the industry is always in question.

In general, the smaller electronic companies are more completely dependent on military business for survival. Many make specialty military products only and as a consequence are extremely vulnerable to any changes in military procurement practices. There is, then, a constant hope and desire on the part of such companies to find new market areas for the products they now produce or to develop new marketable products. The many company mergers and consolidations we have witnessed over the past few years are a mute testimonial to the struggles in this connection.

J. E. Hickey, Jr.

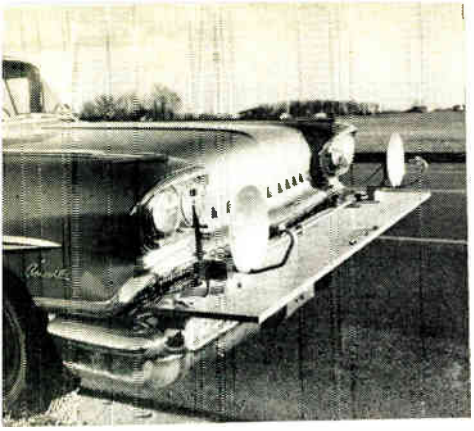
For the sake of future industry stability, the non-military industry segments (consumer and industrial) must be enhanced and broadened. All electronic manufacturers should be active in trying to locate or create new outlets for products they can design and produce.

For the past months the editors of ELECTRONIC INDUSTRIES have been very actively engaged in trying to uncover new electronic markets. (See "Ideas—Insure the Future" page 1, October, 1959.) One of the major stumbling blocks encountered has been the poor communications that exist between the electronic industry and other industries.

There are many industrial activities that could make immediate use of our knowledge and facilities to help them obtain better production and to raise the quality of their goods or services. In many instances electronification will also lead to substantial cost reduction. These industries, however, do not know what our capabilities are, nor do they know how to convey their problems to us. We do not know enough about their industry or their problems to properly approach and help them.

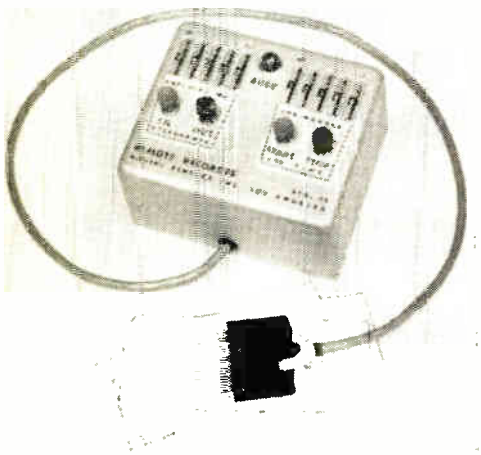
One way to overcome this communication gap is for representatives of our industry to attend professional meetings of the other industries groups. In this way we establish contact and we also learn what problems they have. Knowing the problems will enable us to recommend an electronic solution.

Four Chilton publications recently tried this attack jointly. The editors of ELECTRONIC INDUSTRIES, COMMERCIAL CAR JOURNAL, AUTOMOTIVE INDUSTRIES and DISTRIBUTION AGE

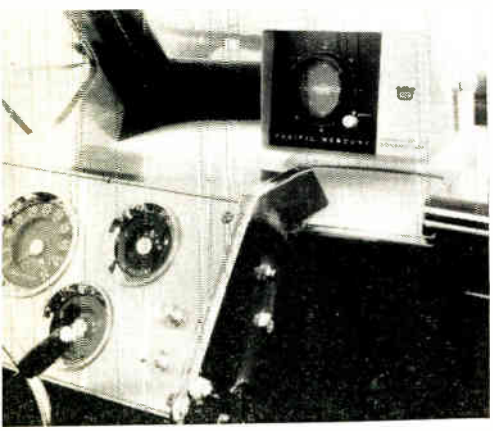


A "breadboard" stage of Delco Radio's experimental proximity device which will automatically stop the car if an object is too close.

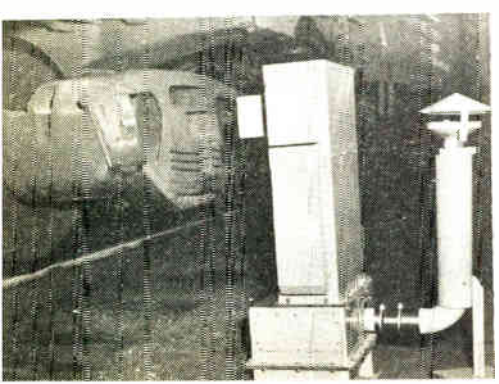
Capacitance alarm developed by Kidde & Co. can be used to protect metal filing cabinets and small safes. Anyone touching protected item will set off an alarm.



Instead of time cards and clocks, an employee merely dials his number and then presses button. Output of unit can be fed directly to a computer for accounting purposes. (Digital Sensors, Inc.)



There are many electronic items available for small boats. Here is a transistorized fish finder built by Pacific Mercury.



This infrared hot box detector made by Link Aviation, Inc. has been credited with preventing many costly rail accidents.

attended the American Trucking Association's Common Carrier Conference in Washington, D. C. The editors, together with representatives of the Truckers Association, acted as panelists at an open forum. The forum was titled, "Where Can Electronics Help Cut Your Fleet Costs?"

Why did these four editors get into the act together? Well, these are all editors of business magazines published by the Chilton Company working as a team to benefit their individual readers. First, Bart Rawson is the editor of COMMERCIAL CAR JOURNAL, which is the publication serving the trucking industries. In the future the truckers will relay their problems or desires to him. He will then pass this information along to Bernie Osbahr, editor of ELECTRONIC INDUSTRIES, Hartley Barclay, editor of AUTOMOTIVE INDUSTRIES and Al Greene, editor of DISTRIBUTION AGE.

We of ELECTRONIC INDUSTRIES will pass this information and desires along to our readers on subjects that are directly tied to the electronic field. Hartley Barclay, editor of AUTOMOTIVE INDUSTRIES, will alert his readers to what they are looking for from the vehicle manufacturers' viewpoint. The vehicle manufacturers knowing what the truckers wish will be more interested in what we, the electronic manufacturers will have to offer. Al Greene, editor of DISTRIBUTION AGE, will tell his readers, the shippers, also what's going on. In many cases the best possible solutions will also require the shipper's cooperation. The shipper will always be interested in anything that will cut his shipping costs.

Now, back to the conference. Before the conference started, the four editors compiled a list of questions and submitted these to the people attending this session. At the end of the session, questionnaires were checked off by the attendees and returned to the moderator. Some of the truckers preferred to take the questionnaires along with them for further study and evaluation before making comments or checking off the answers to the questionnaires. These are being mailed in. These questionnaires will be analyzed for additional new ideas and also as an indication of trends to come.

While the irregular route carriers use mobile communications quite heavily, the panel discussion indicated that there were many avenues still left open. The trucking operators still desire fast, economical and reliable communications, possibly automated. They also showed a great deal of interest in independent microwave systems. The trucking operators wanted equipment that was static free, eliminated dead spots and also prevented someone from listening in. They wished to be able to contact any truck and its driver immediately and at any time or location.

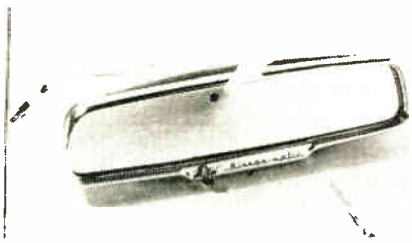
Here are some other items that commanded a great deal of interest by the truckers. Most of these are possible to design and produce with today's technology. While some of these may seem disjointed, there is no doubt that several of them can be incorporated in one black box.

Obstacle Indicator

The size of today's trucks create major problems when moving or backing up the truck. One of the items that a large number of truckers showed an interest in would be a device, such as radar or sonar, which would have a range of 250 to 500 ft. ahead and less behind. This device would indicate low bridges or low hanging obstructions. This is of particular interest to truckers who carry odd sized or bulky loads. It would prevent the truck from becoming wedged or damage to the load because of overhead obstructions such as bridges, wires, etc.

The device should be adjustable for various desired road height clearances. It should have an audible or visual signal, or probably both in the cab of the truck. As a truck would approach an overhead hazard that it could not safely pass under, a warning light or buzzer would sound. Perhaps the device could be a form of radar screen showing the outline of this object. The scope on this piece of equipment might also function as an oscilloscope to check engine performance while the truck is operating.

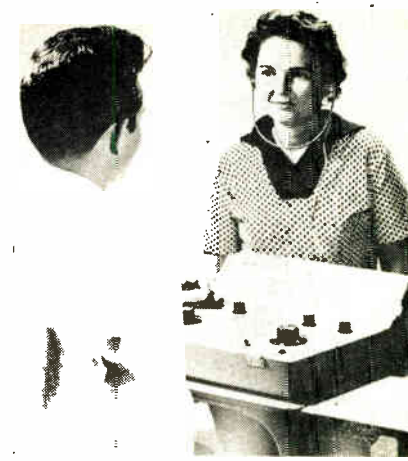
This device or a separate device could be used for side and back clearance when maneuvering the truck into a tight alley-way or up to a loading platform. When the driver sits in the cab of his truck it is difficult to judge exactly how close he is to a loading platform. Also, on the other side of his truck he has to use a mirror to see what his clearance is. This device could be coupled with the one that indicates overhead obstacles. The device would have to be accurate to inches to be of any real use to him. Also the cost must be low in order to encourage the operator to use it. Of course with a mass market this shouldn't be too difficult. These "see" devices could also be coupled to the brakes. In the event the driver is not alert or his reaction time is not as fast as it should be, the brakes would be applied automatically when a collision is imminent. Speed of the vehicle would have to be considered in the unit to insure enough space for stopping.



Small photosensitive cells by Clairex Corp. are the heart of a car mirror that automatically changes when car behind starts to blind driver.

Recorders showed a great deal of interest at the truckers' conference. To them a form of tachograph had the most immediate possibilities of all. Improved tachographs would have a multichannel tape which could be fed directly to a computer. By feeding it directly to a computer, costly time consuming clerical work could be eliminated.

Some of the data that could be included on the tape would be a driver log, wage computation, fuel consumption by state, mechanical conditions, and even accident impact, load weight, refrigeration, temperatures, waiting time, and many other items. The unit should be fool-proof to prevent the truck drivers from tampering with it.



Electronic equipment has been a blessing to the medical profession. Here the exact amount of hearing loss is measured by a device manufactured by Audiotone, a div. of Royal Industries.

The truck owners are eager for low-cost data processing systems. The systems should be specially designed for trunk fleet operations. Most of the truckers complain that the available equipment was too large and too expensive for their operations. Some suggested modifying existing small data processing equipment just for their industry. If possible, they would like to avoid hiring specialized programmers for this equipment. A possible answer would be to supply a well-written manual which details the use of this machine to get the desired answers from their business transactions.

Overweight a Nightmare

Weight loading and overweight on trucks is a nightmare to most fleet operators. They would like to have an electronic indicator on each truck that would indicate the payload of the truck, with a warning device to let them know when the truck has gone over the top load capabilities. The "scales" would have to be automatic and incorporated in the truck. They would also like to have a device which would tell them how many cubic feet. of loading space was still left.

Another costly problem to the fleet operators is the waiting time at loading docks. Many times a truck will roll-up to a loading dock to find that there is no dock loading or unloading space available to him. If some means could be arrived at to eliminate this, perhaps a sort of a "dock is loaded" signal that would alert the trucker or the dispatcher to by-pass this particular location for a while.

Even the drivers would like this latter problem solved. They could avoid the scowls from the dispatcher after a long delay for not having completed the run without going into overtime.

There is a strong desire for written as well as oral contact. Some type of low-cost facsimile device may be the solution to this particular problem. This equipment could be coupled into an automatic system. Here is how it could work. Assume that a customer calls in, writes in or has a standing order for a pickup. This data could be automatically recorded at a terminal and instantly transmitted, in writing, to a pickup truck in the area. When the driver has the load aboard he can instantly relay a facsimile of the bill-of lading to the initiating terminal.

When the package arrives at the consigned terminal,

it could be automatically unloaded, weighed, recorded, and transferred to a waiting out-bound trailer. Then, before the trailer leaves the terminal, its destination terminal would receive a copy of the entire transaction. There the process will be reversed and the shipment would automatically be on its way to the consignee.

Dynamometers programmed with the truckers actual road route ups and downs can be used to check out the truck. By this means they would be all but 100% certain that the truck would pull the load all the way, and on time to their customers. It would be a form of check-out equipment for the complete truck. It could be coupled into their data processing system and used when not processing other types of data.

Closed-circuit TV is already being used by a small group of trucking firms. However, it is not being exploited as widely as it should be. Some of the complaints were the cost of the system. It was obvious from parts of the discussion that there were a good many trucking manufacturers who were not aware of actually how much use a closed-circuit TV system would be to them. One trucker, however, suggested having a traveling camera, like an overhead crane, with location controlled by the viewer. He felt this would result in an efficient manpower utilization in their warehouses. It could also be used to read weight scales on the various trucks being loaded and show how much capacity is left in the trucks. A camera could be located at each loading dock so that traffic could be controlled in the various spaces.

On refrigerated loads, there should be better warning devices when the temperature exceeds a predetermined limit. Periodic temperature control readings could be incorporated on the tachograph tape. In this way if a cargo was spoiled by a temperature rise, the trucker could prove by his tape that certain temperatures were maintained during the time of transportation of the cargo and that defrosting took place before receipt of the load or after delivery.

Electronic refrigeration would find immediate application in the trucking industry. The possibility of obtaining refrigeration with no moving parts together with the possibility of compartmentalizing trucks using printed circuit refrigerating panels was another idea that caused great interest and discussion.

Interest was shown in a device that would rapidly heat diesel engines in cold weather. Perhaps a radar-range-type heating unit could be made to handle this problem. Leak detectors on tank trucks to prevent cargo damage, some type of tamper-proof electronic governor and low/high tire pressure alarm systems were also of considerable interest to the trucking industry.

Truck fleets of ten or more vehicles total over 59,000. (This figure includes light trucks such as milk, bread and other small delivery trucks as well as pick-up trucks.)

The above companies operate over 3.2 million trucks, other than light panel and pick-up trucks—these are not in 3.2 figure because most of these would not require the electronic equipment we mentioned above.

* * * * *

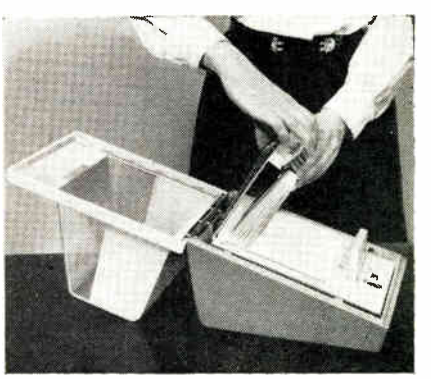
Gadgets, Devices & Systems

The number of gadgets, devices and systems that companies in the electronic field are capable of are infinite. Here are a few items and ideas, some of them quite strange, that we have come upon or heard of.

Television is a useful tool. Systems have been proposed for placing 3 satellites in orbit to make a world-wide television network. Closed-circuit television is being used in schools and universities for teaching. Banks have been making use of closed-circuit TV as a form of protection along with plants. Another use in banking is for bank transactions from a car. Many industrial firms use closed-circuit TV where it would be impractical or unsafe to use man's eyes directly. Provided the price of closed-circuit TV can be brought down, the uses for it can be unlimited. Many uses for TV can be found even in your own home. Yet most of these potential markets are still just that—potential markets.

An annual level of $20 billion has been forecast for the electronic field by 1970.

Now electronic items are invading the class rooms. There are several new teaching devices on the market that aid the teacher. Here students are using a teaching device made by General Atronic Corp. Below is a close-up of the teaching device.



There are several types of electronic equipment used as burglar or intruder alarms or for plant protection. One of these is a new capacitance alarm designed to guard safes, filing cabinets and other metal objects which can be insulated from the ground. Self-contained dry cells supply power for over 2000 hours of operation. The fully transistorized printed-circuit will automatically compensate for changes in temperature and humidity while retaining required sensitivity.

Another protective device utilizes ultrasonics. With it, a complete room can be protected. It will detect even small animals moving about in rooms such as cats. Both of these devices are being manufactured by Walter Kidde & Co., Inc., Belleville, N. J.

Our printing plant is located on the first floor of our offices. In our trips to the printing plant, we notice the lack of any type of automation or electronic equipment. One area in this industry to be explored is a means of rapidly setting type other than linotype which require an operator for each machine. Perhaps some equipment could be produced which would utilize normal typed material. This typesetting equipment could then automatically set the type and the spacing between words to come out in even lines like it does when set manually. To our way of thinking, the printing industry could use a great deal of electronically controlled automation right now.

Cars of the Future

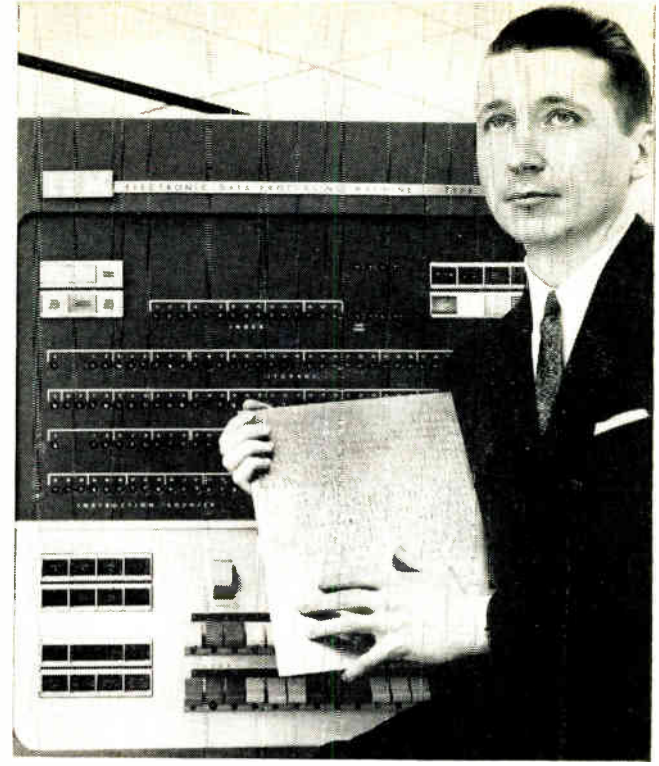
The automotive field has some big ideas for the future. There are several research projects going which consider using radar or other guidance methods to automatically steer vehicles. Should a vehicle approach too closely to an object, the brakes would automatically be applied.

Transistorized electronic ignition systems are being looked at very closely. They offer many benefits such as much longer breaker point life and better firing at high engine speeds. There is also an electronic ignition system under development which does away with the normal breaker points.

Some of the Chrysler cars utilize a little light sensitive cell mounted in the mirror. When the light beam of car behind starts to blind the driver, this little element senses the high light intensity and automatically flicks the mirror to a position where it does not disturb the driver. Once the car behind has either dimmed the lights or disappeared from behind, the mirror is automatically flicked back to its normal position again.

Air conditioners of the future in cars will probably have no moving parts. Cooling will be by an electronic means.

With 181,000 gas stations in the United States, a sizeable market is present. Bowser, Inc. of Ft. Wayne, Ind., has available a modular electronic fueling system. With their device the large pumps we are used to seeing would disappear. The pumping mechanism would be located either underground or completely away from the island. The Bowser unit is a small black box which has the price per gallon of gas, the number of gallons pumped, and the amount of the sale registering as the gas it pumped. Not unlike what we are familiar with now. However, by the use of



Computers are being used to help the handicapped. Dr. Joseph Flanagan, IBM, holds a braille printing plate which was produced electronically by an IBM computer. English text is transcribed at the rate of 4,000 wpm.

electronics this device is quite small and can be mounted in such a position that the driver does not have to strain his neck to see it.

In this new gas station equipment, a highly refined accurate electronic meter converts the fuel quantity flow into electricity. From this point on electronics does the work. Using this unit, printed tickets showing the transaction can be added. Credit cards can also be added to the printed ticket information or coins could control the dispensing process, thus eliminating the requirements of having an attendant deliver the gasoline. Push button control can be used to select the grade of gasoline to be delivered to the car. A small tape could be incorporated for use in processing equipment to facilitate clerical work.

Annual auto production in U. S. in 1959 was 5.6 million. 6.2 million are estimated for 1960. Some of these are exported and purchased by U. S. Gov.

New car registrations were 6 million in 1959. They have been steadily increasing at a rate of about 3% per year. This includes both domestic and foreign cars.

Electronics is being used to control automobile traffic. Some of the larger cities feed traffic information to a special, centrally located computer. Traffic flow is usually recorded by means of a treddle located in the street. With all these facts and information being fed into the computer, the computer automatically adjusts various traffic lights to permit a smooth flow of traffic.

Washington, D. C., goes one step further on busy Connecticut Ave., N. W. Here they control various traffic lights by means of high frequency radio signals. Each small group of traffic lights has a radio receiver-decoder which decodes signals sent to it from a control transmitter. This eliminates the long control cables required to transmit the information back from the computer to the traffic lights.

New Markets *(Continued)*

The individual traffic light controllers themselves could stand modernization. Now they are basically an electro-mechanical device. A possible solution to making these more rugged and reliable would be to make use of magnetic amplifiers. This would eliminate moving parts and make them impervious to most problems that are apparent in the present day electro-mechanical controllers.

Traffic controllers at busy intersections can be equipped with radio receivers that will automatically turn the traffic lights red in all directions except one. These receivers are triggered by radio equipment on emergency vehicles which have to go through this intersection. This assures that they will not be tied-up by traffic while passing through.

The same little light sensitive element that is used in cars is also used to turn street lights on and off.

Perspiration can be a serious problem in some manufacturing processes. This perspiration tester by Ameresco, Inc., facilitates screening those persons which may not be satisfactory for handling certain items.

One of these little elements, along with a small inexpensive black box is mounted on each pole which has a street light. As the darkness sets in the light goes on; as the sun comes up in the morning the light goes off. Utilization of these cells reduces the cost of wiring street lights. Previously they had to be turned on by a switch back at the power plant. This required additional running of wires and also requires either a time clock or manual turn-on and off of the power for these lights.

Electronic equipment is becoming very popular with small boat owners. Items range from two-way communications to radar to fish finders. The mass market for these electronic items has been projected to be very large and rapidly increasing.

Automation Has Problems

Data processing is another field that is still wide open. There are so many possible uses for it that it would be hopeless to even try to list them. However, there are apparently two stumbling blocks to market development here: One of them is the high cost of the equipment, the second problem is their complexity. Most organizations want equipment that average employees can use without any specialized training. Most would be happy if they received a simple instruction manual that could be understood by their employees. Questionable reliability and bulkiness of the equipment are two other deferring items.

Electronic automation business is expected to have a total industry volume of more than $20 billion by 1970.

The Post Office Dept. has been doing extensive work in the areas of expediting mail handling. Already they have let a few contracts for research and development in various areas.

Some of the items they are interested in are machines that read and sort typewritten addressed envelopes; mail carrying missiles; coin-operated self-service postal sub-stations; automatic parcel post acceptance machines which will weigh, insure and compute total cost, affix the postage and return change; high speed face cancelling machines, mail moving conveyor systems, and even the use of electronics on trucks, mobile post offices and other vehicles.

Here is an example of how widespread electronic devices can be. Although the ball point pen has made big inroads in the sales and use of ordinary graphite "lead" pencils, the pencil is still with us and perhaps because of this new competitor, it must be improved. Because few things are as exasperating as a broken pencil point in the middle of an important message, pencil manufacturers are interested in lead that does not break easily. The Instron Engineering Corp., using some Datex equipment, have designed a tester which automatically tests "lead" used in pencils to maintain a very rigid quality control. This testing system is in use by several pencil companies.

Even eyeglass frames are now making use of electronics. Previously the manufacturers were burdened and put to exorbitant expense by cementing of cellulose acetate and cellulose nitrate with solvents. This created ever present fire and explosion hazards, besides having the odors of obnoxious solvents. The General Solids Associates, Brookline, Mass., have solved this problem using an electronic type generator to do the same job. By the use of this equipment, large savings in direct labor and time of processing the eye frames has been cut.

Sales of electronic goods to consumers in 1960 is estimated at $4.5 billion. Industrial sales of electronic items will reach about 1.7 billion dollars and commercial communications will go to $500 million.

A great deal of research and development is taking place to find new power sources such as thermoelectric devices and fuel cells. Solar power is with us and is showing-up in consumer items.

Lockheed Electronics recently developed a new method of air traffic control. It can automatically and continuously tell ground controllers the location, identity and altitude of every plane in the sky over America. The Russians probably could have used this device with our U-2's over their sky.

Have you ever stopped at a roadside pay telephone booth, placed your hand in your pocket and found the smallest coin you had was a quarter? Then, with the quarter in your hand you realized that the call you have to make is a local call requiring only 10 cents. With so many people having faced the same problem we think that perhaps today's pay telephone should have a built-in change device. This is also true with unattended parking lots. We know of one

company that has a device that will make change for a dollar bill.

The LeFebure Corp. wholly owned subsidiary of Craig Systems, Inc., recently demonstrated its new signature verification device. It was designed for use in bank operations, mainly savings banks. As used in savings bank operation, equipment provides for the encoding of the customer's signature into his pass book so that it is invisible and incapable of being deciphered by the naked eye. The signature can be read by placing the pass book in a reader located at the tellers stations in the bank. The teller then compares the signature with the one appearing on the withdrawal slip. In addition to protection against forgery, the reader saves time at the teller's window as it is no longer necessary to refer or maintain costly signature files. Also, a customer can transact business at any one of the bank branches.

Bio-Medical Electronics

Most of the hardware which has been developed in the field of bio-medical electronics has been confined to the diagnostic area. Naturally, with such a limited market, the equipment has been quite expensive. The Cytoanalyzer, which, by rapidly examining smears, aids in the early detection of cancer in women, is a typical example of this costly research equipment. Other research is being conducted to develop an instrument which can detect glaucoma—our nation's greatest blinder; remember that 1 in every 50 persons over 40 in this country becomes blind through its effects.

Considerable time and effort is also being spent on the development of image intensifiers. These devices considerably reduce the radiation requirements thus improving conditions for the patient but more so for the radiologist who must be exposed to the radiation many times a day.

Ultrasonic surgery has been achieved, especially on the brain. This, though therapeutic, is a limited application and also requires expensive machinery.

Another therapeutic device, but more reasonably priced, is the artificial pacemaker. This device, ideally suited for manufacture by even small electronic firms, has its electrodes permanently implanted in a heart disease victim. The unit operates in many ways but basically it monitors the heart operation and when it detects a seizure, applies an electrical shock, which re-establishes the rhythm.

In dental work, fiber optics are being used. In conjunction with closed-circuit TV to show many students at one time the interior of the oral cavity. In this system the flexible bundle of fibers connected to the vidicon is introduced into the mouth and acts as the pick-up device.

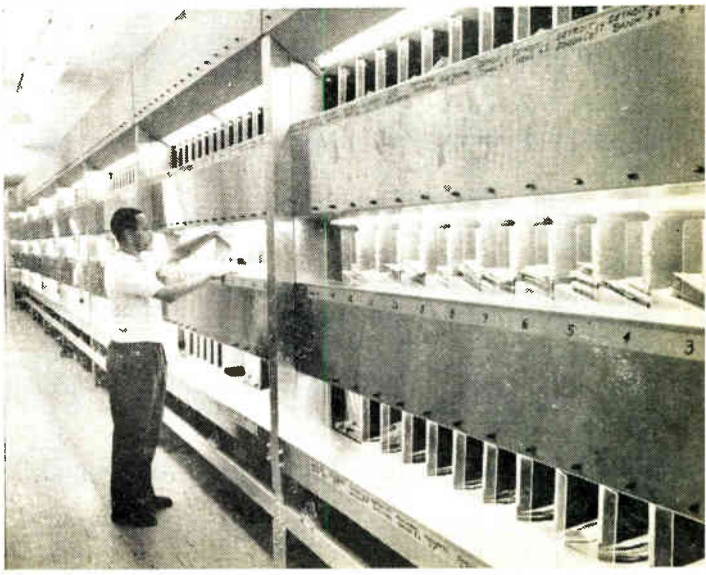
Outside of military sonar devices, the field of ultrasonic is completely divorced from the military. Most of the ultrasonic devices are used in commercial applications. The most popular being ultrasonic cleaners. These cleaners are available at prices starting from $100.00.

Several companies have been trying to make an ultrasonic dishwasher for home use. These should be a boon to curtailing water usage. Many rural homes have been reluctant to use conventional dishwashers because they obtain their water from wells. They also dispose of waste through their own sewage systems. The water used by a normal dishwasher would overload the system. Ultrasonic dishwashers will use much less water. This is expected to be one of their best selling points along with doing a good cleaning job. Quite frankly, we had expected to see these dishwashers on the open market by now. Obviously the item is not as simple to design and produce as many manufacturers originally thought.

The non-military market for ultrasonic equipment,

This postal sub-station, made by Minnesota Electronics Co., sells stamps, stamp books, stamped envelopes, postcards, stationery, weighs mail, keeps a running account of purchases and makes change, even for dollar bills.

On the left is the old fashion "peek" and "poke" method of sorting mail. The right shows a modern approach using a mail sorter built by Burroughs that reads addresses.



New Markets *(Concluded)*

including welders, cleaners, gaging devices, small boat sonar, flaw detectors, etc., is estimated at $30 million for 1960.

When people go outdoors for their vacation, there are usually two items they take with them. One of them is a portable radio and the other is a camera. Mr. Rene Lopez has been awarded Patent No. 2,899,-879 which covers a combination camera, radio and telescope finder, all in one case. The case is two parts hinged together, one being a radio and the other being the camera and telescope. With this item both the camera and the radio are in one compact package.

There are about 55 million portable radios in use in the U. S. Sales of portable radios is increasing, mainly because of foreign transistorized imports. Sales will reach 4 million in 1960.

The Ser Co., Waltham, Mass., has been actively engaged in designing a wrist watch which is transistorized. One of the ideas being tried makes use of an electromechanical oscillator that induces an EMF picked up from a mechanical system. It is applied to a transistor which then generates a current spike that drives the pendulum. Due to a negative feedback feature, this device is quite stable—it cannot run away. A small cell can keep the oscillating pendulum going for a year.

Economical Heating

Samuel Friedman of the Chemalloy Electronics Corp., Santee, Calif., has been busily engaged in developing a microwave calorimeter for such jobs as cooking, baking, heating, hot water and even heating homes. With this calorimeter more efficiency can be obtained from a watt of electrical power. The conversion of calorimeteric techniques from defense radar power measurement or absorption into a civilian type stove or heating source is largely a reverse usage of the same thing. The changes are primarily in the load designing and matching the 60 cycles as compared to microwave frequencies. And also in utilizing liquids more responsive heat-wise than water by selecting fluids which have a specific heat substantially less than water (unit). One design resembles an attractive kitchen stove. This will have a switch to turn on 60 cycle power to be absorbed as heat in liquid. This energy may be rheostated down if more power is available than is needed.

Projections indicate that there will be a need for 22 million new homes in the next fifteen years. This is more than were built in the last 30 years.

Home plate baseball umpires may be on their way out. Brocker Labs, Palo Alto, Calif., has been developing an electronic umpire that shows the path of a ball across the plate. Presently it is designed for training pitchers. This device senses very accurately where the ball passed over the plate, both in height and distance from a batter.

A French inventor, Monseur Rene Borie, has applied for a French patent for a device that will remotely change radio receiver stations. The simplified, inexpensive device utilizes a few transistors to accomplish the task.

A manufacturer of heavy road grading equipment has enlisted the aid of an electronic manufacturer. Minneapolis-Honeywell is presently developing a stabilization unit to be used on large road graders. With this unit the blade can be maintained at either level or at a few degrees off of level for highway construction. No matter how the large road grader moves or what the position of its wheels are on the contour of the ground, the blade will always maintain the same fixed relationship to a level point. Previously this required quite a bit of operator skill to always maintain this blade at the same position.

Proximity indicators should find acceptance on cranes and derricks. It is quite a task for the operator to watch his load and the end of his boom at the same time. With a proximity indicator, a light could flash or a horn sound when the end of the boom was in danger of striking an object.

Good, reliable sorting devices are still in demand. Units that will sort according to color, size and weight can be used in practically any production process.

The nuclear field is growing fast. Sales should be picking-up for general nuclear instruments, reactor control instrumentation, reactor simulators and particle accelerators.

75 to 100 companies are known to be engaged in the manufacture and sales of radiation instruments and/or instrument components. Many of these companies are quite small, manufacturing only a single instrument or component. The products these companies make are non-military. Sales to future power plants look good.

For 1958, total nuclear industry sales were estimated at more than $659 million with electronic-based items amounting to about 7% ($47.1 million).

Electronic teaching machines are coming — an estimated $100 million a year market within the next ten years is expected. Several companies are quite actively engaged in their development and sale for use in the Nation's classrooms.

The teaching machines teach by exposing the student to a brief written explanation of a point and then checking his understanding of that point by asking him to make some kind of a response—perhaps fill in a blank or answer a multiple choice question. The teaching machines presently cost from about $200 to $5000 each, depending on their use. These will quite likely be one of the solutions to the teacher shortage. While these machines cannot replace teachers, they will most assuredly assist them as an educational tool.

We hope some of the foregoing thoughts and ideas will stimulate imaginations to find new avenues of income. You will be reading quite a bit more in future ELECTRONIC INDUSTRIES articles enhancing on the market potentialities mentioned in this article and pointing out new areas that need new electronic developments.

PLUG AND SOCKET BODIES SHOWING CONTACT ARRANGEMENT AND STANDARD LOCK WHEN A CAP IS NOT REQUIRED

CINCH HINGE CONNECTORS

MAXIMUM NUMBER OF CONTACTS IN MINIMUM SPACE

PATENT PENDING

Cinch ELECTRONIC COMPONENTS ®

Insure positive contact. Wiping contact action keeps contacts clean at all times. Units are held together by a simple, yet positive lock, requiring minimum pressure to fasten. By releasing the lock, the units instantly separate by spring action of the contacts. Illustration above shows plug and socket without cap and with hinge action in place prior to closing. Cap assembly with alternate lock and cable clamp shown below. Standard units are supplied with General Purpose insulation and cadmium plated contacts. However for more severe conditions of temperature and humidity glass filled Diallyl-phthalate insulation (Type GDI—30 per Mil. M-19833) can be supplied with contacts having gold plate over silver. Contact tails will take either conventional solder wiring or AMP "78" series Taper Tab receptacles. The Cinch "H" series is made in 20 to 100 contacts in multiples of 10 contacts.

Write today for complete information.

CONTACT ASSEMBLY WITH
BLE CLAMP SHOWING ALTERNATE
CK WHICH FITS INTO SLOT IN
OF CAP. CANNOT BE ACCIDENTALLY
LOCKED.

(Left) Lifting up top section releases lock prior to unlocking Pulling out on spring unlocks assembly

ELECTRONIC DOT ASSEMBLIES

Centrally located plants at Chicago, Illinois; Shelbyville, Indiana; City of Industry, California; St. Louis, Missouri.

Circle 51 on Inquiry Card

Cinch ®

CINCH MANUFACTURING COMPANY

1026 South Homan Ave., Chicago 24, Illinois

Division of United-Carr Fastener Corporation, Boston, Mass.

New Tech Data for Engineers

Zener Diodes

Engineering Bulletin from International Telephone and Telegraph Corp., P. O. Box 412, Clifton, N. J., gives preliminary specs for gold crown Zener Voltage Regulator Diodes. Electrical data (in tabular form) includes Zener voltage range, typical dynamic impedance, max. Zener current, and nominal temp. coefficient. Curves are included.

Circle 226 on Inquiry Card

Pilot Light Handbook

A 256-page "Dialco Handbook of Pilot Lights" is being offered to qualified personnel by Dialight Corp., 60 Stewart Ave., Brooklyn 37, N. Y. (an application form will be sent to those who apply). The basic theme of the manual is: "How to select the proper Pilot Light to accomodate the required lamp?" The text has an 8-page Lamps Section which discusses 15 types of Incandescent Lamps and 6 types of Neon Glow Lamps. The following sections are in categories by particular lamp type; the text covers in detail the specific assemblies designed to receive the lamps, including life-size illustrations of all pilot lights as well as technical data such as dimensions, lens styles, finishes, optional features, mounting clearance hole, etc. An 8-page catalog Number Index is included.

Circle 227 on Inquiry Card

Selecting a Fan

Application notes from Rotron Manufacturing Co., Inc., Schoonmaker Lane, Woodstock, New York, deal with the selection of the correct type of "Fan" for cooling electronic equipment. Included is an 8-page folder called, "Weightflow Nomograms for High Altitude Air Cooling." Formulae, tech data, graphs, and nomograms are included.

Circle 228 on Inquiry Card

Ultrasonic Cleaners

Tech data sheets from Curtiss Wright Corp., Princeton Div., Princeton, N. J., describes their line of ultrasonic cleaners. Specs and outline drawings are included.

Circle 229 on Inquiry Card

Components Guide

Vest Pocket Guide and Wall Chart, to help the design engineer choose the right test and sensing component, contains complete specs on Alden panel lights, switches, fuseholders, test prods and jacks and molding materials. Alden Products Co., Dept. TS 114, 117 N. Main St., Brockton 64, Mass.

Circle 230 on Inquiry Card

Mobile Tape Recorder

Specs and features of a new Honeywell Mobile Tape Recorder, Model 3116, are described in Bulletin DD-5. The new system is said to have the accuracy of a laboratory tape system, yet weigh less than 60 lbs. Minneapolis-Honeywell Regulator Co., Industrial Systems Div., 10721 Hanna St., Beltsville, Md.

Circle 231 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 161 on Inquiry Card

Amplifiers-Choppers

May issue of monthly bulletin, "Tung-Sol Tips," published by Tung-Sol Electric, Inc., 95 8th Ave., Newark, N. J., discusses dc amplifiers and choppers. Included are sections on: The need for dc amplifiers; Typical dc amplifier circuits; Typical applications; The transistorized dc amplifier; Choppers as circuit elements, etc. The bulletin is well illustrated with schematics.

Circle 232 on Inquiry Card

Semiconductor Production

Four-page bulletin on Precision Purity Microforms for semiconductor and electronic production, features facilities for producing ultra high purity spheres, discs, dots, and washers; tabs and base clad tabs. Metals used are indium, gold, tin, lead, silver, aluminum and doped alloys of these metals in p and n type. Anchor Alloya, Inc., 968 Meeker Ave., Brooklyn 22, N. Y.

Circle 233 on Inquiry Card

Epoxy Resin Chart

Selection chart for Dolphon epoxy resins is available from the John C. Dolph Co., Monmouth Junction, N. J. Given is the product, consistency, reactor, pot life, filler, cure, max. useful temp., properties, and use.

Circle 234 on Inquiry Card

Radiation Patterns

The March issue of ESSAY, a collection of engineering notes on techniques of antenna and r-f instrumentation, published by Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta 9, Ga., is a 6-page article called "Calculation of Microwave Antenna Radiation Patterns by the Fourier Integral Method," by L. Clayton, Jr., and J. S. Hollis. This paper discusses the well-known Fourier integral technique of calculating the radiation pattern from a set of assumed, calculated, or measured data about the antenna under design and includes a description of the Scientific-Atlanta Model CF 1 Fourier Integral Computer.

Circle 235 on Inquiry Card

Filters-Coils

Catalog from United Transformer Corp., 150 Varick St., New York 13, N. Y., describes the Company's line of electric wave filters, high Q coils, magnetic amplifiers, reactors, and transformers. Included are specs including charts, graphs, tables, tabular listings, etc. Recommended circuitry for typical regulated and unregulated transistor supplies, magnetic amplifier servo motor applications, vacuum tube power supplies, vacuum tube amplifier circuits, transistor amplifier circuits, etc., are included. A two page spread gives information on factors controlling frequency response, wave form distortion, etc., and a reactance vs frequency chart.

Circle 236 on Inquiry Card

Synchros Resolvers

Illustrated technical discussion, 27-pages, of the electrical characteristics of synchros and resolvers describes application and significance of such parameters as electrical error, electrical zero, fundamental null, total null, transformation ratio, and phase shift. When synchros and resolvers are used in systems, each of the "data-sheet properties" undergoes drastic change whose nature is thoroughly explained. Methods of measurement and the basic specs for test equipment also included. Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.

Circle 237 on Inquiry Card

Transformer Kits

Catalog page gives tech. specs of Model C-2650 micro-miniature transformer kit of 10 transformers covering the full range of input impedances and impedance ratios to conveniently apply transformers in transistor circuits. James Electronics Inc., 4050 N. Rockwell St., Chicago 18, Ill.

Circle 238 on Inquiry Card

New Tech Data for Engineers

Waveguide Filters

Four-page bulletin from Waveline, Inc., Passaic Ave., Caldwell, N. J., describes a Tunable Two Section Dual TE_{m} Mode Preselector Filter, a Band Rejection Cutoff Filter, and Rectangular Waveguide Cavity Band Pass Filters. Tech data included.

Circle 239 on Inquiry Card

Copper-Clad Laminates

Technical information on copper-clad laminates, composite sheets made by facing selected base laminated plastics with copper foil on one or both sides, is given in Data Sheet No. 8-1A from Taylor Fibre Co., Norristown, Pa. A table lists engineering data for 8 grades of Taylor copper-clad laminates, including bond strength (for both electrolytic rolled and electrolytically deposited copper foil), hot solder resistance and heat resistance. Included are corresponding NEMA grade base laminate designation and, where applicable, the corresponding military specs for both the base laminate and the copper-clad laminate. Another table lists min./max. physical, mechanical, and electrical properties for the 8 base laminates. Also tabulated are the overload currents and resistances for printed circuits made with 1-oz and 2-oz copper foil and in 5 line widths from ¼ to 1/64 in.

Circle 240 on Inquiry Card

DC Capacitors

Bulletins give physical and electrical characteristics of line of metal-cased, hermetically sealed, dc oil-impregnated capacitors. Bulletins cover drawn case "bathtub" types, rectangular case dual and triple section types, and details on a new line of compact rectangular case units. Bulletins contain complete listings of available capacitance and voltage rating combinations. New Bedford Div., Aerovox Corp., New Bedford, Mass.

Circle 241 on Inquiry Card

Signal Dropout

Definition of a signal dropout in a video recording system and effects of total circuit gain and demodulator performance on dropouts are discussed in "Video Talk" Bulletin No. 3. Study points out that the majority of dropouts are never seen, and that the effects of circuit malfunctions are sometimes mistaken for defective tape. Also available: Bulletins No. 1 on proper handling and storage of video tape; No. 2 on factors affecting dropout performance in video tape, and a folder for permanent filing of the continuing "Video Talk" series. Minnesota Mining & Mfg. Co. (3M) Dept. TPC, 900 Bush Ave., St. Paul 6, Minn.

Circle 242 on Inquiry Card

Servo Design Simplified

This 4-page brochure describes a simplified procedure and calculations necessary to obtain optimum performance from 2nd and 3rd order Servo Systems. In a step-by-step procedure, the basic requirements for servo performance are covered, i.e., static error or accuracy and ability to follow up at a given speed or acceleration. From the information contained are derived all the parameters of the optimum Servo System. Application & Sales Dept., M. Ten Bosch, Inc., 80 Wheeler Ave., Pleasantville, N. Y.

Circle 243 on Inquiry Card

Data Link Conversion

A 4-page tech data and application brochure describes the Company's high Speed Data Link Converter system. It consists of two solid-state analog-digital converters designed for 9-bit straight binary digital encoding and decoding. The converter unit at the transmitter translates with ±0.05% absolute accuracy ±½ least significant bit analog voltage data into digital form. The companion converter, located at the receiver translates, with the same accuracy, the transmitted data back into its original analog form. Equipment Div., Epsco, Inc., 275 Massachusetts Ave., Cambridge 39, Mass.

Circle 244 on Inquiry Card

Chilling Equipment

Large capacity production chilling equipment for stabilization of metals, etc. Temp. range available to —150°F, and thermal capacities from 500 to 10,000 btu/hr. Chambers can be modified for the addition of accessories and special equipment. Refrigeration systems can be adapted for connection to existing plant evaporators or other equipment. Chambers are also provided with drains for handling of convection fluids. Bulletin. Cincinnati Sub-Zero Products, 3930 Reading Rd., Cincinnati 29, Ohio.

Circle 245 on Inquiry Card

Transistor Guide

Transistor Application Guide indicates suitable transistor types for each major application. Transistors are classified in terms of 1 or 2 important parameters. Information is in graphs and curves. Data given by charts is intended to be reasonably typical of performance that has been obtained in practical circuits. Applications covered are listed under: Communications circuits (tuned amplifiers and related circuits), Untuned amplifiers, Switching circuits (computer applications), and Switching circuits (non-computer applications). Philco Corp., Lansdale Div., Lansdale, Pa.

Circle 246 on Inquiry Card

RF Filters

Expanded catalog on line of standard radio interference filters. After current and voltage of circuit is determined, a basic part number is read from the catalog tables based on light, medium or heavy suppression requirements. To this base number is added the desired type of terminals and mounting. The result is a standard filter that exactly fits all mechanical and electrical specs. Basic information "why filters are used" and "how to use filters effectively" is also given. All-Tronics, 45 Bond St., Westbury, L. I., N. Y.

Circle 247 on Inquiry Card

Transistor Testing

New brochure describes the ITVAC family of automatic test and classification equipment for semiconductor devices. This equipment tests parameters of all types of transistors at rates varying from 750/hr to 3600/hr. It is for use in incoming Quality Control and for Production testing. The brochure describes the uses and function of the equipment and lists the tests performed and test limits available. Industro Transistor Corp., 35-10 36th Ave., Long Island City 6, N. Y.

Circle 248 on Inquiry Card

High Purity Gases

Properties, applications and storage of ultra-high purity gases are the topics in a 16-page booklet, F-10020, offered by Linde Co. Div. of Union Carbide Corp., 270 Park Ave., New York 17, N. Y. These gases are: helium; krypton; xenon; radioactive gases and special mixtures, have a variety of uses as protective atmospheres, refrigerants, insulators, radiation sources and easily ionizable materials. In the monatomic gases no nitrogen is detectable by mass spectrometer analysis; and, all other polyatomic gases are present in quantities less than 10 ppm. Moisture content is considerably less than 5 ppm. The booklet contains charts and graphs showing the results of extensive testing including the areas of heat conductivity, excitation potentials, and discharge characteristics.

Circle 249 on Inquiry Card

Microwave Equipment

Catalog No. 60 provides 32 pages of information on microwave receiver front ends including data on a number of waveguide and coaxial mixer-preamplifier assemblies. Other products described include Solid-state, Miniature and sub-miniature IF amplifiers, TWT amplifiers, Octave RF amplifiers, Beacons and AFC units. LEL Inc., 380 Oak St., Copiague, L.I., N.Y.

Circle 250 on Inquiry Card

New Tech Data for Engineers

High Temperature Tape

Six-page brochure presents information and properties on 10 high-temp. tapes developed by the Connecticut Hard Rubber Co. It analyzes each tape individually as to construction and recommends uses. Typical design features and physical properties are also presented. The Connecticut Hard Rubber Co., Dept. TRT, 407 East St., New Haven, Conn.

Circle 251 on Inquiry Card

High Voltage Tests

Manual C-61 describes methods and equipment for high voltage breakdown and insulation resistance tests to meet high reliability specs and extended environmental conditions. Equipment is shown for measuring to 5 million megohms, and for high voltage leakage tests at 150 kv and higher on electronic components, cables, wiring harnesses, control circuits, etc. Associated Research, Inc., 3777 W. Belmont Ave., Chicago, Ill.

Circle 252 on Inquiry Card

Toggle Switches

A 2-page data sheet describes the "400" series tab-indicator toggle switch assemblies. The paddle-shaped tab enables easy identification of the lever position. It will maintain a bright metallic appearance through long and constant use. Five models are available, including both maintained and momentary contact versions with either 2 or 3 operating positions. Snap-action contacts insure accurate repeatability. Micro Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Circle 253 on Inquiry Card

Loading Reactor

Two-page Exel data sheet, SE-L2606, from Superior Electric Co., Dept. LR2, Bristol, Conn., describes a self-contained loading reactor for inductive load testing. It provides a convenient inductive load which can be made adjustable by using in conjuction a Powerstat variable transformer. Ratings are: 120 v; 60 CPS; 2.0 amp. at 120 v continuous duty (3.0 amp for intermittent duty); inductive reactance, 60 ohms; dc resistance, 4.0 ohms; inductance 0.16 h.

Circle 254 on Inquiry Card

DC Voltage Monitor

Pub. No. 60-119, Preliminary Engineering Bulletin, discusses the miniature DC Voltage Monitor, Model 203-1. Instrument has full-time, precision sensing with Go/No-Go output. Contents include: features, general description, specs. and outline drawing. Trio Laboratories, Inc., Dept. VM, Plainview, L.I., New York.

Circle 255 on Inquiry Card

High Voltage Pentode

Brochure, Form 2156-9, on the 7234 high voltage pentode tube gives tech. and performance data. The tube is a beam-type pentode for use with plate voltages as high as 10 kv. Applications include use as a shunt regulator in power supplies (to 10 kv) and series regulator (to 20 kv). The 4-page bulletin is illustrated, gives electrical and mechanical specs, ratings, etc. Transfer, screen and plate characteristic curves included. Schematic diagrams show the tube in typical circuits with a Victoreen Corotron in high voltage regulators. The Victoreen Instrument Co., 5806 Hough Ave., Cleveland 3, Ohio.

Circle 256 on Inquiry Card

TV Equipment

A 16 page brochure from Photo-Video Electronics Inc., 36 Commerce Rd., Cedar Grove, N. J., describes the company's line of Television Equipment and Power Supplies. Included are camera systems and accessories, monitors, sync equipment, video amplifiers and equalizers and video power supplies, measuring and test equipment, and automatic program control systems.

Circle 257 on Inquiry Card

Thermal Time Delay Relay

Catalog on thermal time delay relays contains information on engineering data for applications. The Company's line is broken down on separate sheets giving part numbers, time delay ranges, and voltage. Thermal Controls, Inc., 43 River Road, North Arlington, N. J.

Circle 258 on Inquiry Card

Dielectric Materials

Chart on dielectric materials available from Amphenol Borg Electronics Corp., 25th Ave. at Cermax, Broadview, Ill. (Chicago). Twenty-eight dielectric materials are listed. Characteristics include: specific gravity, tensile strength, compressive strength, flexural strength, impact strength, max. operating temp., volume resistivity, dielectric strength, dielectric constant, power factor, water absorption, arc resistance and loss factor.

Circle 259 on Inquiry Card

Autocollimator

Bulletin 205-60 gives applications, product features, specs, and a description of the operation of a new autocollimator for precision measurement of angular position and small linear displacements. (The autocollimator is an optical tool which combines the functions of a collimator and a telescope—it is used to gage small linear displacements.) Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill.

Circle 260 on Inquiry Card

Temperature Controls

Stable temperature control packages, Simplytrols, are described in a 12-page Bulletin 108 from Assembly Products, Inc. 75 Wilson Mills Road, Chesterland, Ohio. It explains circuitry and safety features of the three basic types of devices. Included is a proportioning model that can hold temperature to $\pm 1^\circ$ F of set point. Other types are manual reset and automatic on-off controls.

Circle 261 on Inquiry Card

Guide To Silicones

Brochure from Dow Corning Corp., Midland, Michigan, is called "Engineers' Guide to Silicones" (Electronic Engineers). Included are Encapsulants, Fluid Coolants, Impregnating and Coating Materials, Molded Rubber Parts, Potting and Filling Materials, Printed Circuit Overcoating, Process Aids, Properties of Silicones, Resistor Coatings, Rigid Structural Parts, Semiconductor Materials, Wire (Hookup, Magnet) and Cable. Technical data sheets on the Company's products and processes are also available.

Circle 262 on Inquiry Card

Automation Technology

Management-oriented publication discusses the technology, equipment, and economics of automation. Titled "Automation and You," the 16-page bulletin (GED-3908) assesses the current state of the automation art, summarizes the need for and economic benefits of automation, and provides information for management on 6 key functions of automation: Process control, Computing, Instrumentation, Numerical control of machines, Sensing, and Communications. General Electric Co., Schenectady 5, N. Y.

Circle 263 on Inquiry Card

Thumbwheel Switch

Catalog sheet contains 2 illustrations, 3 dimensional drawings and complete technical data on multi-deck 8, 10, 12 or 16 position rotary thumbwheel switch. It unites high reliability with a simpler approach to complex switching problems and is available with internal lighting if desired. Chicago Dynamic Industries, Inc., Precision Products Div., 1725 Diversey Blvd., Chicago 14, Ill.

Circle 264 on Inquiry Card

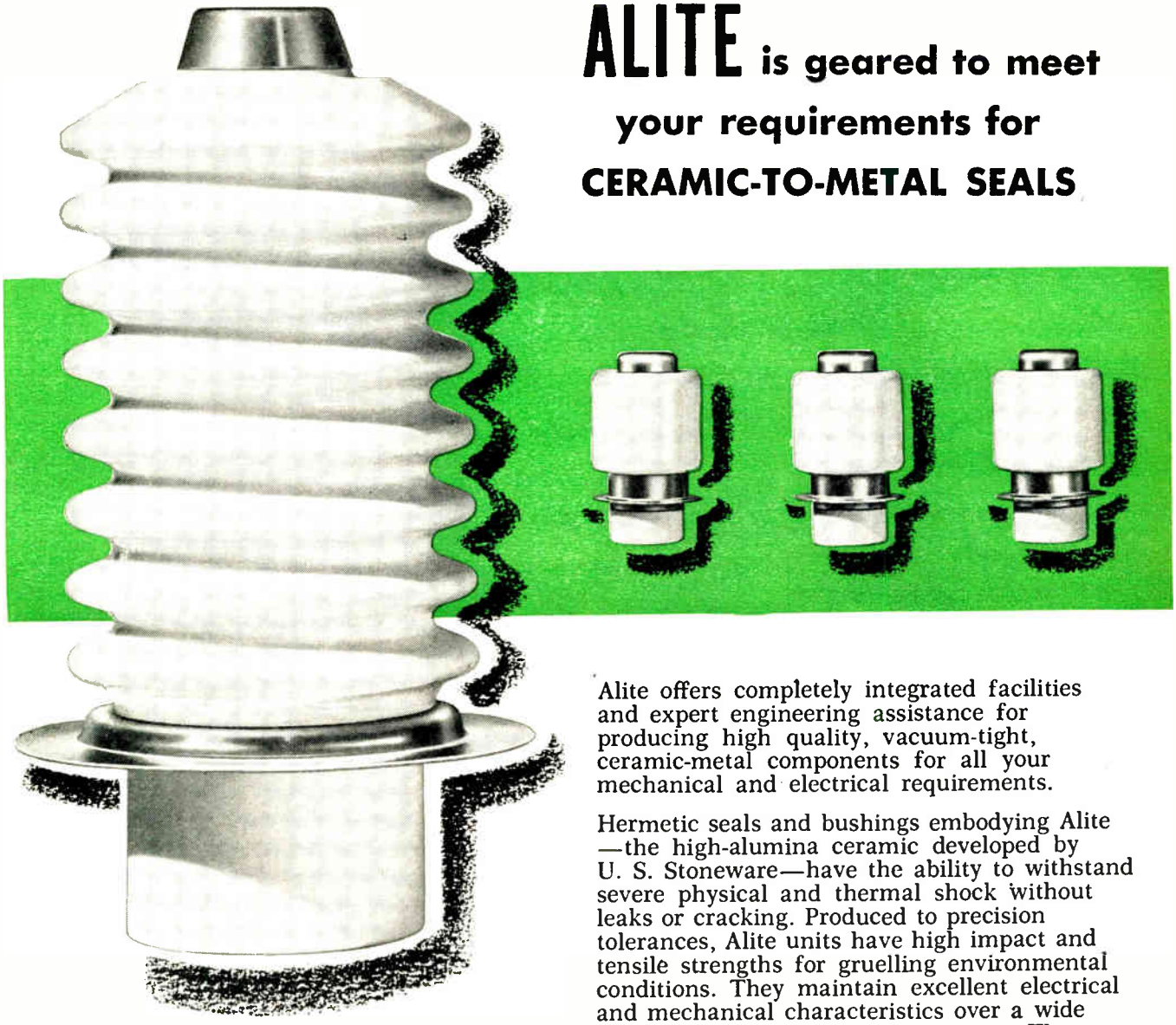
Handling Compressed Gas

Wall chart illustrates recommended procedures for the safe handling of all types of compressed gases. The chart, 14 x 21 in. shows the proper methods of Receiving cylinders, Storage, Moving, Handling empty cylinders, and Using compressed gases. The Matheson Co., Inc., P. O. Box 85, E. Rutherford, N. J.

Circle 265 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

New Bulletins A-20 and A-35 describe Alite facilities and standard Alite High Voltage Bushings. Write for them now.

ALITE DIVISION

U. S. STONEWARE

BOX 119 ORRVILLE, OHIO

New York Office
60 East 42nd St.

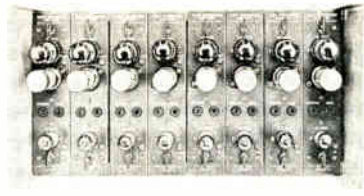
118-F

Circle 52 on Inquiry Card

New Products

MODULAR AMPLIFIERS

Modular amplifiers for color and black-and-white video distribution includes plug-in and rack-mounted units. Typical examples are: Type VA-P-101 (Video Distribution) for

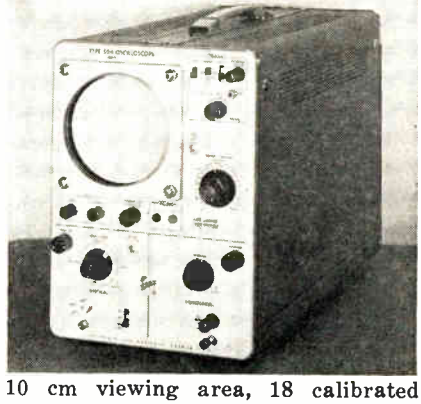


systems requiring a simple one input, one output unity-gain unit; Type VA-P-102 (Sync Adding) plugs into 1 of the positions, when sync-adding is required, allowing the addition of sync to 1 or any number of the remaining 7 VA-P-101 units; Type VA-P-103 (Video Distribution) is a one input, one output unit with nom. gain of +3 db; and Type VA-P-201 is a multiple output type for simultaneously feeding 3 identical signals to several different points. The Daven Co., Livingston, N. J.

Circle 161 on Inquiry Card

OSCILLOSCOPE

The Type 504 range is dc-to-450 KC. It uses a min. number of tubes (equivalent 17 plus rectifiers) for the max. degree of reliability. Basic sensitivity is 5 mv/cm. Vertical amplifier characteristics include: input state electronically regulated, calibrated steps to 20 v/cm, adjustable between 12 steps and to over 50 v/cm uncalibrated, and constant input impedance (for easy probe use) at all sensitivities. Other features include: functional panel layout, 8 x

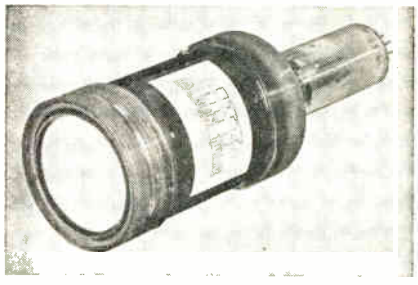


10 cm viewing area, 18 calibrated sweep rates, electronically-regulated power supplies, and extremely adaptable trigger facilities. Tektronix, Inc., P. O. Box 831, Portland, Ore.

Circle 162 on Inquiry Card

STORAGE CR TUBE

The FW-211 Iatron is used as a panel-mounted radar or infrared indicator in aircraft. Fast writing and high deflection speed permits accurate and instantaneous presenta-



tions. A coaxial electron gun system eliminates trapezoidal distortion of the scanning pattern. Special features: Full daylight viewing by image intensification and the ability to write, store and erase information at will. A display exceeding 4000 ft.-lamberts brightness is obtained at a phosphor voltage of 8.5 kv. The tube fits within standard case dimensions for a 2¾ in. dial instrument and meets MIL-E-5400. ITT Laboratories, 3700 East Pontiac St., Fort Wayne, Ind.

Circle 163 on Inquiry Card

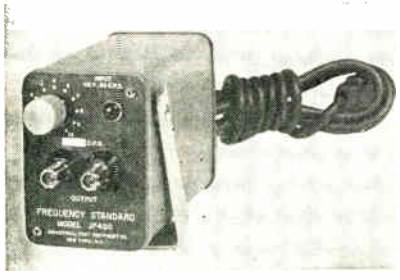
! MORE !

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.

New Products

TUNING FORK OSCILLATOR

Frequency Standard, Model JF400 Tuning Fork Oscillator, is an electronically driven tuning fork and output filter. Instrument is complete with power supply for operation from

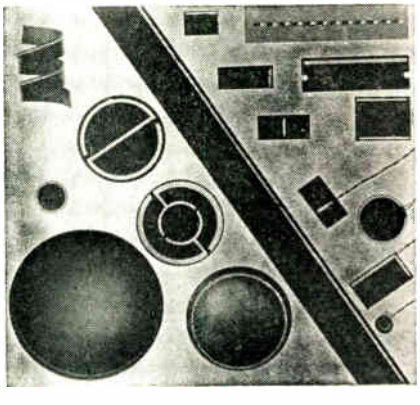


115 v. 60 CPS line. Specs are: frequency, 400 CPS; accuracy, ±0.1% at 25°C; temp. coefficient, 0.002%/degree °C approx.; output voltage, variable 0-5 v. (no load); recommended load impedance, 0.5 megohm or higher; distortion, 1% approx.; power, 115 v., 60 CPS, 15 w; output, binding posts. Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y.

Circle 164 on Inquiry Card

PHOTOELECTRIC CELLS

New Type 5 photoelectric cells, 50% more sensitive, are available in almost any shape or size. Self-generating selenium cells may be made in various spherical or cylindrical shapes, or as flexible strips which can be twisted into a variety of spiral designs. Sizes range as small as 1/16 in. square. Current sensitivity



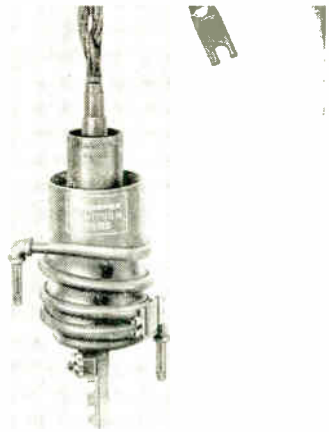
has been stepped up by 2 to 1 foot-candle, and potential sensitivity has been increased by 5 to 1 foot-candle. Daystrom, Inc., Weston Instruments Div., 614 Frelinghuysen Ave., Newark 12, N. J.

Circle 165 on Inquiry Card

New Products

NEW IGNITRON

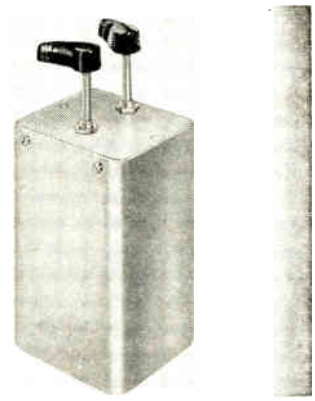
Type 7585 ignitron, features a unique spiral cooling coil so distributed as to concentrate cooling action around the discharge chamber to promote condensation at the bottom of the tube and thus reduce the problem of arc-back. The Type 7585 has been designed for single phase welding control and similar applications. It is completely compatible and interchangeable with all existing C-size tubes. Its electrical characteristics are identical with the standard type 5552A. The temp. sensing plate of this type fits all existing thermostats. Amperex Electronic Corp., Industrial Tube Div., 230 Duffy Ave., Hicksville, L. I., N. Y.



Circle 166 on Inquiry Card

STEREO EQUALIZER

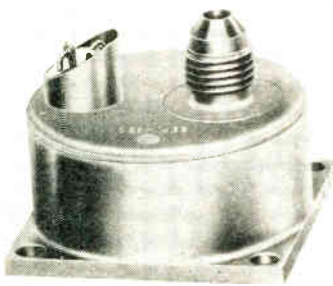
A broadcast stereo equalizer to enable radio stations to compensate for the recorded frequency of stereo as well as monophonic recordings. The unit, M66, is used between the cartridge and the first line preamplifier. It compensates the recorded frequency to a choice of 3 playback characteristics: Standard RIAA, flat, and roll-off. It also matches the impedance of the cartridge to the low impedance of the line transformer with no high frequency losses and minimum insertion loss. Since it is a passive-type equalizer, it provides no controls for volume, bass and treble. Shure Bros., Inc., 222 Hartrey Ave., Evanston, Ill.



Circle 168 on Inquiry Card

PRESSURE TRANSDUCER

Model 725 is a 35g miniature absolute pressure transducer in 10 standard pressure ranges from 0-600 to 0-5000 psi. Resistance elements are available from 5000 to 10,000 ohms and power rating of the unit 1.5 w. Static error band based on terminal base calibration is ±0.9% for a 1000 PSIA unit, including hysteresis, friction, resolution and deviation from the theoretical perfect calibration. Dimensions are 1¾ in. (dia.) x ⅞ in. (height). Bourns, Inc., 6135 Magnolia Avenue, Riverside, Calif.



Circle 167 on Inquiry Card

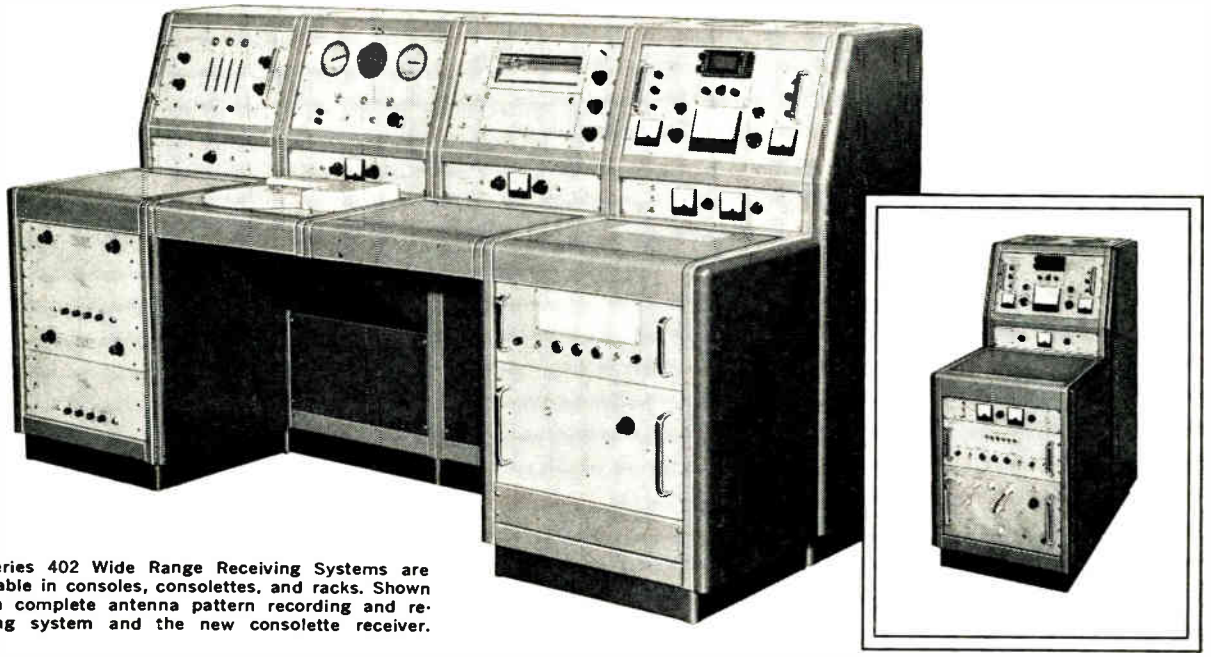
CABLE PLUG

New "ConheX" cable plug eliminates the adaptor in running subminiature coaxial cables into BNC and TNC panel connectors. It minimizes power loss and lower costs of assembly through direct connection, and provides a vise-like grip on the sub-miniature cable with a strength greater than the cable itself. It is gold-plated to resist corrosion and to provide lower contact resistance. Plugs are available to fit all subminiature cable sizes. Sealectro Corp., 610 Fayette Ave., Mamaroneck, N. Y.

Circle 169 on Inquiry Card

MAJORS and MINORS

... A Message to the Antenna Designer



● Series 402 Wide Range Receiving Systems are available in consoles, consolettes, and racks. Shown are a complete antenna pattern recording and receiving system and the new consolette receiver.

A crowded spectrum plus high power radar and communication systems critically compound the problems of the antenna design engineer.

More than ever, the complete pattern including all the major and minor lobes of every radiating element must be graphed for sound engineering evaluation.

S-A Receiver Gets the Whole Signal

Scientific-Atlanta Series 402 Wide Range Receiving Systems are specifically designed for antenna pattern measurements. Unique in design, these receivers combine maximum sensitivity and linearity from 30 mc to above 100 kmc. They are also useful as multipurpose laboratory instruments for microwave testing, monitoring, and measuring applications.

Only from S-A, 1 db Linearity over Full 60 db Dynamic Range

A recent development, S-A's P-4 modification adds 20 db to the normal 40 db dynamic range. The modification takes advantage of the gain vs AGC voltage characteristics of the Series 402. Existing receivers can be modified at the factory.

New Modification Z Broadens Use

Modification Z adds a precision IF attenuator and VTVM to the Series 402. Now RF and microwave signal level, gain, and isolation measurements can be made with fewer components and instruments. *For instance,* an X band 80 db attenuator can be calibrated to within ±0.5 db with a 1 mw signal source, a flap attenuator, a mixer, and an S-A Series 402Z Receiver. Antenna gain can be measured by direct comparison with a standard gain antenna. Signal levels can be compared against a reference standard.

Other Features

One coaxial cable from antenna to receiver eliminates costly lossy waveguides and rotary joints. Antenna can be located up to 75 feet away with negligible loss in sensitivity ☆ One receiving system covers 30 mc to above 100 kmc without plug-ins ☆ Reception of cw signals from simple sources eliminates need for precise modulation ☆ High sensitivity means low source power and long ranges ☆ High selectivity reduces interference and cross talk between adjacent test ranges ☆ Positive AFC action over full dynamic range provides pattern recording in deep nulls.

PRICES

Series 402, 2 to above 100 kmc	$7500
Series 402A, 2 to above 100 kmc with AGC	8000
Series 402B, 30 mc to above 100 kmc	8500
Series 402C, 30 mc to above 100 kmc with AGC	9000
Modification P-4	500
Modification Z	1000

NEW DATA FOLDER READY

For complete information ask for our new data folder from your nearby S-A engineering representative or write directly to Dept. 44.

SCIENTIFIC-ATLANTA, INC.

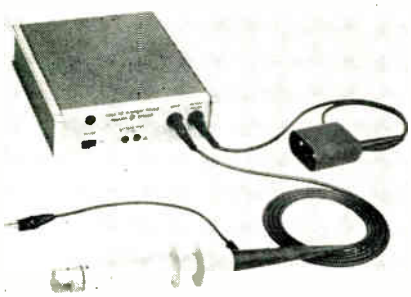
2162 PIEDMONT ROAD, N. E.
ATLANTA 9, GEORGIA
PHONE: TRinity 5-7291

Wescon Booths
538-539

New Products

AC CURRENT PROBE

Instrument converts ac current to ac voltage for direct reading on a conventional oscilloscope or ac voltmeter. Model 456A has a probe which simply clamps around the current-carrying

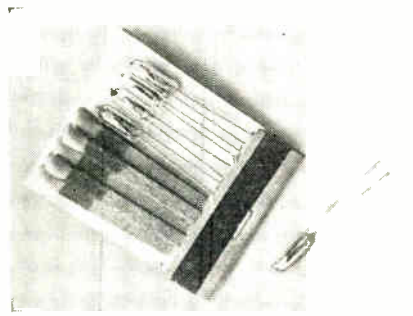


wire, providing a voltage output which is quickly and easily read on a VTVM or oscilloscope. The instrument's 1 mv to 1 ma unity conversion permits direct readings in milliamperes on voltmeters or oscilloscopes. Bandwidth is 20 CPS to 15 MC, permits oscilloscope viewing of complex current waveforms with rise time as fast as 0.08 μsec. Hewlett-Packard Co., 275 Page Mill Rd., Palo Alto, Calif.

Circle 170 on Inquiry Card

MERCURY SWITCH

Mercury switch (Type HG220LO), has ½ in. max. length, 0.162 in. dia. and 1/10 a rating. It is suited for applications requiring slight force, or applications that have a low load,

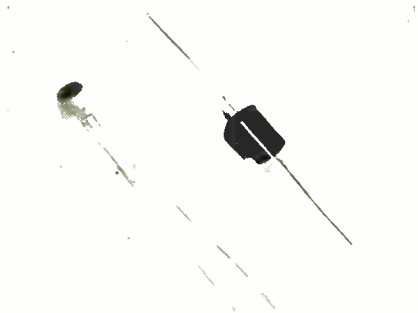


light weight or space factor. Switching action is SPST; differential angle is 15°. AC load at 115 v. and 230 v. is 0.1 a; dc load at 115 v. and 230 v. is 0.1 a; lamp load is 10 w; Locked rotor rating: ac inrush at 115 v. is 1 a, at 230 v. is 0.5 a; dc inrush at 115 v. is 1 a, at 230 v. is 0.5 a. 8 in. length of #26 PVC is the standard lead wire. Gordos Corp., 250 Glenwood Ave., Bloomfield, N. J.

Circle 172 on Inquiry Card

CONTACT PROTECTION

For solving the problem of destructive arcing due to inductive voltage surges at contact points, contact protection units extend life of contacts up to 100 times over unprotected contacts. Units will serve all relays operating up to 40 times/sec. drawing to 200 ma operation current at 130 vac or 250 ma at 154 vdc, ratings based on operation in amb. temp. of 35°C. They are encased in phenolic tubing. Max. width is ⅜ in.; length ranges from ⅝ to 15/16 in. max.

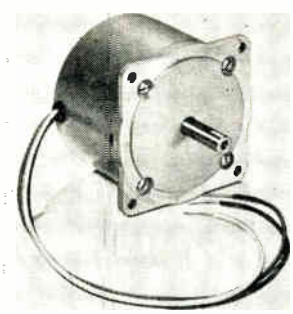


Plastic encapsulated assemblies have a max. length of 0.380 in.; widths from 0.340 to 0.380 in. Dept. CP, Radio Receptor Co., Inc., (Selenium Div.), 240 Wythe Ave., Brooklyn 11, N. Y.

Circle 171 on Inquiry Card

SYNCHRONOUS MOTOR

Slo-Syn Synchronous Motor type SS50 is a permanent magnet type ac motor for applications requiring constant, 72 RPM synchronous speed and/or dc stepping with instant starting, stopping or reversing. Ratings are: input 120 v., 40/70 CPS, 1 phase, 0.30 a max. current (at 60 CPS); 72 RPM output speed at 60 CPS, 50 oz.-in. torque. Uses Class B insulation and is rated for 75°C temp. rise from 40°C max. amb. under continuous duty. Standard types avail-



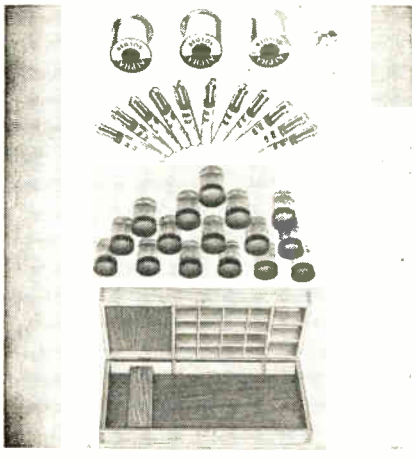
able with planetary gear speed reduction assemblies providing speeds of approx. 16.6, 3.3, 0.67, 0.133 or 0.027 RPM. Has 3 leads, weighs 3 lbs. The Superior Electric Co., Dept. SS, 83 Laurel St., Bristol, Conn.

Circle 173 on Inquiry Card

New Products

SOLDER AND FLUX KIT

For design and process engineers, kit has 16 different soldering chemicals—fluxes, solder paste, flux and dross removers and printed circuit board coatings—11 kinds of flux-

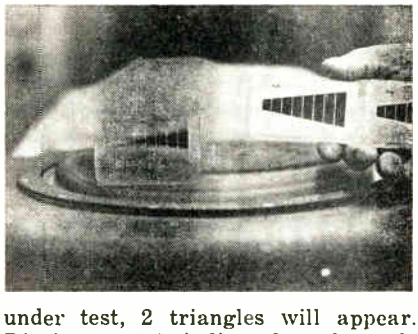


filled and solid wire solders in dispenser tubes, and 3 different foil solders for making preforms. Materials are in a compartmented, wood kit. It has a flux finder guide and solder selector chart, a special soft solder alloys diagram and a solder alloy chart. Charts list tensile strengths of various tin-lead alloys, order of solderability and melting points of metals most often encountered in experimental jobs. Alpha Metals, Inc., 56 Water St., Jersey City, N. J.

Circle 174 on Inquiry Card

OPTICAL WEDGE

A simplified method for measuring displacement in vibration testing, the "optical wedge" is a pressure-sensitive wedge-shaped sticker that can be affixed to a flat surface on the object under test. The long axis of the wedge should be exactly perpendicular to the axis of vibration. Then, as the wedge vibrates with the piece



under test, 2 triangles will appear. Displacement is indicated on the scale directly below the point of the darkest triangle. MB Electronics, 781 Whalley Ave., New Haven 8, Conn.

Circle 175 on Inquiry Card

BEAM POWER TUBE

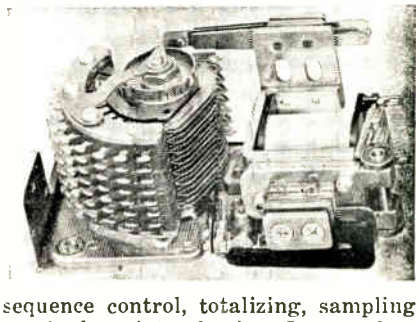
An r-f beam power pentode, WL-7371, for communication transmitters and adaptable for single sideband linear amplifier service. Input power ratings of 300 w and plate dissipation

of 75 w are applicable for continuous commercial service. A max. signal power dissipation of 125 w applies for SSB service. Performance extends to 175 MC. Reliable service and high efficiency are obtained by the thoriated tungsten cathode. Also, good isolation between input and output circuit is provided by tube's construction. A rugged screen grid gives ample dissipation for all types of communication service. Westinghouse Electric Corp., Electronic Tube Div., P. O. Box 284, Elmira, N. Y.

Circle 176 on Inquiry Card

STEPPING SWITCH

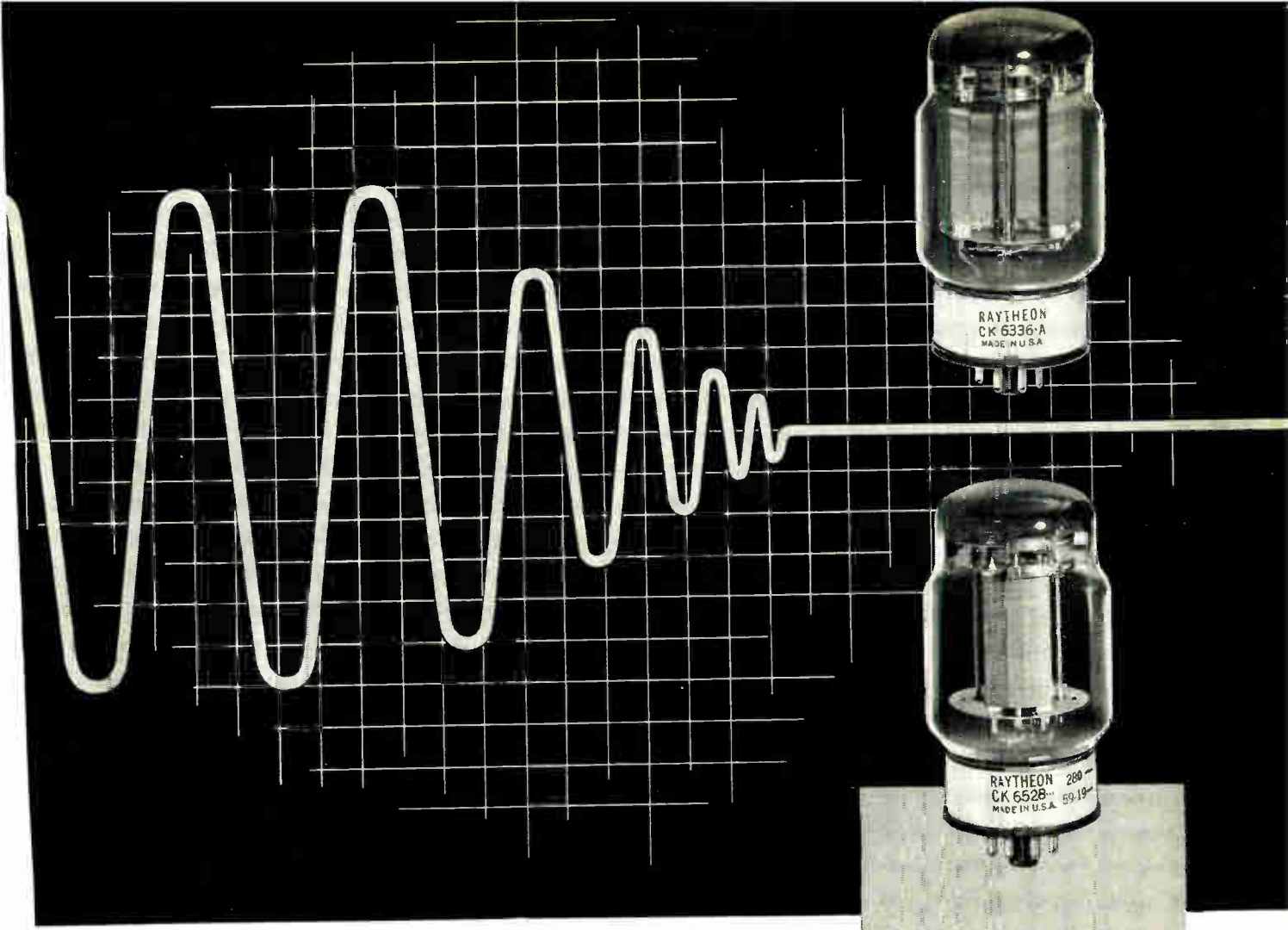
A 10-point stepping switch, Type 210, for digital operation, is small (maximum length 4 5/16 in.), light weight (1½ lbs. with 12 levels) and capable of over 100,000,000 operations with twelve 10-point levels; 300,000,000 with four 30-point levels (properly lubricated and adjusted). It is designed for such applications as



sequence control, totalizing, sampling or single point selection. It transfers from Position 10 to Position 1 without special circuitry. C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill.

Circle 177 on Inquiry Card

Circle 64 on Inquiry Card →



A Pair of Smoothies For Series Regulator Service

The Raytheon CK6336A and CK6528 are mechanically rugged, long-life twin power triodes. They are designed to handle large currents over a wide voltage range and at high temperatures in regulated power supplies. Zirconium coated graphite anodes, ceramic insulators, gold plated molybdenum grid wires, and hard glass envelopes are some of the advanced design features of both types.

Stringent power supply regulation requirements are no problem for these "smoothies." Get full technical data on the CK6336A and CK6528 as well as Raytheon's expanding line of high voltage rectifiers, pulse modulators, and transmitting types. Please write to: Raytheon, Industrial Components Division, 55 Chapel St., Newton 58, Mass.

For Small Order or Prototype Requirements See Your Local Franchised Raytheon Distributor.

RATINGS

	Max. Plate Voltage	Max. Plate Dissipation Watts	Max. Plate Current (per plate)	Amplification Factor
CK6336A	400	2 x 30	400 mAdc	2.7
CK6528	400	2 x 30	300 mAdc	9

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION

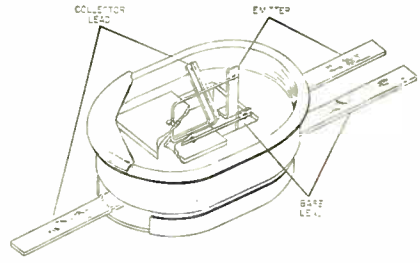
RAYTHEON CK6336A AND CK6528

RAYTHEON

New Products

TRANSISTOR ENCLOSURE

New micro-miniature transistor enclosure is small enough to permit component densities on the order of 1,000,000 parts/ft.³. The enclosure is a flat package measuring 0.125 x



0.180 x 0.060 in. About 42 enclosures can be mounted on 1 sq. in. multi-element wafer, and still add only about 1/16 in. to its thickness. Featured is a cold welded, metal-to-glass, hermetically sealed package providing a min. seal length of 0.050 in. It will house any type of standard computer transistor. Philco Corp., Lansdale Div., Lansdale, Pa.

Circle 178 on Inquiry Card

PRESSURE SWITCH

Miniature pressure switch weighs less than ½ oz. Model PS375-1 provides positive snap-action switching in response to changing pressures in air, fuels, lubricants, gases or other media. Operating range is from 0 to 500 PSI. Repeatable accuracy is to within ±0.5% of the original setting depending upon the operating range. The SPDT snap-action microswitch is rated for 6 a at 125/250

vac. Excellent sensitivity and repeatability and low hysteresis and drift are assured from −65 to +300°F. Pamar Electronics Co., 103 Marine St., Farmingdale, N. Y.

Circle 179 on Inquiry Card

RECORDING OSCILLOGRAPH

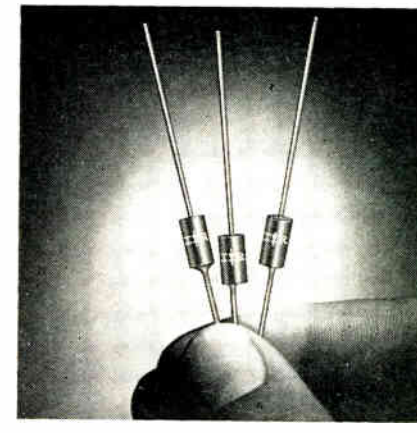
The 621 HT (horizontal table) model, direct-recording oscillograph, can record up to 14 data traces on 6 in.-wide recording paper. The record transport can be operated in 3 speed

ranges—one starting at 0.2 in./min. and the highest range ending at 60 in./sec. The transport is reversible. Standard miniature light-beam type galvanometers are used. They are available in frequency response from dc to 10,000 CPS natural response—6,000 CPS flat response. Midwestern Instruments, P. O. Box 7186, Tulsa, Okla.

Circle 180 on Inquiry Card

SILICON DIODES

First of a series of miniaturized 750 MA rated diffused junction silicon diodes featuring low reverse current (200 μa) at rated PRV, a surge current rating of 50 a peak, 1 cycle, and a low forward voltage drop (0.92 v.) at rated current. The complete series (types X5A2, X5A4, X5A5 and X5A6), provides peak reverse voltage ratings of 200, 400, 500 and 600 v., and an operating temp. range



from −65 to +130°C. Each junction is encapsulated in a stable, high temp. non-metallic case. International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.

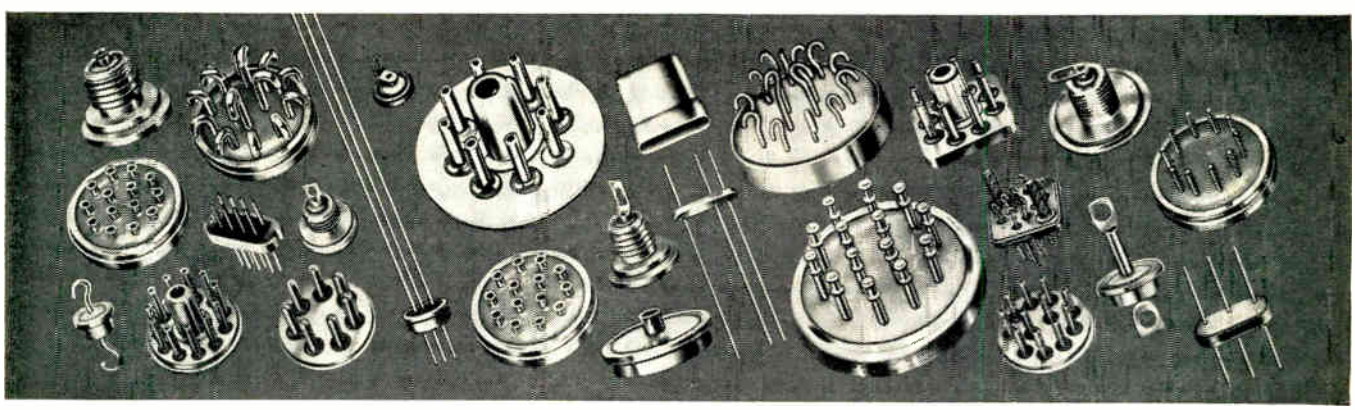
Circle 181 on Inquiry Card

Glass-to-Metal Seals for the Space Age...

E-I MULTI-LEAD HEADERS CONDENSER SEALS INDIVIDUAL TERMINALS

Versatile in Design — Dependable in Performance!

Specify the seals employed by leading manufacturers for complete reliability in vital space age programs and critical commercial equipment. E-I hermetically sealed terminations and custom sealed components have proven their ability to withstand the extreme environments encountered in today's most critical applications. In addition to their demonstrated dependability in all types of commercial and military service, E-I offers engineers widest possible design flexibility . . . a complete line of standard seals, design service on "specials"... and custom sealing of assemblies of your own manufacture.



Write for Complete Information — on standard seals, special types or custom sealing service including miniature closures and color-coded terminals . . . or ask E-I engineers for recommendations on your specific sealing requirements.

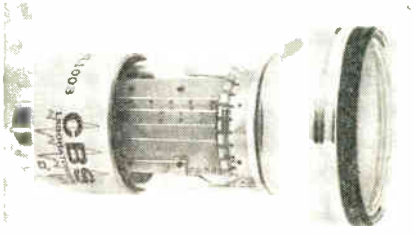
Patented in Canada, No. 523,390; in United Kingdom, No. 734,583; licensed in U. S. under No. 2561520

ELECTRICAL INDUSTRIES
MURRAY HILL, NEW JERSEY, U.S.A.
A Division of Philips Electronics & Pharmaceutical Industries Corp.

New Products

PHOTOMULTIPLIER TUBE

Two new 10-stage photomultiplier tubes sensitive to the visible portion of the spectrum and designed to withstand shock and vibration, the CL-1002 and CL-1003 are 2 and 3 in. dia. respectively. The faceplate is plano-concave with S-11 photocathode (visible response) deposited on a curved-surface to ensure excellent uniformity of response across the face of the tube. They have Inconel



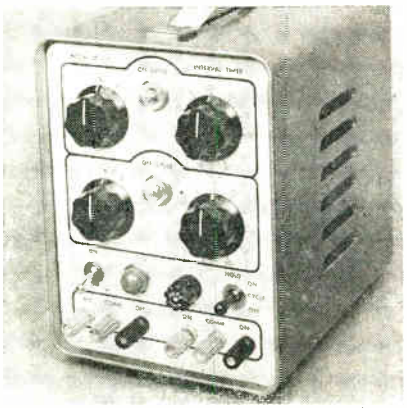
spring support and rugged construction for more resistance to shock and vibration. Electron Tube Dept., CBS Laboratories, High Ridge Rd., Stamford, Conn.

Circle 182 on Inquiry Card

New Products . . . for the Electronic Industries

INTERVAL TIMER

A wide range repeat cycle timer with independent time rate controls for the on and off cycle. Device uses lights to indicate on or off cycle. A switch provides hold in either on or



off cycle. Applications are in environmental testing, life cycle test, electromechanical testing, and photography. Control relay has 15 a DPDT contacts with 1500 vac insulation. Max. and min. time rates for either the on or off cycle are approximately 4 min. to 60 μsec. Technitron Co., 7088 Osbun Rd., San Bernardino, Calif.

Circle 223 on Inquiry Card

HIGH VOLTAGE SUPPLY

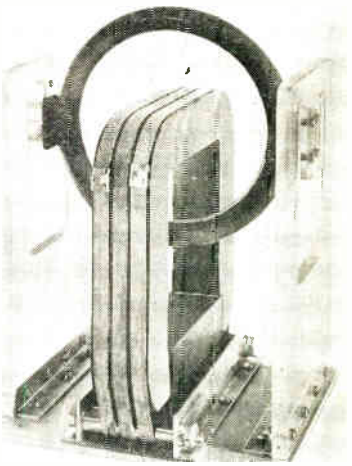
High voltage supply is a hermetically sealed, static supply, operated from voltages as low as 1.3 v. and capable of producing any range of voltage in separate, standard units,

from its initial input voltage to 20,000 v. It can function from any battery source or line supplying 1.5 vdc. Units are designed to operate from 3 v. or from such standard vehicle a/c battery sources from 6 to 28 vdc. Where greater power or loads are in demand. Victory Electronics Inc., 50 Bond St., Westbury, N. Y.

Circle 224 on Inquiry Card

FILAMENT TRANSFORMER

Low capacitance, high voltage insulated filament transformer is rated at 300 kv pulse immersed in oil, or 30 kv pulse, ac, or dc in air. Variety of output voltages and currents avail-



able including the common heater voltages for high power klystrons, TWT's, hydrogen thyratrons, high voltage diodes, mangetrons, etc. Pearson Electronics, Inc., 707 Urban Lane, Palo Alto, California.

Circle 225 on Inquiry Card

New Products

PORTABLE METER

Meter sensitivities to 0.2 μa full scale available in a portable instrument. A "slip-on" Formica carrying case, converts the Greibach Model 700 meter from a panel to a portable unit.

Case will convert meters now in use. The Model 700 features better than ¼% accuracy, multiple (to 23) ranges, and the meter withstands overload surges to 125,000,000% in some cases. It absorbs shocks to 500 g's. Overall dimensions (with carrying case) are: 5⅞ x 8½ x 11¾ in. Greibach Instruments Corp., 315 North Ave., New Rochelle, N. Y.

Circle 183 on Inquiry Card

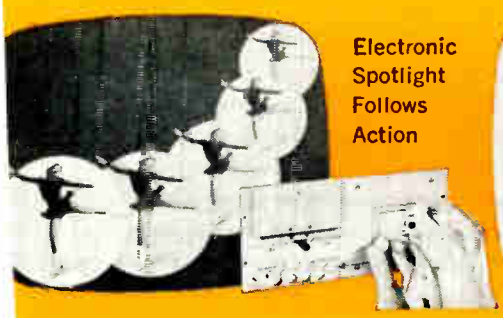
Circle 70 on Inquiry Card

Circle 72 on Inquiry Card →

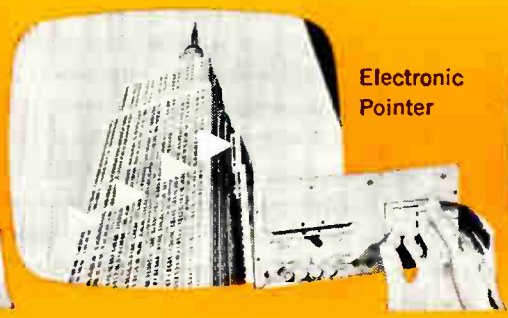
NEW "Joy Stick" Positioner

Move Insert To Any Position

Model 491-A1



Electronic Spotlight Follows Action



Electronic Pointer

Create Wipes With Motion

TELECHROME SPECIAL EFFECTS GENERATOR

with Exclusive "JOY STICK" POSITIONER

First, Telechrome provided broadcasters with a vastly improved system for producing a wider variety of dramatic wipes, inserts, keying and other special effects. Now, Telechrome engineering introduces the "Joy Stick" Positioner. This makes it possible to create many hundreds more effects and to move wipes, inserts, keying or other special effects to any place on the TV screen. The effects are startling! A new era in program creativity begins now! Ask to see the "Joy Stick" Positioner demonstrated, today!

Write, Wire, Phone for Literature

COLOR TV • INDUSTRIAL INSTRUMENTATION • TELEMETRY

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AT THE FRONTIERS OF ELECTRONICS

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WESTERN ENGINEERING DIVISION • 13635 Victory Blvd., Van Nuys, Calif., STate 2-7479
MIDWESTERN ENGINEERING DIVISION • 106 W. St. Charles Rd., Lombard, Ill., MAyfair 7-6026
SOUTHWESTERN ENGINEERING DIVISION • 4207 Gaston Ave., Dallas, Tex., TAylor 3-3291

490WA1 Waveform generator. Generates keying signals for the 72 different wipes.

490SA1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.

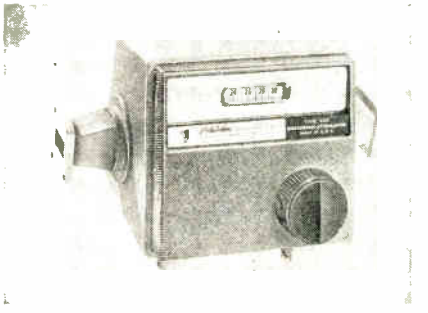
490RA1 Remote Control Unit. Selects and controls desired effect. Designed for console or desk mounting. Easily modified for integration into existing studio facilities. Complete with power supply—512CR1

Available Portable or Rack Mounted

New Products

BROADBAND ATTENUATORS

New series (PRD Type 101) of Broadband Direct Reading Attenuators of the rotary vane type covers frequency range of 3.95 to 40 KMC in 9 models. Attenuators have an attenuation range of 60 db and a max. VSWR of 1.15. Value of attenuation is determined by angular position of a resistive film with respect to the waveguide and is independent of frequency. All 9 units feature small insertion length; 60 db range; tape readout; built-in height adjustment; and low insertion loss. PRD Electronics, Inc., 202 Tillary St., Brooklyn 1, N. Y.

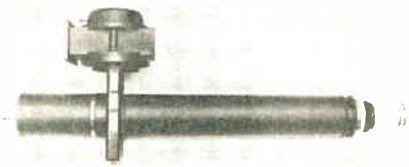


Circle 184 on Inquiry Card

New Products

KLYSTRON AMPLIFIER

Broadband Klystron Amplifier tube provides over 2 megawatts of peak r-f power with a 100 MC bandwidth at L-band. Designated the L-3270 Klystron, it features flat bandpass and linear phase shift characteristics



over the 100 MC bandwidth centered at 1300 MC as well as a min. gain of 30 db. It is suited for application as the output stage of sophisticated radar systems, particularly where frequency diversity or precisely shaped pulses are required. Marketing Dept., KPL, Litton Industries, Electron Tube Div., 960 Industrial Rd., San Carlos, Calif.

Circle 185 on Inquiry Card

RELAYS

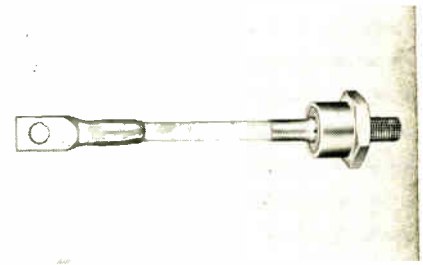
Contact ratings of company's PR series relays increased from 13 a to 25 a, 115/230 vac non-inductive. The 25 a rating is also for 1 hp, 115/230 v., non-inductive, 1 phase. It is a

heavy duty power relay used extensively in elevator controls, motor starting applications and for high current or voltage switching, and is available in contact arrangements up to DPDT. Most PR Series relays listed with U/L and CAS are available with coils of 6, 12, 24, 110 or 230 vac. Potter & Brumfield Div., American Machine & Foundry Co., Princeton, Ind.

Circle 186 on Inquiry Card

SILICON RECTIFIER

New double diffused, hermetically sealed, Silicon Power Rectifier, Style 40, is rated at 60 a average at 20°C amb. on a 7 x 7 x ⅛ in. copper heat



sink. Peak inverse voltages range from 100 to 400 v. in 100 v. steps. Typical forward dynamic resistance is 0.0015 ohms. Data includes a peak forward voltage of 1.2 v. max. at 100 a. Temp. range is −75° to +175°C (junction) and the thermal drop, junction to case, is 1.0°C/w max. Peak surge current is 1,000 a for ½ cycle of a 60 CPS sine wave. The new diode has a peak inverse current of 25 ma at rated PIV. Syntron Co., 263 Lexington Ave., Homer City, Pa.

Circle 187 on Inquiry Card

Circle 77 on Inquiry Card

New Products

DELAY RELAY

Addition to line of thermal time delay relays, Model 900 G, a rugged, economical, miniaturized standard 9 pin-in socket, hermetically sealed in a metal can. The time delay ranges of

this unit are 2 sec. to 180 sec. with a voltage range of 6.3 v. to 115 vac or dc (heater). The unit is engineered for both military and commercial uses, wherever a rugged miniature thermal device is required. Thermal Controls, Inc., 41 River Rd., North Arlington, N. J.

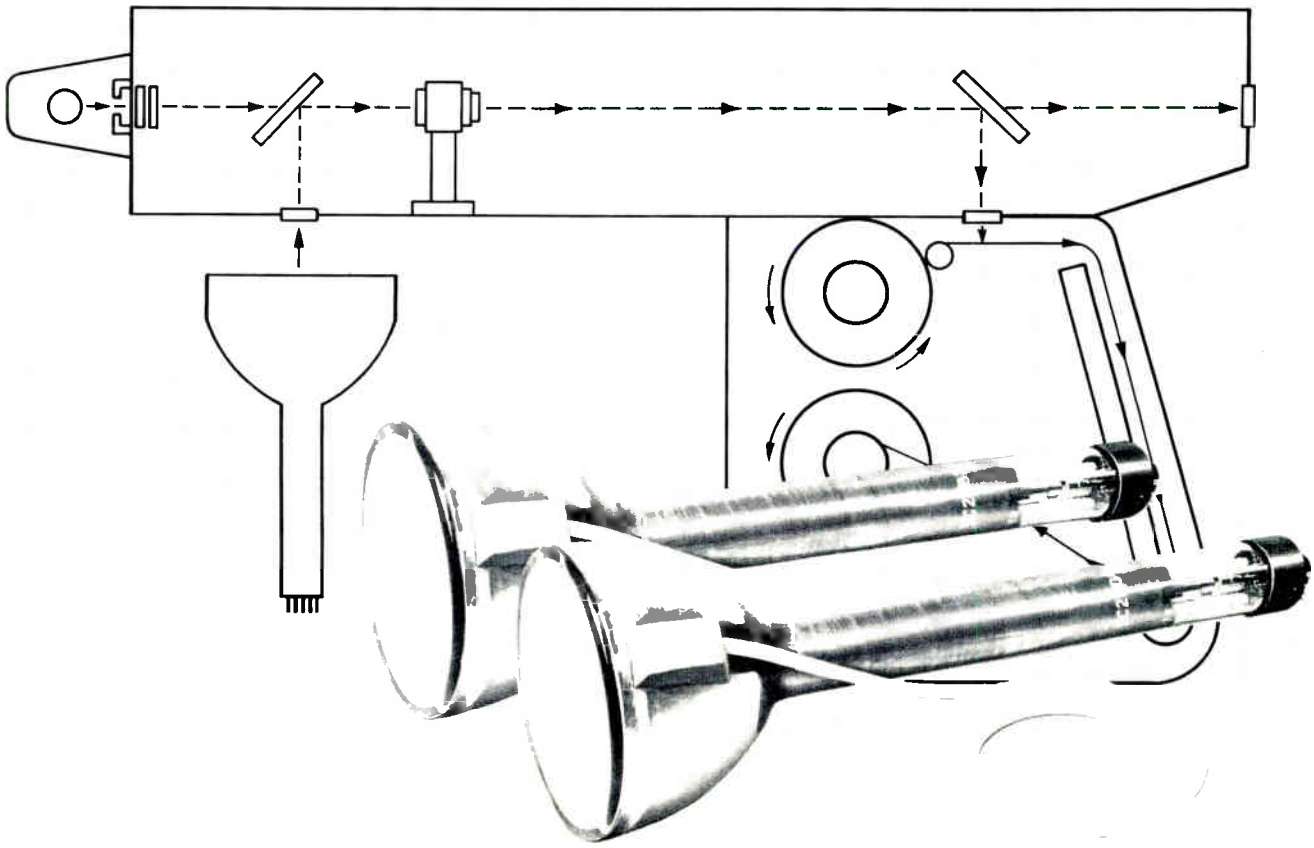
Circle 188 on Inquiry Card

Circle 78 on Inquiry Card

Circle 79 on Inquiry Card ➔

ELECTRON TUBE NEWS

...from SYLVANIA



• HIGH RESOLUTION
• SIMPLIFIED CIRCUITRY
• IMAGE BRILLIANCE

with 2 new Sylvania C.R.T.'s for photo-recording applications

Sylvania SC-2809, SC-2782 utilize precision guns, fine grain P11 phosphor, aluminized screens, clear nonbrowning optical faceplates. Result: remarkably high resolution and excellent brilliance. SC-2809 has a line width of .0008", a resolution of 6000 lines. SC-2782 has a .001" line width and a 3000-line resolution. Both tube types feature conventional magnetic focusing and deflection, simple beam-centering magnets, no ion traps. They simplify external circuitry requirements, offer potential savings in equipment costs. Minimum useful screen area is 4¼". Deflection angle is 50°. Use of an integral encapsulated high-voltage connector minimizes possibility of corona at high altitudes. Screens other than P11 are available if desired. For further information and complete technical data, contact the Sylvania Field Office nearest you.

KEY CHARACTERISTICS	SC-2809	SC-2782
Anode Voltage	25,000 Volts dc*	25,000 Volts dc*
Anode Current (E_{G1}=0)	3 μA dc*	
Grid No. 2 Voltage	2,500 Volts dc*	2,500 Volts dc*
Grid No. 2 Current (E_{G1}=0)	2,000 μA dc*	
Screen Current	2 μA dc	5 μA dc
Line Width	0.0008"	0.001"
Face Diameter	5"	5"
Over-all Length	16⅜"	16"

*Absolute Max. Ratings

NEW SYLVANIA C.R.T.'s FEATURE

LOW HEATER POWER HIGH RELIABILITY "COOL" OPERATION

for battery-powered, portable 'scope applications

Sylvania 3BGP1, 3BGP2, 3BGP7, 3BGP11 . . . feature direct-view rectangular faces, electrostatic deflection and focus, high deflection sensitivity.

KEY CHARACTERISTICS	
Anode No. 2 Voltage	2,750 Volts dc*
Anode No. 2 Input	6 Watts*
Anode No. 1 Voltage (Focusing Electrode)	1,100 Volts dc*
Heater Ratings	1.5V/140mA
Line Width (Light output of 20 ft. Lamberts)	0.026"
Face Dimension	1½" x 3¼"
Useful Screen Area	1⅛" x 2¾"
Over-all Length	9¼"
*Absolute Max. Ratings	

The 3BGP-family of 'scope tubes is typical of the continuing work of Sylvania to advance the "state of the art." Combining modern C.R.T. technology and powder metallurgy techniques, Sylvania has produced a heater-cathode assembly requiring only 1.5V @ 140mA – less than 7% of the power normally needed. Reduced power demands result in much lower tube operating temperatures and low drain from battery or flyback heater supply. The heater-assembly has a relatively low mass which makes it virtually impervious to vibration of portable equipment. Clear, pressed faceplates are utilized for improved glass quality, greater uniformity of thickness resulting in minimized distortion. Complete information and technical data can be obtained from your local Sylvania Field Office.

The new Sylvania low power heater-cathode assembly holds vast promise for picture tubes for portable, battery-operated TV receivers. This concept is currently under investigation at Sylvania. Your inquiry is welcome.

4 NEW "BONDED SHIELD" TV PICTURE TUBES

all available with new reflection-diffusing, treated caps

Sylvania continues its leadership in "Bonded Shield" picture tubes with an expanded line to help you meet the demand for squared-corner TV. Now, you can offer *broad-angle* and *low-reflection* viewing with the specially treated laminated cap. The treated surface of the tube cap can diffuse up to 70% of reflected light without appreciable loss in resolution–eliminating the old problem of mirror images.

Bonded Shield eliminates front-of-the-cabinet safety glass • Reduces front-to-back cabinet dimensions • Reduces danger of implosion • Reduces production-line rejects significantly • Offers squared-corner screen • Simplifies mounting with integral mounting lugs • Offers potential savings in set manufacture.

Sylvania pioneered the quantity production techniques of bonding cover panels to the face of a picture tube. These same techniques hold exciting possibilities for application in industrial and military cathode ray tubes. You may have a C.R.T. application that can benefit from Sylvania Bonded Shield "know-how." Sylvania Engineers will be pleased to work with you.

If your industrial or military design demands specialized Cathode Ray Tubes, call on the creative experience and production capabilities of Sylvania. Electronic Tubes Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, New York.

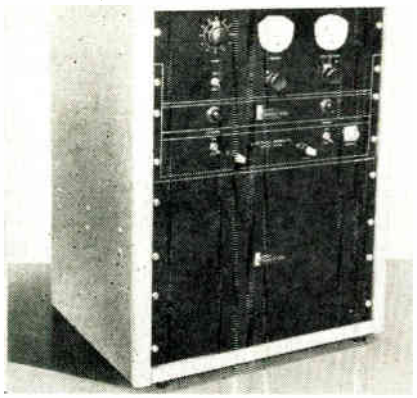
SYLVANIA

Subsidiary of GENERAL TELEPHONE & ELECTRONICS

New Products

ULTRASONIC GENERATOR

New 1 kw ultrasonic generator, Model G-310, is rated at an output of 1000 w ave. and 2000 w peak power at 38 to 42 KC and will drive 192 sq. in. of barium titanate crystal radiating surface. It operates on 115 v. at 20 a, is 21¾ x 18 x 28⅝ in. and is powered



by two vacuum tubes. It weighs 225 lbs. It is housed in a welded aluminum cabinet and the generator has front panel controls. National Ultrasonic Corp., 111 Montgomery Ave., Irvington, N. J.

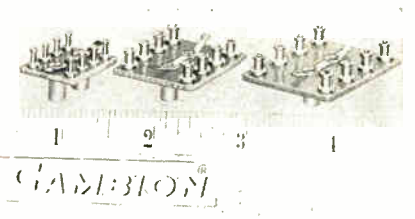
Circle 189 on Inquiry Card

← Circle 79 on Inquiry Card

New Products

TERMINAL BOARDS

Three new Cambion®8 lug terminal boards for resistor mounting. The boards are 1/16 in. fibre glass, impregnated with melamine resin. Board No. 1451 is 1 7/32 x 1 1/32

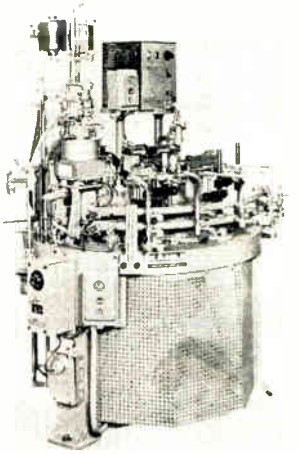


in. with terminal rows ¾ in. apart; No. 1452 is 1½ x 1 5/32 in. with terminal rows ⅞ in. apart. Terminals extend 3/16 in. Each board has rounding strap swaged to mounting studs for positive r-f grounding. Metal parts are brass per QQ-B-626 ½ hard. Mounting studs have 0.0002 in. cadmium plate plus Iridite. Terminals have 0.0003 in. silver plate plus water-dip lacquer. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

Circle 190 on Inquiry Card

DIODE MACHINE

Automatic combination beading and cat-whisker welding machine for glass diodes. Machine No. 3438 produces beaded leads with the formed cat-whisker welded to the lead. The lead wire is fed from the spool, straightened, cut-off and beaded. The cat-whisker wire is similarly fed



from the spool, welded, cut-off and formed. Production is 1500-2000 per hr. Kahle Engineering Company, 3322 Hudson Avenue, Union City, New Jersey.

Circle 191 on Inquiry Card

New Products

BIMETAL DISC THERMOSTAT

New line of bimetal disc thermostats provides close temp. differentials. The certified Type MX Thermostats can be supplied with differentials, as r easured on the disc, of 1°

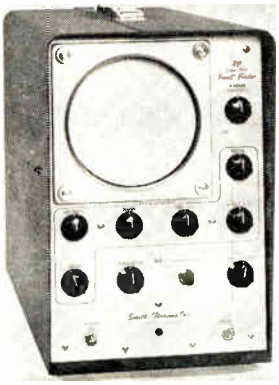
to 4°F. Standard types available with differentials of 2° to 6°F. In conjunction with the snap-acting feature, they provide exceptional temp. control for missile, avionic and astrionic applications. Type MX are conservatively rated, based on non-inductive load, at 3 a for 25,000 operations, 30 vac/dc and 115 vac to 1 a, same voltage, for 250,000 operations. Stevens Mfg. Co., Inc., P. O. Box 1007, Mansfield, Ohio.

Circle 192 on Inquiry Card

New Products

CABLE FAULT FINDER

The 5 in. presentation Model 751 is designed for the Broadcast and TV industry, where large dia. coaxial air dielectric cable is to be periodically examined for impedance mismatches,

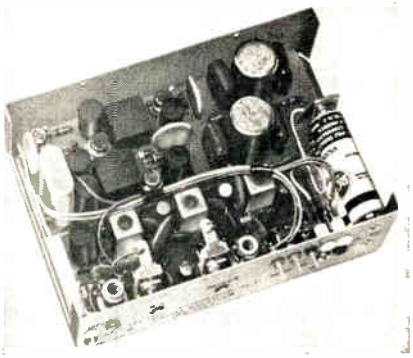


shorts or opens. An "air-poly" switch is incorporated to change the range mark and sweep circuitry to agree with the difference in propagation constants of air and polyethelene cables; hence, the 751 reads faults from 0 to 1200 feet on either type of cable. It has lighted graticule, with variable intensity control, range mark amplitude control to vary height of the 12 100 foot marks, 50 ohms and 72 ohm termination switch and camera mount bezel. Smith-Florence, Inc., 4228 23rd Ave., West, Seattle 99, Wash.

Circle 193 on Inquiry Card

COMMAND RECEIVER

The LEL TRR-1263 command receiver is a completely transistorized, crystal-controlled, fixed tuned receiver designed to operate over the 5 MC to 16 MC range. The integral multi-tone decorder section provides



high immunity from interference. Applications include telemetering, range safety, and missile command-destruct use. LEL Inc., 380 Oak St., Copiague, L. I., N. Y.

Circle 194 on Inquiry Card

Here's data on the *New*

DIAL HEAD AGASTAT®

time/delay/relays

These relays have recently been re-designed—improved in performance *and* appearance. So you'll want up-to-date specs.

This free folder gives complete details on all models. In it you'll find operating specs, timing ranges, contact capacities, dimensions, diagrams of contact and terminal arrangements, and data on mounting and installation accessories.

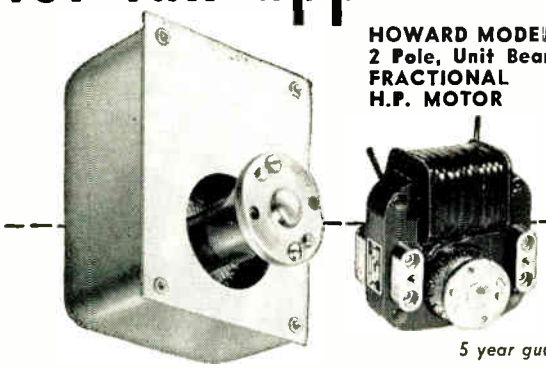
For your copy, write: Dept. A34-732.

AGASTAT TIMING INSTRUMENTS
ELASTIC STOP NUT CORPORATION OF AMERICA
1027 NEWARK AVENUE, ELIZABETH 3, NEW JERSEY

Circle 140 on Inquiry Card

THE CHOICE OF LEADING MANUFACTURERS

for fan applications



HOWARD MODEL 108S
2 Pole, Unit Bearing
FRACTIONAL
H.P. MOTOR

5 year guarantee

Available with Open or Closed Construction

MOUNTING: From rear or by special pads on front.
BEARING: Single, long-life, permanently lubricated.
STATOR: Vacuum varnish impregnated coil on molded nylon bobbin.
ROTOR: Dynamically balanced for ultra-quiet operation.
ROTATION: Unidirectional (CW or CCW as specified).
SHAFT-HUB: Assures positive and accurate location of connecting part (fan) which must run concentric. Can also be furnished with shaft extension from hub..

HP: 1/750 to 1/185
NO LOAD RPM: 3400
FULL LOAD RPM:* 2600-3200
INPUT WATTS: 8-30
VOLTS: 115 V. 60 cy. AC std.
*Lower full load speeds also available.

Send us your specifications or write for complete catalog.

POWERED BY **HOWARD**

HOWARD INDUSTRIES, INC.
1730 State St., Racine, Wisconsin
Divisions: Electric Motor Corp., Cyclohm Motor Corp., Loyd Scruggs Co.

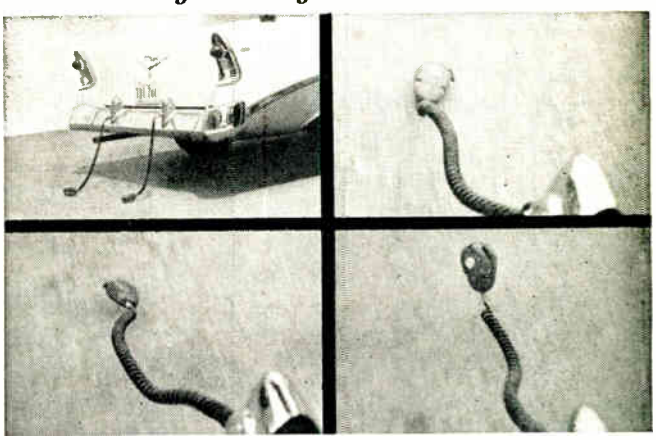
Circle 138 on Inquiry Card

35,000 SMASHING, BATTERING IMPACTS—

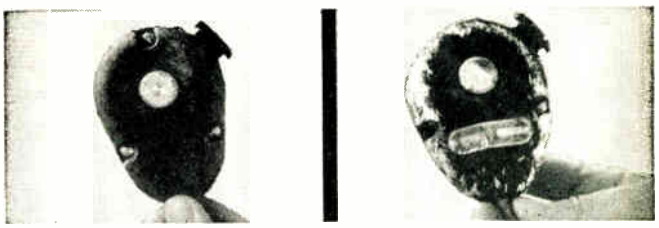
and still working perfectly!

SHURE "TEN-FOUR"
COMMUNICATIONS MICROPHONE

proves its incredible durability in this gruelling destruction test!



New SHURE "TEN-FOUR" MICROPHONE, with exclusive Armo-Dur housing, and another microphone with standard die-cast metal housing were dragged for miles on a test drive over all kinds of pavements at speeds to 30 mph. In a matter of minutes, it was subjected to greater punishment than a lifetime of severest mishandling *and here's the result:*



Ten-Four with Armo-Dur Housing virtually unmarked—still performed perfectly!

Standard microphone with die-cast metal housing — cracked, broken, abraded—microphone inoperable.

For the microphone that stands up under severe operating conditions with no loss of high speech intelligibility, be sure to specify the Shure "Ten-Four" when you order your new communications equipment or replacements.

(Can be furnished with "Controlled Magnetic" or carbon cartridge.)

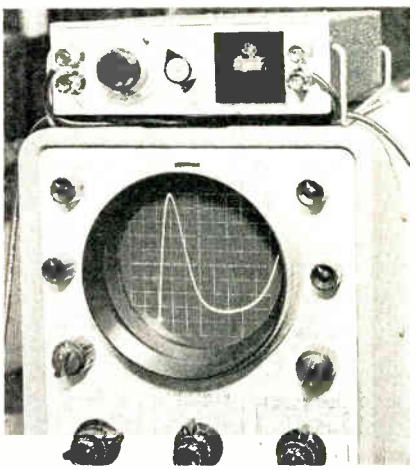
SHURE BROTHERS, INCORPORATED
222 Hartrey Avenue, Evanston, Illinois
HIGHEST QUALITY MICROPHONES — FIXED - STATION AND MOBILE

Circle 88 on Inquiry Card

New Products

TUNNEL DIODE CURVE TRACER

Instrument permits study of forward characteristics of tunnel diodes including gallium arsenide tunnel diodes. A plug-in adapter can be changed to accommodate different package configurations. Any sensi-

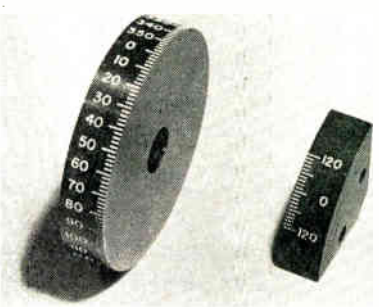


tive oscilloscope may be used for current and voltage wave forms. It creates a sharp representation of the entire critical region of the forward characteristics curve rather than just a portion of that curve. With an external decade box shunted across the horizontal terminals, it is practical to read the actual negative resistance at any point. Texas Instruments Incorporated, Geosciences and Instrumentation Div., Instrumentation Product Group, 3609 Buffalo Speedway, Houston 6, Texas.

Circle 195 on Inquiry Card

DRUM DIALS & VERNIERS

A complete new line of ultra precision engraved drum dials and verniers, are available in 4 basic diameters, 1½ in., 2 in., 2½ in., and 3 in. These drum dials are made to Mil Specifications, black anodized



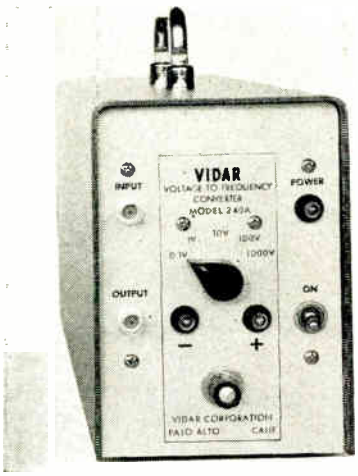
with white filled engraving. They offer exact vernier reading within 6 seconds of a degree. PIC Design Corp., 477 Atlantic Avenue, East Rockaway, Long Island, New York.

Circle 196 on Inquiry Card

New Products

CONVERTER

Fully transistorized circuitry develops a frequency precisely proportional to input voltage with 0.1% long-term accuracy. Frequency range is 0-100 KC. Full-scale sensitivity

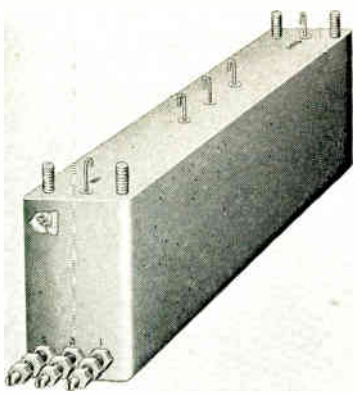


can be switched from 0.1 v. through 1000 v. in 5 steps. Input polarity is indicated automatically. Applications include: Analog-to-digital conversion (used with a counter), precise integration, and telemetry. Three package designs are available. Model 240A. Vidar Corp., 2107 El Camino Real, Palo Alto, Calif.

Circle 197 on Inquiry Card

VARIABLE DELAY LINE

New Special Triple Output Variable Delay Line, Model 72-22, has applications in variable coding systems, provides 3 variable taps over a total delay of 1.5 μsec. Taps can be individually adjusted over the delay range with a resolution of 0.025 μsec. Im-



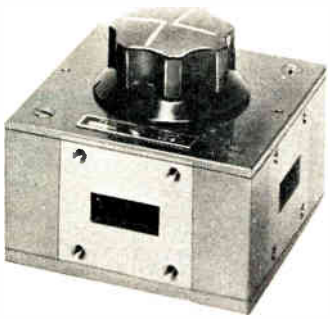
pedance is 300 ohms. Pulse rise time and attenuation for full delay is 0.07 μsec. and 2 db (max.) respectively. ESC Corp., 534 Bergen Boulevard, Palisades Park, N. J.

Circle 198 on Inquiry Card

New Products

WAVEGUIDE SWITCHES

New series of waveguide switches designed to be operated manually or driven electrically by a 28 vdc solenoid actuator. Characteristics include broadband operation, low VSWR,

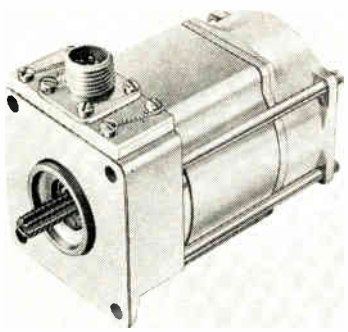


excellent isolation and high power capacity. Series 641 waveguide switches cover the frequency ranges from 3.95 to 40 KMC and each switch operates over the full waveguide bandwidth. Max. VSWR is 1.10. The min. isolation is 60 db for frequencies from 3.95 to 26.50 KMC and 50 db from 26.50 to 40 KMC. FXR, Inc., 26-12 Borough Place, Woodside 77, N. Y.

Circle 199 on Inquiry Card

HI-TEMP MOTOR

The HM420 Type Hi-Temp Motor is for an amb. temp. range of −65° to +600°F. This motor uses materials of construction radically different from basic motor materials. Ordinary copper wire windings oxidize and deteriorate above 400°F and standard wire insulation coatings have negligible life at 600°F. Thus nickel-clad copper wire is used, insulated by glass impregnated with a specially developed high-temperature additive. Similar problems have

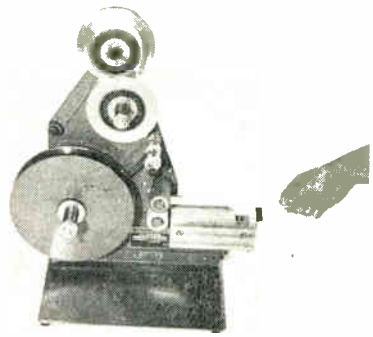


been solved in the case of bearing materials, stator plating, soldering, etc. Marketing Dept., Airborne Accessories Corp., 1414 Chestnut Ave., Hillside 5, N. J.

Circle 200 on Inquiry Card

LAMINATOR

For making any electrical insulation pressure-sensitive right on the production line, the "Scotch" brand E-10 insulation laminator, is for use with the double-coated polyester film

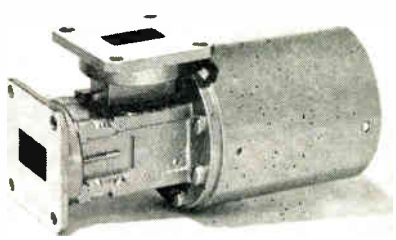


tape, "Scotch" brand electrical tape No. X-1115. Insulating materials, such as mica, metal foil and fish paper may now be made pressure-sensitive. The laminator features feed spools for the double-coated tape and the insulating material, with a take-up spool for the tape separation liner. Dept. WO-202, Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

Circle 201 on Inquiry Card

HIGH SPEED FERRITE SWITCH

A high-speed ferrite switch capable of on-off or single-pole double-throw switching in less than 0.2 μsec utilizes Faraday rotation. The switch operates over a 10% bandwidth at X-band without programming the drive current. Characteristics include under 0.7 db "on" insertion loss, 30 db "off" insertion loss, or cross-channel separation, and power capability of 200 wave. Applications include pulse modulation of CW sources, TR tube replacement in high-repetition rate



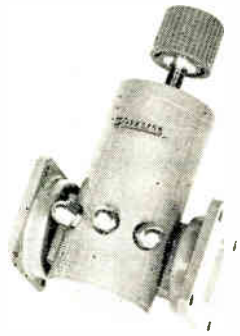
radar systems, and diplexing of 2 sources into a common waveguide. Hughes Aircraft Co., Components Div., Florence Ave. & Teale St., Bldg. 20, Culver City, Calif.

Circle 202 on Inquiry Card

New Products

TUNABLE WAVEGUIDE FILTER

A tunable single section dual mode band pass filter for operation in the 8.5-9.6 KMC range. This single section filter is tunable over the range of 8.5-9.6 KMC and has a 3 db bandwith

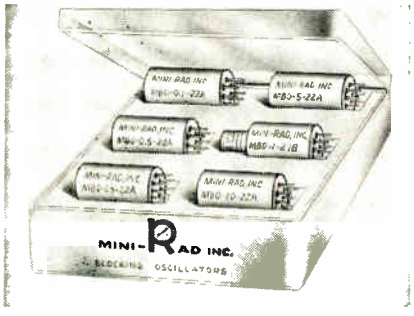


which varies from 29 to 36 MC over the band. The insertion loss at Fo −60 MC is 21 db min. Unit, part number 60017, is manufactured in aluminum and has been designed to withstand severe shock and vibration environments. The insertion length or dimension from flange to flange is 2.75 in. and tuning is accomplished through a precision micrometer type drive screw with a positive locking device. Waveline Inc., Caldwell, N. J.

Circle 203 on Inquiry Card

BLOCKING OSCILLATORS

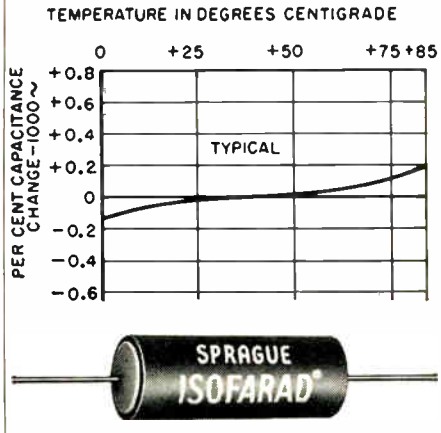
Test kits consist of 6 standard "Nuvistorized" blocking, oscillator units for research, breadboarding, and experimental laboratory applications. Monostable Blocking Oscillator Kit provides a complete range of output pulse widths from 0.05 to 25 μsec. The Astable Blocking Oscillator Kit contains 6 units which provide output pulse (free running) repetition rates from 1 to 1,000,000 pps. The 6 units comprising the Counting Blocking Oscillator Kit provide a dc control pulse



repetition rate countdown from 1-to-1 to 10-to-1 over an input pulse repetition range of 100 to 1,000,000 pps. Mini-Rad, Inc., 7416 E. Varna Ave., N. Hollywood, Calif.

Circle 204 on Inquiry Card

New Film Dielectric Displays Unusual Stability



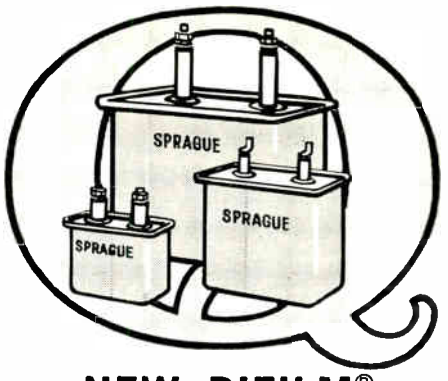
A new duplex plastic film dielectric developed and patented by the Sprague Electric Co. displays practically a zero temperature coefficient of capacitance over operating ranges up to +85 C. The retrace on return to room temperature is within ± 0.10%.

This new dielectric is currently being used in Sprague Electric's ISOFARAD Capacitors which are finding wide application in critical circuits of color TV receivers. The insulation resistance and dielectric absorption characteristics of these capacitors approach those of polystyrene film capacitors. ISOFARAD capacitors also are said to be superior to silvered mica capacitors in insulation resistance. Their tubular shape makes them more adaptable than silvered mica units for machine insertion on printed wiring boards. For practical purposes, their capacitance stability is equivalent to the more expensive silvered mica units.

Capacitor sections are of extended-foil design and are housed in pre-molded phenolic shells with plastic-resin end seals for protection against moisture and mechanical damage. Standard ISOFARAD Capacitors are rated at 500-volts d-c and are available with capacitance tolerances as close as ± 5%.

For complete technical data on ISOFARAD Capacitors (Type 145P), write for Engineering Bulletin 2073A to Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

Circle 92 on Inquiry Card



NEW DIFILM® VITAMIN Q® CAPACITORS

operate at +125 C without derating... save space and weight

Surpassing MIL-C-25A Type CP-70 requirements for performance, reliability, size, and temperature range without voltage derating, Sprague Type 272P DIFILM Vitamin Q® Capacitors are made to withstand the most severe operating conditions encountered in military and industrial electronic equipment.

The new dual dielectric used in these capacitors consists of both synthetic polyester film and the highest grade capacitor tissue... a combination which offers the best properties of both materials! The impregnant is Vitamin Q, a synthetic polymer which has been used exclusively by Sprague with outstanding success in paper capacitors for many years.

Seamless drawn rectangular capacitor cases provide virtually leakproof containers with increased reliability over MIL-type units using fabricated cases.

Especially important to designers of electronic equipment is the saving in physical size and weight over conventional oil-paper capacitors. There is no need to use larger, bulkier, higher voltage capacitors because of the need to derate above 40 C. And there is no +85 C limitation to upper operating temperature so that ventilating and cooling devices for equipment enclosures often may be eliminated.

For complete engineering data on Drawn-Rectangular Case DIFILM Vitamin Q Capacitors, write for Bulletin 2340 to Technical Literature Section, Sprague Electric Company, 233 Marshall St., N. Adams, Mass.

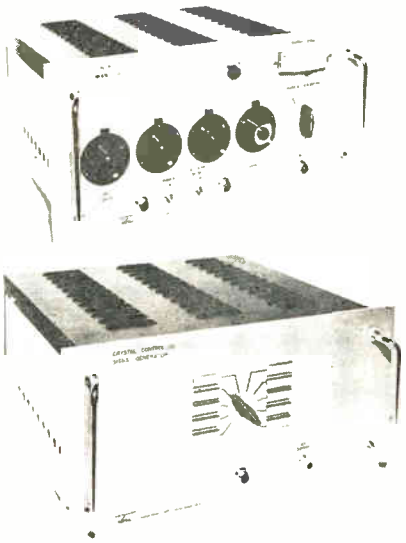
SPRAGUE®
THE MARK OF RELIABILITY

Circle 93 on Inquiry Card

New Products

SIGNAL GENERATOR

Crystal-controlled signal generator, produces up to 50 fixed-frequency CW signals in the 50 KC to 900 MC range. Model SP-120 uses a separate crystal-controlled oscillator-amplifier for each frequency generated. Frequency sta-

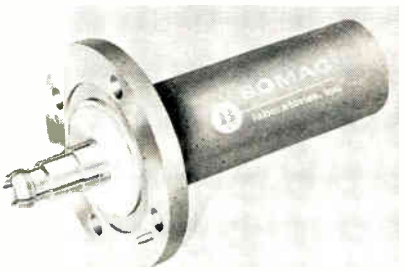


bility of 5 x 10^{-7} parts per week may be achieved, or conventional vacuum tube oscillators may be specified with an accuracy of 0.005%. R-f output is over 2 v RMS into 50 ohms. R-f leakage is below 1μv, spurious signal content is down 60 db from the desired signal. Fundamental output of the oscillators is used below 75 MC; above 75 MC, frequency multiplying circuits are used. Telonic Industries, Inc., Beech Grove, Ind.

Circle 205 on Inquiry Card

COAXIAL LOAD

Developed for use with balanced duplexers in radar systems, this coaxial load in 1⅝ in. 50 ohm EIA line, can dissipate an average power of 20 watts at 20 kw peak. Over a range



of 400-450 MC, it presents maximum VSWR of 1.2. It is designed as an expendable component Bomac Laboratories, Inc., Salem Road, Beverly, Mass.

Circle 206 on Inquiry Card

New Products

VOLTMETER-CONVERTER

New 70 db log voltmeter and converter is potentiometric and accurate to 0.2 db or 2% anywhere on the 14 in. 3 cycle scale with ac or dc inputs. Model HLV-150 uses a mirror scale and knife-edge pointer eliminating

parallax. A second manually adjustable db reference scale provides for any arbitrary 0-db reference. Very low frequency inputs are handled by the chopper stabilized preamplifier used for dc measurements. R-f inputs are handled with a separate r-f probe. A log converter readout circuit with separate zero control and floated Zener reference may be used as a source for any conventional dc recorder for decibel recording. Houston Instrument Corp., P. O. Box 22234, Houston 27, Tex.

Circle 207 on Inquiry Card

TW AMPLIFIER

A full octave band ultra low noise traveling-wave amplifier, the WJ-211, covers the 2-4 KMC band with spot noise figures in the order of 2.7 db and fixed voltage noise figures below 4.8 db across the band. Externally, the new tube is compatible in size, weight and power supply requirements with present solenoid-focused low noise tubes, so that "retrofitting"

changes are minimized. Long life is anticipated because of the low cathode operating temp. (typical 650°C) and excellent tube vacuum. Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Calif.

Circle 208 on Inquiry Card

10-inch high-quality Storatrons are available. Choice of electrostatically or magnetically deflected writing guns. The popularity of these tubes has been proved—a result of their overall quality of display plus excellent resolution and brightness.

Electrostatic tubes feature two identical writing guns—mounted along with a view gun on a single, sturdy, centrally located mount for ease of control and operation.

Magnetic tubes feature a viewing gun axially located for uniformity of display and a writing gun placed for use with standard yokes. Both guns have standard miniature bases. These Storatrons are just two examples from the largest line of immediately available quality direct view storage tubes (2¾" to 21")—DU MONT STORATRONS.

Send for complete specifications including circuit information.

ELECTRONIC TUBE SALES

DU MONT®

precision electronics is our business *T.M.

ELECTRONIC TUBES/INDUSTRIAL TV/MILITARY ELECTRONICS/MOBILE COMMUNICATIONS/SCIENTIFIC INSTRUMENTS/AUTOMOTIVE TEST EQUIPMENT

Allen B. Du Mont

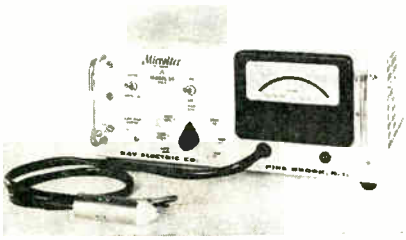
ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J., U. S. A.

INTERNATIONAL DIVISION • 515 MADISON AVENUE, NEW YORK 22, N. Y. • CABLES ALBEEDU, NEW YORK

New Products

VACUUM-TUBE VOLTMETER

Low level, high frequency r-f voltages from 250 μv to 1 v. can be measured with Microlter, a combination 50 MC VTVM and video amplifier. Featuring improved stability over the entire frequency range, it provides direct readings within 1% accuracy on a full scale 6 in. mirror-back meter —with no tuning. Max. output voltages of video amplifier is 0.5 v. at 75 ohms with amplifier gain of 45 db. A 7-position switch gives full scale readings of low-level r-f signals between 1 and 0.0001 v.; lowest reading is 250 μv. Operating range is from 50 CPS to 50 MC with direct readings in volts and decibels. Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.



Circle 209 on Inquiry Card

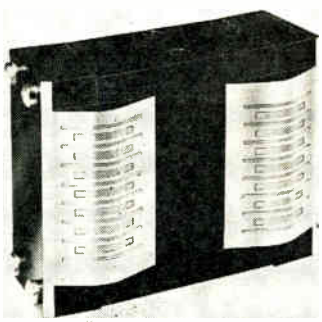
LOW PASS FILTER

Low Pass Filter for use in the output stage of a personal page transmitter operating on a 60 KC carrier frequency. The LF-122, provides a min. attenuation of 40 db throughout the aircraft and citizen band frequencies. It was designed to carry high power in the order of a 75 w peak and 25 w normal and can be driven from source impedances of between 5 to 10 ohms. Output is to the transmitter's loop antenna. Attenuation is 50 db down at the 3rd Harmonic. Attenuation is held to less than 1 db up to 60 KC and less than 3 db at 65 KC. Control Electronics Co., Inc., 10 Stepar Place, Huntington Station, L. I., N. Y.

Circle 211 on Inquiry Card

MAGNETIC HEADS

Series of integral interlace magnetic heads, Series 2000, for analog and digital recording, provides more efficient use of tape and maintains critical relative azimuth and spacing between two gap lines. A Gap-Mounted® feature of the Integral Interlace heads assures that the two gaplines are parallel within 0°5′ and spacing between gaps is held to ±0.001 in. The butting surfaces of the "H" mounting block and head cartridges are ground and lapped with reference to the gapline of the head. Clevite Electronic Components Div., Clevite Corp., 3405 Perkins Ave., Cleveland 14, Ohio.



Circle 210 on Inquiry Card

DECADE AMPLIFIER

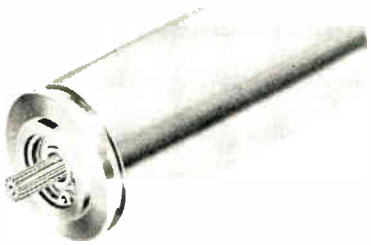
Decade Amplifier, Model 140-B, features response from 1 CPS to over 3 MC, 40 v. output and 10 megohm input impedance. It has a very low noise level, and low output impedance; its self-contained power supply is electronically regulated. Gain of 1, 10, 100 and approx. 700 is selected by switch. The broader band of this new Decade Amplifier makes it invaluable for geophysical work and vibration studies. It is available as a chassis unit, in a cabinet, or on a rack panel. H. H. Scott, Inc., Instrument Div., 111 Powder Mill Rd., Maynard, Mass.

Circle 212 on Inquiry Card

New Products

MOTOR TACH GENERATOR

A new −55°C to +125°C size 11 motor tach generator for damping in position servo and similar applications. Motor has 6000 RPM min. no load speed, 0.6 oz. in. min. at 25°C

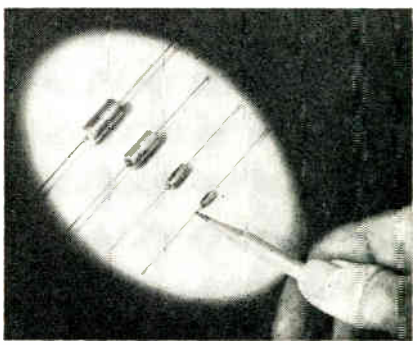


torque at stall, 1.3 gm. cm.² rotor moment of inertia, 3.5 w per phase stall power, 120 + J1780 = 2175 ohms impedance at stall, 115 v. fixed phase and 115/57.5 v. control phase voltage and 0.053 a per phase current at stall. 115 v, 400 CPS generator has 3.05 w input, 0.5 v per RPM min. at 25°C output voltage, 10° max. phase shift, and 1200 ohms output impedance. John Oster Manufacturing Co., Avionic Division, 1 Main St., Racine, Wisc.

Circle 213 on Inquiry Card

SOLID TANTALUM CAPACITOR

Small, solid tantalum capacitors, Series J, can operate at full-rated voltage at 85°C. They can be operated at as high as 125°C at ⅔ rated voltage, and at room temp.

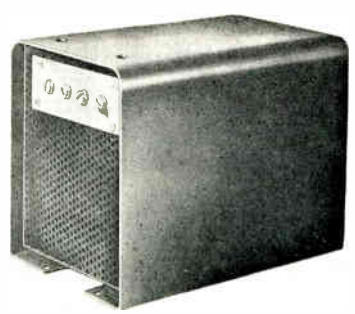


their working voltage is approx. 4/3 rated value. Available in capacitances from 0.33 to 330 μf, and in 6, 10, 25, 35, and 50 v. ratings. The 50 v., 85° capacitor is available in capacitance values up to 22 μf. They are supplied in 4 military case sizes, with the smallest measuring 1/6-in. in dia. and 1.4-in. long. Supplied with or without insulated cases. Kemet Co., 11901 Madison Ave., Cleveland 1, Ohio.

Circle 215 on Inquiry Card

TRANSFORMER

A Sine Wave (7% distortion) Constant Voltage Transformer in 60 and 400 cycle units. With a line variation of 95 v. to 130 v., output of this unit will remain constant to within ±1½%. The new Sine Wave Constant Voltage Transformer has a current-limiting feature which prevents excessive fault currents. It can replace non-regulating transformers in

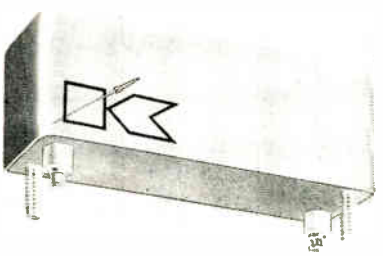


step-up or step-down service. This unit can be hermetically sealed for military application at elevated temp. Freed Transformer Co., 1718 Weirfield St., Brooklyn 27, N. Y.

Circle 214 on Inquiry Card

CRYSTAL FILTER

KCF Series of high frequency bandpass crystals filters cover a frequency range of 1 MC through 21 MC with bandwidths from 0.01% to 0.45% with 60/6 db shape factors from 4/1 to 2/1. The series is also available in compact, ruggedized packaging to meet all applicable MIL specifications and is particularly applicable in Doppler radar, receiver-i-f, comb filter



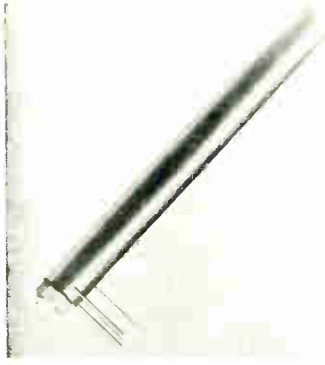
sets or wherever filters of high stability factors and narrow bandwidths are required. The Keystone Electronics Co., 65 Seventh Ave., Newark 4, N. J.

Circle 216 on Inquiry Card

New Products

VARIABLE DELAY LINES

For printed circuit board applications, continuously variable delay line provides a high ratio of delay to rise time in min. space. The high impedance variable tap provides fine resolution per turn. Provision is



made for locking shaft in any position. Characteristics include: ruggedness, precise pulse fidelity, −55°C to +125°C operating temp. range, high resistance to environmental conditions, such as moisture, humidity, shock and vibration. 0.1 in. grid spacing for printed circuit mounting, approx. 1 db per μsec. attenuation, extremely low temp. coefficient and positive and stops. JFD Electronics Corp., 6101 16th Ave., Brooklyn, N. Y.

Circle 217 on Inquiry Card

HIGH-POWER WATER LOADS

Three new high-power water loads of the 3⅛ in. 50-ohm coaxial type provide extremely flat terminations and accurate r-f power measurements for high-power UHF transmitting equipment. They include an r-f sampling probe. Units have EIA standard r-f connections and standard water-hose connections. All 3 loads are guaranteed to handle aver-

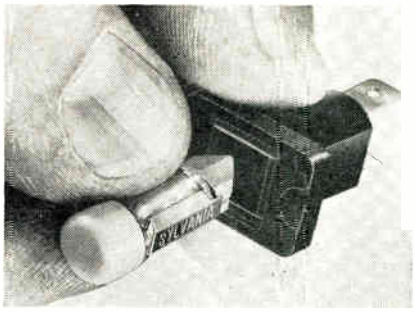
age power in excess of rating for 3⅛ in. coaxial air line since they are water-cooled. The loads have been tested to over 50 kw average power. Eitel-McCullough, Inc., San Carlos, Calif.

Circle 218 on Inquiry Card

New Products

INDICATOR LAMP

Electronic indicator lamp includes a redesigned short base indicator lamp, plastic color lamp caps, multi-socket strips for panel mounting, and single sockets. Rated life is 3,000 to

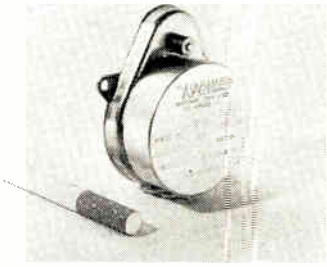


5,000 laboratory test hours. Flat-top end construction permits relocation of the filament, increasing end foot candles providing up to 60% more light. Lamps are available in standard 4, 6, 10, 12, 16, 24, and 28 v. sizes. Standard current ratings are 35 to 45 ma and lower current ratings available. End foot candles of illumination range from 200 for the 4 v. lamp to 1285 for the 28 v. lamp. Sylvania Electric Products, Inc., 730 Third Ave., New York 17, N. Y.

Circle 219 on Inquiry Card

MINIATURIZED MOTOR

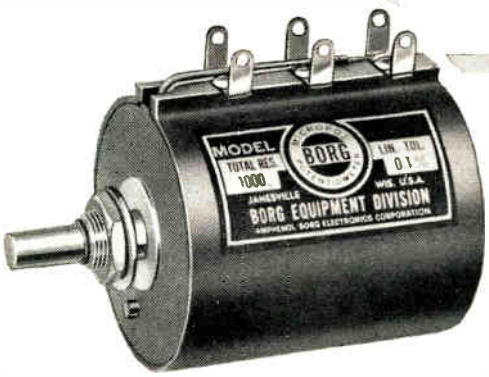
Miniaturized motor allows the direction of rotation to be established by electrical control alone. Latest addition to line of synchronous ac timing motors, the 42100 Series Commer-



cial 60-cycle ac Timing Motor, currently being used in many applications, is only ⅞ in. long. Available in voltages ranging from 6 to 230 v. at 20 ma max., the unit's rotor speed is 300 rpm with output speeds of 300 rpm to 1/6 rph. Max. temp. rise is only 40°C. Power input is 2.5 w max. A. W. Haydon Co., 232 N. Elm St., Waterbury, Conn.

Circle 220 on Inquiry Card

You be the judge...



The Borg 1100 Series Micropot Potentiometer is a high resolution, 10-turn, *precision* potentiometer developed for a competitive spot in the commercial market. It is priced accordingly. Units with a total resistance of 50 to 500 ohms are supplied with .25% independent linearity . . . 1,000 to 100K ohms with .25% or .1% independent linearity. Single or dual units. Compare . . . judge for yourself. We think you'll find the Borg 1100 Series offers more precision features per dollar than any comparable potentiometer. Catalog data sheet BED-A132 gives complete specifications. See your Borg technical representative, distributor or write us direct. *Borg Equipment Division, Amphenol-Borg Electronics Corporation, Janesville, Wisconsin. Phone Pleasant 4-6616.*

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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 Electrical Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

Ann. de Radio. Annales de Radioelectricite
Bull. Fr. El. Bulletin de la Societe Francaise des Electriciens
Cab. & Trans. Cables & Transmission
Comp. Rend. Comptes Rendus Hebdomadaires des Seances
Onde. L'Onde Electrique
Rev. Tech. Revue Technique
Telonde. Telonde
Toute R. Toute la Radio
Vide. Le Vide

GERMANY

AEG Prog. AEG Progress
Arc. El Uber. Archiv der Elektrischen Uebertragung
El Rund. Electronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Electroakustik
NTF. Nachrichtentechnische Fachberichte
Nach. Z. Nachrichtentechnische Zeitschrift
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Arch. Auto. i Tel. Archiwum Automatyki i Telemechaniki
Prace ITR. Prace Instytutu Tele-I Radiotechnicznego
Roz. Elek. Rozprawy Electrotechniczne

USSR

Avto. i Tel. Artomatika i Telemakhanika
Radio. Radio
Radiotek. Radiotekhnika
Rad. i Elek. Radiotekhnika i Elektranika
Iz. Acad. Bulletin of Academy of Sciences, USSR.

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ANTENNAS, PROPAGATION

Determining the Actual Radiation Pattern of an Antenna with a Nonplanar Incident Wave, V. P. Peresada. "Radiotek," 15, No. 3 (1960). 7 pp. The solution of two types of problems is examined: 1. Determining the directional pattern of an antenna working in the receiving condition when the wavefront of the incident wave is nonplanar and the planar radiation pattern of the antenna is known; 2. Determining the planar directional pattern of the antenna or the field distribution of the source from the measured directional pattern of the antenna receiving radiations from that source. A full solution of the problem which involves a complex integral is given, and also an approximate solution useful for practical calculations. (U.S.S.R.)

An Experiment on the Reflecting Properties of Plane Reflectors in the 10 CM Region, E. Dueniss and K. E. Mueller. "Hochfreq." Jan. 1960. 8 pp. Approximate expressions are developed for the calculation of the radiation pattern, gain, and attenuation due to reflection. Results obtained using these theoretical expressions are compared to experimental data in the 10 cm region. Since good correlation between them is established, the results obtained through these calculations are considered to be useful for the future installation of passive relay stations. (Germany.)

Determination of Gain and Directional Characteristic of a Yagi Aerial for Decimetric Waves, Dieter Stahl. "Rundfunk." Apr. 1960. 3 pp. The paper describes the optimum arrangement of transmitting and receiving aerials in the field, when determining gain and polar diagrams. Particular mention is made of the sources of faults that may occur during these measurements. The paper goes on to give results and the measured polar diagrams. (Germany.)

Wideband Omnidirectional Radiators of Axial Symmetry with High-Pass Matching Characteristics, H. Meike. "Nach. Z." Apr. 1960. 8 pp. Part I contains a report relating to measurements of the input impedance and reflection coefficient of different types of omnidirectional radiators with an extreme bandwidth and to the optimum shape of a wideband radiator. Part II describes the electrostatic field of these radiators for the purpose of providing in Part III a basis for the calculation of the impedance at very low frequencies and an approximation for the lower cut-off frequency for matching. (Germany.)

Effects of Obstacles and Reflections on the Propagation of V.H.F. Television Signals, B. Chatterjee. "J. ITE." Dec. 1959. 4 pp. Studies were carried out on the V.H.F. propagation of television signals with special reference to the effects of reflection from nearby objects. (India, in English.)

Polarization of Sources of Solar Activity on 3 CM. Wavelength, M. R. Kundu & J. L. Steinberg. "J. ITE." Dec. 1959. 8 pp. (India, in English.)

AUDIO

Subjective Measurements of the Loudness of a Given Noise Bandwidth Using Equal and Unequal Noise Bandwidth for Each Ear, to Establish Hearing Characteristics and to Develop an Analogous Method Applicable for Objective Measurements of Loudness, H. Niese. "Hochfreq." Jan. 1960 15 pp. A large number of experiments were conducted to determine the mechanism of hearing, so that helpful hints could be obtained from building an objective sound level meter. The different methods employed in the subjective test are described and the results are discussed and analyzed. These include: simultaneous exposure of both ears to a narrow or wide band of noise or exposure of one ear to wide band noise and the other to narrow band noise. The large number of measurements were used to get an indication of the statistical distribution of the loudness judgment of individuals. (Germany.)

The Behavior of Longitudinal Waves at the Boundary of Two Media, M. Perschel. "Hochfreq." Jan. 1960. 5 pp. A sound wave at the boundary between two media is treated mathematically. Expressions are developed for the cases where one medium at the boundary is an elastic solid and the other medium can be: another elastic solid, an ideal liquid, or a vacuum. The electroacoustic analogy of the longitudinal wave is derived and the notion of wave impedance is introduced. (Germany.)

New Studio Test Loudspeaker System, H. Harz. "El. Rund." May 1960. 5 pp. This new system, primarily for broadcasting studios, substitutes the spherical speaker often employed for high frequencies and sometimes presenting difficulties in accurately locating the sound source. (Germany.)

Improving the Objective and Subjective Acoustical Measuring Techniques Through the Use of an FM Noise Band, H. Niese. "Hochfreq." Jan. 1960. 9 pp. The problems and inaccuracies encountered when making acoustical measurements are enumerated. It is shown that the disadvantages in both subjective and objective measurements can be avoided if a new type of noise generation is applied. These new type noises are produced when a sine wave is frequency modulated and then transposed into the audio region. Results of subjective and objective measurements using the new method are compared with results obtained using standard techniques. The new method proved to be superior in both the subjective and objective tests. (Germany.)

Determination of the Natural Tones of Brass Instruments. E. Liebek. "Hochfreq." Feb. 1960. 4 pp. The vast amount of available data on brass instruments is subject to variations due to individual players. Two methods are developed to eliminate these variations. The first is a theoretical determination of the positions of the natural tones, the second is the use of an equivalent electronic network for the instrument tube. A comparison is given of measured experimental values and the calculated ones using both methods. (Germany.)

CIRCUITS

Anode Modulation of a Common Grid Stage. B. P. Terent's ev. "Radiotek" 15, No. 3 (1960). 4 pp. The majority of powerful short wave transmitters use common grid output stages. This article deals with the peculiarities of their modulation and dynamic characteristics with anode modulation for various values of the driver modulation factor. Formulas are derived for determining the required modulation factor. Theoretical conclusions about the dynamic characteristics of tubes working under different modulation conditions are confirmed by measurements shown on appended oscillograms. (USSR.)

The Possibility of Using a Superregenerative Amplifier for Amplifying Very Short Pulse Signals. M. M. Gerdov. "Radiotek" 15, No. 3 (1960). 3 pp. The minimum duration of signals amplified by ordinary superregenerative receivers is limited by the frequency of the quenching voltage. Satisfactory reception is obtained for signals of 0.5 μsec. For shorter signals the amplifier gain drops rapidly. This defect can be eliminated by shunting the superregenerative circuit during its high frequency decay period. The shape of the quenching voltage should be made asymmetrical so that the half period which releases the superregenerator and blocks the shunting tube is equal to the building up time of the amplified signal and the other half period a small fraction of that time. (USSR.)

Single-stage Selective Amplifier with an Amplified Selective Negative Feedback. A. I. Belichenko. "Radiotek", 15, n. o. 3 (1960). 5 pp. In an attempt to increase the Q-factor of single stage tuned amplifiers with a double T RC network negative feedback, two-stage amplifiers are sometimes used. At a given amplitude the signal begins to distort at the grid of the second stage, and the gain, and with it the Q-factor, have to be reduced. In the amplifier described in the article this difficulty is overcome by placing in the negative feedback circuit, after the filter, a single amplifying tube which is connected to the amplifying stage by means of a cathode follower. This amplifier is stable in operation, and easy to adjust since its gain is determined only by the amplifying stage. (USSR.)

Transfer Characteristics of Transistors in Grounded Emitter and Grounded Collector Circuits. A. A. Grinberg. "Radiotek" 15, No. 3 (1960). 8 pp. Formulas of transistor transfer characteristics in grounded emitter and grounded collector circuits with voltage and current control are derived. The calculations are made taking into account the collector capacity. The transistors are fed with an emf from a generator with a finite internal resistance. The effect of the emitter efficiency on the transfer characteristic with respect to the type of control is worked out. (USSR.)

Rectified Voltage Regulator, O. G. Malkina. "Avto. i Tel." Apr. 1960. 6 pp. A new version of a circuit to stabilize rectified and reduced voltage for a load of hundreds watt is considered. As an example there are given curves and oscillograms of changing output voltage in dependence of changing a load. (USSR.)

Theory of Magnetic Amplifiers with DC Drive, L. W. Safris. " Avto. i Tel." Mar. 1960. 9 pp. Equations characterizing the basic peculiarities of operation of a saturable magnetic amplifier with a dc drive are determined. The simplified technique of designing such an amplifier is described. (USSR.)

Reliability of Switching Circuits of Distributed Systems, V. A. Il'in. "Avto. i Tel." Apr. 1960. 3 pp. The reliability of parallel and successive switching circuits of executive points of a remote control system in the line is considered. (USSR.)

Ladder Networks, Used as Coupling Circuits in Oscillators, R. Paul, "Freq." Mar. 1960, 10 pp. A selfexcitation criterion is developed for vacuum tube and transistor oscillators with RC feedback networks. The electrical properties of a ladder network with an arbitrary number of sections is presented. It is developed that at least three sections are needed for oscillation, and that using at least five sections, two frequencies of oscillation can be obtained. The theoretical work is proven experimentally. (Germany.)

Generation of Linear Sawtooth Voltages by the Bootstrap Method, K. Kranert. "El. Rund." May 1960. 3 pp. Description of a sawtooth generator operating on the principles of the bootstrap circuit for the charging voltage. (Germany.)

Analysis of All-Pass Networks, Part 1, Generalization and Classification, G. Wunsch-"Hochfreq." Jan. 1960. 8 pp. Applying known results from circuit theory, general and exhaustive treatment of all-pass networks is given. A new theory is developed, that not only embraces all presently known all-pass circuits, but also covers a large number of new ones. The great number of new circuits that can be designed using the new theory include known types of circuits as special cases. Only essential parts of the theory are given in detail, while other considerations are treated only briefly. For practical design information the reader is referred to another article by the author, that is now in preparation. (Germany.)

A Contribution to the Theory of Realizable Linear Four Terminal Networks that Include Lossy Elements, and Satisfy a Prescribed Transfer Function, Nai-Ta Ming. "Hochfreq." Jan. 1960. 3 pp. An abstract of a paper in Chinese with the same title is given. Mathematical treatment of four terminal networks with lossy elements is developed, to determine which type of transfer function is possible in this type of network. The necessary and sufficient conditions for realizing such a four terminal network are developed. (Germany.)

Transistorized Cyclic Counter, Forward and Backward. "El. Rund." Apr. 1960. 5 pp. Two samples of counters are described which comprise bistable multi-vibrator stages with transistors OC 71 and permit forward and backward-cycling counting. (Germany.)

COMMUNICATIONS

Choice of Frequency Range for Telemetering Industrial Devices or Pulse-Frequency System, A. M. Pshenichnikov. "Avto. i Tel." Apr. 1960. 5 pp. The influence of choice of a frequency range for telemetering devices of a pulse frequency system on error, noise stability of transmission, high speed and dynamics of a receiver is considered. (U.S.S.R.)

Basic Consideration about the Introduction of Electronics in Telephone Routing Techniques and Some Consideration of the Use of Automation for Long Distance Service, F. Lucantonio. "Freq." Mar. 1960. 4 pp. (Continuation of article in Frequenz, October 1959.) Engineering considerations are presented for long distance dial systems, taking into consideration the different systems now in use. Mathematical treatment of long distance traffic planning on a statistical basis, proposed by two other authors, is reviewed. Two methods presently proposed for international long distance dial service in Europe are discussed. (Germany.)

Through-Switching in Radio Relay Stations, Alois Egger. "Rundfunk." Apr. 1960. 5 pp. The paper explains by means of block schematics the "through-switching" system and goes on to show its effect on the transmission quality of the radio link and on operation technique. (Germany.)

Registers in Telephone Exchange Engineering, H. Nordsieck. "Nach. Z." Apr. 1960. 4 pp. After a survey on the various telephone exchange systems, the conditions for the application of registers and their operating methods are investigated. (Germany.)

A New Method for Determining Overloaded Telephone Lines, A. Rose. "Nach. Z." Apr. 1960. 2 pp. A method is explained which in comparison with methods known so far has the advantage that routine measurements of the simultaneous busy cases among 100 subscribers can be made. (Germany.)

New "Balloon" Polyethylene Insulation for Telephone Cables, G. Fuchs and P. Verges. "Cab. & Trans." Apr. 1960. 19 pp. A new insulation type is described, designed at the Societe Anonyme de Telecommunications at a time when the French Post and Telecommunications Administration, foreseeing the extended use of transistors in telephone circuit equipment, initiated the development of small diameter coaxial pairs. (France.)

Long Distance "Broadband" Telecommunicaton Systems, A. H. Kaye. "Proc. AIRE." Jan. 1960. 6 pp. The Australian Post Office is introducing a number of broadband cable and radio links to cope with increased telephonic communication and the need for television relay. (Australia.)

COMPONENTS

Microminiature Indicator Lamp, W. Hennig. "El. Rund." Mar. 1960. 1 p. Progressing miniaturization of electronic equipment calls for indicator lamps of small dimensions and low current drain. The author reports on a laboratory sample of a cylindric lamp 2.5 mm high and 0.6 mm dia., weight 6 milligrams. The tungsten filament is only 6.25 μm in dia. and consumes 30 MA at a rated voltage 1.5 v. (Germany.)

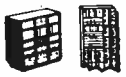
The Physical Operation of the Theory of Ferrite Resonance Isolators, R. Steinhart. "Nach. Z." March 1960. 10 pp. Starting with spin interaction in ferrite materials an attempt has been made to explain the principle of ferrimagnetism by means of a model. Subsequently, the physics of resonance absorption of electro-magnetic waves by means of ferrite materials installed in waveguides is explained in a lucid way. (Germany.)

Power Sources for Astronautics, A. V. J. Martin. "el. & auto." March 1960. 4 pp. Spatial electronics sets a number of new problems. The most fundamental of all is probably the problem of power sources. Three possible solutions are indicated: Electrochemical batteries, solar energy, nuclear energy. For each, present and future possibilities are studied, and examples of design are given. (France.)

Dependence of Winding Overheating and Heat-Production Coefficient of Relay on Temperature of Surrounding Air, M. I. Vitenberg. "Avto. i Tel." Mar. 1960. 9 pp. Dependence of overheating temperature and heat-production coefficient of relay windings on temperature of surrounding air is considered. Empiric formulae are obtained to determine winding overheating and heat-production coefficient. (U.S.S.R.)

The Problem of Reliability of Switching Devices, K. P. Kurdukov. "Avto. i Tel." Apr. 1960. 9 pp. Increasing reliability of switching devices operation by means of reversing elements is considered. A new method of reversing for multistage circuits which permits to increase reliability of the device with minimum number of spare relays is proposed. (U.S.S.R.)

International **ELECTRONIC SOURCES**



COMPUTERS

Superhigh Frequency Discrete Operating Computer Automation, M. S. Neiman. "Radiotek" 15, No. 3 (1960). 6 pp. The possibility of a further increase in the speed of high-speed computers is examined. It is found that the application of superhigh frequency radio techniques to computers achieves this object. The flexibility of the system is greatly improved by using combinations of amplitude, frequency and phase methods of signal separation. At high operating speeds such factors as the speed of electromagnetic wave propagation along conductors and miniaturization of components play an important part. The superhigh frequency technology is now confronted both theoretically and practically with the development of super-fast triggers and intermittently operating systems of automation. (U.S.S.R.)

Design Principles of Pattern Recognition Machines, V. S. Fain. "Radiotek" 15, No. 3 (1960). 5 pp. The design of an apparatus working on the "parallel" method is analyzed. A theoretical basic for determining the most expedient methods of designing such apparatus is given and a scheme based on such methods is analyzed. This scheme can encompass the whole field of vision, and discern not only lines but degrees of brightness, color, etc. "Comprehension" of the image is carried out in several stages, the basic comprehension being sometimes relegated to higher stages. The recognition is independent of the size, position and orientation of the object in the field of vision. If required the system provides the position of the object in the field of vision. Finally in this system the number of information channels rapidly decreases at higher stages of comprehension. The scheme is functionally similar to the apparatus of an eye. (U.S.S.R.)

Noise Stability of Incremental Coding, V. M. Baikovsky. "Avto. i Tel." Mar. 1960. 15 pp. Potential noise stability of incremental coding with fluctuation noises is determined. The noise stability of incremental coding is compared with the noise stability of pulse-code modulation and of delta-modulation. The comparison shows that the noise stability of incremental coding is sometimes better than the noise stability of pulse-code modulation or the noise stability of delta-modulation. (U.S.S.R.)

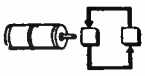
Visual-Matrix Method for Minimization of Boolean Functions, A. D. Zakrevsky. "Avto. i Tel." Mar. 1960. 5 pp. A method for minimization of Boolean functions based on using some peculiarities of visual perception of information is expounded. The method is applicable for minimization of arbitrary Boolean functions with about 10-12 variables. It is especially efficient for minimization of not completely determined functions. (U.S.S.R.)

Application of Hall Pick-Ups in Reading Heads, A. Vasilevsky. "Avto. i Tel." Mar. 1960. 7 pp. The paper deals with the development and experimental study of reading magnetic record heads based on Hall effect. The main property of the considered head is that its e.m.f. is proportional to carrier residual flux. (U.S.S.R.)

A Computer for the Calculation of Power Generation Costs, C. H. Wolff. "ATE J." Apr. 1959. 15 pp. This article describes a small electronic digital computer which has been designed and built by B.T.R. Ltd. for the Central Electricity Generating Board. The calculations carried out are described, and some details of the design and construction of the computer are given. (England.)

Transistor Circuits as Logical Computing Elements for a Magnetic Drum System, B. Lowe & B. H. Capper. "ATE J." Apr. 1959. 32 pp. Some of the major factors considered and the problems encountered in the design and application of semiconductor circuitry to the control of an electronic exchange system are indicated. (England.)

Use of the Stantec-Zebra Computer in Research, R. A. J. Ord-Smith. "Brit. C&E." Apr. 1960. 4 pp. Since the Stantec-Zebra computer was introduced some two years ago, it has found use in many branches of research. This article first discusses the advantages of the Zebra machine in this work and then deals with its growing importance in computer and programming research. (England.)



CONTROLS

The Construction and Control of the Unit-Melter, G. Thies. "rt." Jan. 1960. 7 pp. The Unit-Melter developed by Emhart in the USA has recently gained more and more ground on the smaller regenerative tanks. Not only is the initial cost of the former lower, but also its specific fuel consumption, if working to full capacity. (Germany.)

An Electric Sampling Technique for Measuring and Controling the Glass Level in Melting Tanks, P. Weber-Klein "rt." Jan. 1960. 5 pp. First of all a definition of the term "glass level" is given, followed by a brief enumeration of the advantages obtained by measuring and controlling this value. Furthermore, the various measuring methods are surveyed. (Germany.)

Industrial Counting Equipment. P. Lagadec. "el and auto." Jan.-Feb. 1960. 9 pp. A range of industrial counting equipment is presented. It is made of small independent units, in metallic cases, each taking care of a basic function. These units may be quickly combined and interconnected to answer a large number of industrial needs. (France.)

Industrial Applications of Data Processing Machines, A. Claveirole. "el and auto." Jan.-Feb. 1960. 4 pp. The rentability of a machine, as well as the various modalities of buying or leasing are studied with respect to the needs of the potential user. The problems set by programming are also reviewed. Finally, a partial list of the various firms active in the field is given. (France.)

Industrial Applications of Artificial Radio-Elements, S. Margolinas. "el and auto." Jan.-Feb. 1960. 2 pp. The industrial applications of artificial radio-elements have been considerably expanded during the last few years, and continue to grow every day. The now classical uses for thickness, density or level measurements are of interest to various branches of industry. (France.)

Finite Automata. I, M. A. Aizerman, et al. "Avto i Tel." Feb. 1960. 13 pp. The paper deals with the authors' viewpoint on the basic concept and problems of the theory of finite automata and on the relationship of this theory to the theory of switching circuits. (U.S.S.R.)

Determination of Second Order Moments of Various Coordinates of Automatic Control Systems Using Electronic Computers, L. A. Telksnys. "Avto i Tel." Feb. 1960. 4 pp. The paper deals with determination of the second order moments of various coordinates of the automatic control systems by means of the method of canonical representation of random functions with using electronic computers. (U.S.S.R.)

Treatment of Experimental Frequency Characteristics, G. I. Monastyrshin. "Avto. i Tel." Mar. 1960. 7 pp. Approximation of experimental frequency characteristics of the automatic control systems is considered. Calculation formulae are given. The use of the formulae is illustrated with an example. (U.S.S.R.)

Drive with Preset Equation of Motion, L. A. Boguslavsky. "Avto. i Tel." Mar. 1960. 4 pp. The way of designing a drive having the preset equation of motion without using operational amplifiers is described. (U.S.S.R.)
Finite Automata. II, M. A. Aizerman, et al. "Avto. i Tel." Mar. 1960. 10 pp. The paper sets the general problem of designing automata of given time pace which consist of elements operating with different time pace. As an example of such a system abstract neurons (of MacCallock and Pitts neuron type) and neuron nets are considered. (U.S.S.R.)

Optimum Frequency Control of Induction Electrical Motor, P. Petrov. "Avto. i Tel." Mar. 1960. 7 pp. The problem according to what law you have to control voltage and frequency in induction electrical motors in order to provide optimum transient processes is studied. Optimum control laws are derived for different requirements which are applied to transient process character and for a resistance moment which depends linearly on torque speed. (U.S.S.R.)

Error in Integrator for Directing Motion Along Circumference, V. V. Karibsky. "Avto. i Tel." Mar. 1960. 6 pp. The algorithm of the digital interpolating device being used for directing the motion along the circumference is described. The theoretical investigation of interpolation error is carried out. Brief description of the device under consideration is given. (U.S.S.R.)

GENERAL

Experiments in the Field of Parametric Amplification, B. Bollee & G. de Vries. "Phil. Tech. #2, 1960. 5 pp. In attempts to design parametric amplifiers for radio-waves, methods of "pumping" usually rely on the use of voltage-dependent capacitances (e.g. Germanium diodes) or current-dependent inductances. The theory of these "auto-parametric" systems is less accessible to analysis than that of "heteropatametric" systems, in which the oscillation to be amplified does not react on the pumping. The authors describe a simple heteroparametric system of their own design, using a magnetostrictive resonator as pump, the pump frequency being 22 kc s. (Netherlands, in English.)

Vector-electrocardiograph, G. C. E. Burger & G. Klein. "Phil. Tech." #1, 1960. 14 pp. The electrical action of a contracting muscle fibre is equivalent to that of a dipole and can be represented by a vector. The same applies to an entire muscle, such as the hear, insofar as the electrical phenomena are observed at a large distance from the source. During the heart beat the heart vector changes in magnitude and direction. Since the human body is a conductor, potential differences carrying with time appear between various points on the human body during each heart beat. (Netherlands, in English.)

The Application of Electronic Memories in Radiology, Th. G. Schut & W. J. Oosterkamp. "El. Rund." Jan. 1960. 2 pp. In X-ray diagnostic investigations either an X-ray image or a photograph is made. Both methods have disadvantages: The X-ray image needs a big X-ray dose and the photograph is not quickly available. The author describes a device for magnetic storage and television transfer of X-ray image which may be evaluated at once, can be viewed as long as one likes, and demands a small radiation dose only. (Germany.)

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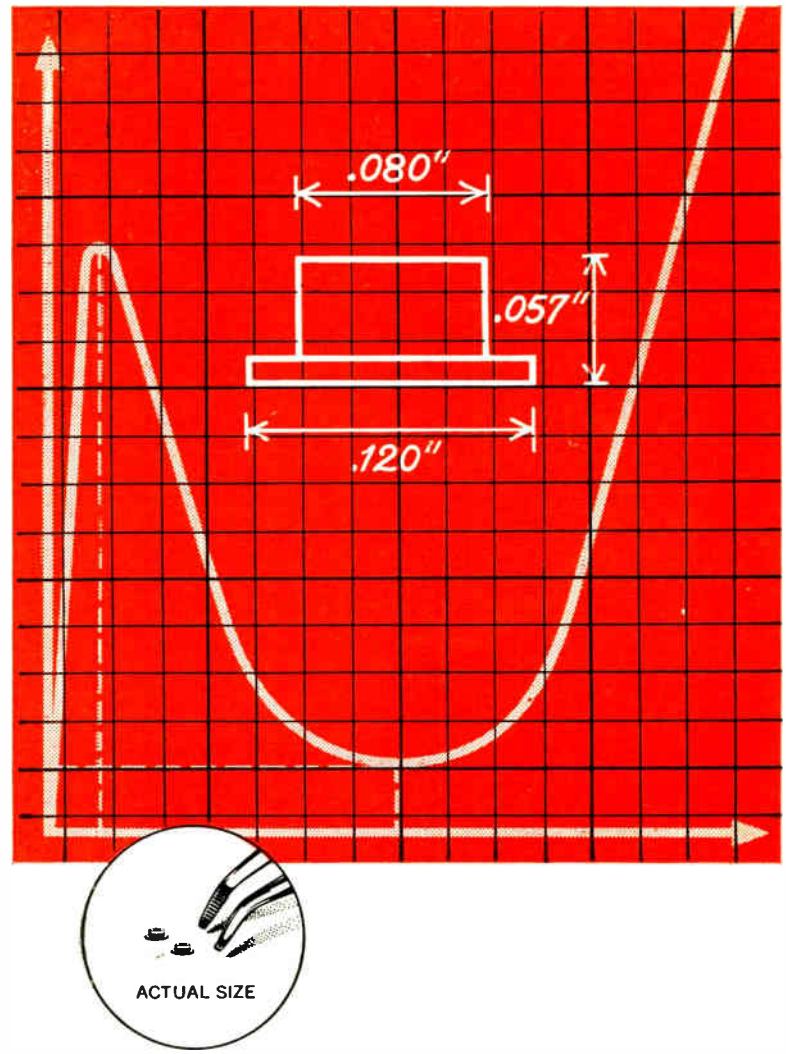

- basic package design offers potential of 10 KMC operation
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- hermetic ceramic-to-metal seal—Sylvania tunnel units will pass MIL moisture tests

ELECTRICAL CHARACTERISTICS—SYLVANIA TUNNEL DIODES

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Measured Oscillation Freq.	2 KMC min.	3 KMC min.	4 KMC min.
I_p	1.8 mA typ.	1.7 mA typ.	1.6 mA typ.
$I_p : I_v$	5:1 min.	5:1 min.	5:1 min.
V_v	350 mV typ.	350 mV typ.	350 mV typ.
V_p	55 mV typ.	55 mV typ.	55 mV typ.
R_s	1 ohm typ.	2 ohm typ.	3 ohm typ.
C	8 $\mu\mu$f typ.	6 $\mu\mu$f typ.	4 $\mu\mu$f typ.

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SYLVANIA

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International ELECTRONIC SOURCES

Electronic 'Rotor,' J. S. Johnston. "El. Tech." Jan. 1960. 5 pp. This article discusses a novel method which has been developed for introducing the concepts of bearing and angle into fast cartesian analogue computations, without the use of mechanical shaft and servomechanisms. (England.)

Reflection Coefficients, R. A. Waldron, et. al. "E. & R. Eng." Dec. 1959. 2 pp. The reflection and transmission coefficients are considered for reflecting surfaces which have the same medium on either side. (England.)

Analytical Geometry and Impedance Calculations, Computer. "E. & R. Eng." Dec. 1959. 3 pp. (England.)

The Use of Silica Seals in the Production of Special Valves with Numerous Lead-in Wires, M. Pequignot, M. Verna. "Vide." #83, 1959. 5 pp. Because of its thermic and mechanical properties silica has proved, during the last few years, to be absolutely essential for some applications of vacuum techniques; its optical characteristics being particularly interesting for the production of valves working at high temperature or requiring U.V. transparent windows, arc tubes, C.R. tubes mercury valves, photo-multipliers, etc. (France, in English.) is derived for the determination of the necessary length of the taper for a stated mode conversion figure. (England.)

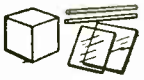
INDUSTRIAL ELECTRONICS

The Use of Radioactive Isotopes for the Study of Littoral Drift, J. J. Arlman, et al. "Phil. Tech." No. 6, 1960. 10 pp. During and after the execution of the Delta works in Holland, a regular check will have to be kept on the movements of sediment on the sea bed around the Dutch coast. To this end Delta Authority engineers, in cooperation with the Philips-Duphar Isotope Laboratory, are measuring sand movements by means of a radioactive tracer, 46Sc, bonded to an ion-exchange substance, "Ionac C 50," which is a granular material closely resembling North-Sea sand. (Netherlands, in English.)

Metal Vacuum Equipment, N. Warmoltz & E. Bouwmeester. "Phil. Tech." No. 6, 1960. 5 pp. The development of arc-welding in an argon atmosphere has opened the way to the construction of dependable vacuum-tight metal components for vacuum apparatus. The authors discuss components that have been produced with the aid of this welding technique, namely a cold trap, and a vacuum valve, both of high conductance, two smaller valves and a vacuum chamber for a mass spectrometer; they further describe the joints by which these components are coupled. (Netherlands, in English.)

A Survey of Industrial Weighing Techniques, P. A. Jassoy. "Brit. C&E." May 1960. 4 pp. A general comparison is made between the various weighing techniques. A review is then made in greater detail of the newer methods employing electrical and electronic principles. (England.)

The Possible Applications of Ultrasonics in Electroplating, Dr. J. M. Odekerken. "Brit. C&E." May 1960. 2 pp. The great importance of ultrasonics in the surface treatment of metals is well known, and for cleaning especially a large number of extremely useful applications have been found. But although the applications of ultrasonics to electroplating have led to very spectacular claims, they have been followed only too often by disappointment and disillusionment. The purpose of this short article is therefore to survey the literature on this subject and to evaluate the potentialities of ultrasonics in this important field. (England.)



MATERIALS

Experimental Study of Rubber-Fabric Membrane Characteristics, G. T. Berezovets, Chjou Tzin-Len. "Avto. i Tel." Mar. 1960. 10 pp. The results of the experimental study of the characteristics of the rubber-fabric membrane used in devices of pneumatic automation is expounded. (U.S.S.R.)

Measurements of Certain Magnetic and Dielectric Properties of Magnetically Soft Ferrites Within A Frequency Band from 10 Hz to 1000 MHz. A Goral. "Roz. Elek." Vol. 5, No. 4, 44 pp. Relations between the primary parameters of the material and the secondary magnitudes obtained as a result of the measurement of the impedance inserted by the sample into the measurement circuit in a weak field of high frequency are discussed in the paper. (Poland.)

Microwave Properties of Metal-Flake Artificial Dielectrics, Krishnaji & Shanke Swarup. "J. ITE." Dec. 1959. 9 pp. (India, in English.)

MEASURE & TESTING

A Portable Radiation Measuring Set with GM-Tubes, H. Mahnau. "El. Rund." Mar. 1960. 3 pp. A radiation measuring set is described which, apart from the counter-tubes is fully transistorized. The unit is used for dose-rate measurement of gamma radiation but by using special probes alpha and beta measurements can also be undertaken. (Germany.)

Calculation of the Mean Duration for a Reliable Working of Equipment, M. A. Sinitsa "Radiotek", 15, No. 3 (1960). 8 pp. The mean time which elapses between two failures of radio-electronic equipment is the most convenient way of determining its reliability. Asymptotic expressions for the laws of probability distribution of the duration of time for which the equipment will work up to its first failure, were derived. The method of approximate calculation of the law of the variation of the mean duration of time for which the equipment will work between two failures is outlined. A formula for determining the mathematical expectation of the duration of reliable working of the equipment from any arbitrary time is derived. The value of the error due to the use of simplified expressions is evaluated. (U.S.S.R.)

Measurement of the Nonlinearity of Pulse Devices by the Comparison Method, I. F. Ivanov. "Radiotek", 15, No. 3, (1960). 8 pp. The possibility of measuring the nonlinearity of pulse devices by comparing the voltages at their inputs and outputs is examined. The measurements are made with signals similar to the normal operating signals. The nonlinearity can be measured with an error not exceeding 3-7% of the measured value. For precision measurements the error of the elements in front of the comparison circuit should not exceed 0.5-1%, the error of the elements following the comparison circuit may amount to 2-3%. (U.S.S.R.)

Calculation of a Phantastron Pulse Duration, Z. P. Vazhenina and N. A. Suslov. "Radiotek", 15, No. 3 (1960). 3 pp. Phantastrons are widely used in pulse time delay circuits. The linear relation between the controlling voltage and the duration of the output pulse generated by the phantastron is used for varying the delay. However no analytical relations convenient for calculating the effect of the controlling voltage on the duration of the output pulse of a phantastron have as yet appeared in the literature on the subject. This article attempts to fill the gap. (U.S.S.R.)

Semiconductor Element Pick-up for Voltage Deflections, S. V. Kulikov. "Avto. i Tel." Mar. 1960. 8 pp. A pick-up for voltage deflections which is designed on semiconductor elements—silicon diodes, transistors and thermic resistances is described. The method of calculation is described, obtained relationships and the results of the experimental study are given. (U.S.S.R.)

Differentiation of Slowly Changing Signals, S. N. Diligensky. "Avto. i Tel." Apr. 1960. 12 pp. Methods of differentiation in time of slowly changing electrical signals with taking into account non-linearities which are characteristic of real devices are considered. Some ways of replacing differentiation by determination of input increase during the fixed time period are analyzed. (U.S.S.R.)

Self-Oscillations of the Dynamic Table Platform, G. P. Miroshnichenko. "Avto. i Tel." Mar. 1960. 8 pp. Some properties of motion of the platform of the single-axis dynamic table with an induction motor having a hollow rotor are determined. Conditions of self-oscillation rise (with dry friction in mountings) are found. (U.S.S.R.)

A Meter for Measuring Magnetic Interference Fields, H. Wiechmann. "Hochfreq." Jan. 1960. 4 pp. A fieldstrength meter is described for measuring interference from low frequency magnetic fields. The instrument is described in detail, including the circuit diagram. Mathematical expressions are given for performing and analyzing actual measurements. (Germany.)

Scanning Oscilloscope for the Millimicrosecond Range, H. P. Louis. "El. Rund." Apr. 1960. 4 pp. In the development of high-speed switching components, the requirements to the cathode-ray oscilloscope often exceed the ratings of the best delay-chain amplifiers. However, high time resolution and high sensitivity can be had simultaneously when a pulse-scanning method is employed. (Germany.)

The Measurement of Low Partial Gas Pressures with the Mass Spectrometer, H. W. Drawin & C. Brunnee. "Vak. Tech." Apr. 1960. 8 pp. It is shown that the factory produced mass spectrometers under normal operating conditions partial pressures as low as 10^{-11} micron can be measured whereby the resolving power $M/\triangle M$ of the instrument is 250. The calibration was made by means of gas input measurement. (Germany.)

RADAR, NAVIGATION

Dynamic Properties of Pulse Automatic Radio Rangefinders with Two Integrators, E. P. Nikitin and A. G. Saibel. "Radiotek" 15, No. 3 (1960). 6 pp. Such radio rangefinders are essentially pulse automatic control systems. In some of the work on the subject they are regarded as continuous control systems. Such an approach leads to results which are incorrect in a general case. This article provides formulas and graphs for determining the stability of the system, its behavior in a transient state and for calculating its systematic dynamic errors. (U.S.S.R.)

Weather Radar Organization and Some Observations in India, L. S. Mathur. "J. ITE." Dec. 1959. 11 pp. The paper describes in detail the organization of weather radar stations established by the India Meteorological Dept. in India, including the plans for the immediate future network of storm-detecting radar stations in the country. (India, in English.)

International ELECTRONIC SOURCES

Are Radar Radiations Dangerous?, Charles B. Bovill. "Brit. C&E." May 1960. 3 pp. Since the advent of radar, rumors have circulated about the harm which u.h.f. electromagnetic waves can cause to health—that they can cause sterility and other damage. For obvious reasons such rumors were discounted during the war and experts are on record as stating categorically that no harm of any kind could befall humans exposed to electromagnetic waves. With the projected BMEWS, super power radar stations in the news, the rumors are again in circulation. It is therefore timely to examine the problem and to endeavor to form some conclusions as to whether or not radiation from a radar station can do any harm to the human body. (England.)

A Visual System for Flight Simulators, G. Hellings & E. T. Emms. "Brit. C&E." May 1960. 4 pp. The need is discussed for a Visual Flight System to be used in conjunction with a Flight Simulator. The major design problems are outlined and a description given of a Visual Flight System which has been evolved to overcome them. (England.)

SEMICONDUCTORS

An Equation for the Thermal Stability of Transistor Voltage Amplifiers of Various Types, Yu. R. Nosov and B. I. Khazanov. "Radiotek" 15, No. 3 (1960). 7 pp. In this article an equation for determining the thermal stability of transistor voltage amplifiers in terms of their parameter variations is derived for a general case and applied for various commercial types of germanium and silicon transistors. For small emitter currents stabilization can be attained independently of individual variations of parameters. For large currents stabilization can only be attained for large values of alpha and a small base resistance. For high emitter currents in silicon transistors in addition to limitations due to the base resistance there also exists a lower limit of permissible emitter current. (U.S.S.R.)

Germanium Tunnel-Diodes for High Frequencies, G. Kessel, et al. "Nach. Z." Apr. 1960. 5 pp. As an introduction the physics of tunnel-diodes are outlined. The design of Ge tunnel-diodes is described and the characteristic data of prototype series are reported. (Germany.)

The Possibilities of the Tecnectron, S. Handel. "Brit. C&E." Apr. 1960. 4 pp. The author of this article has been investigating a number of samples supplied by M. Teszner. The results obtained, together with measurements and applications studies made in the Paris Laboratories, are detailed. The article is introduced by a summary of the theory of operation of the device. (England.)

The Tunnel Diode—A Significant New Semiconductor Device, R. W. A. Scarr. "Brit. C&E." Apr. 1960. 4 pp. The tunnel diode is thought by some to be the most important advance in the semiconductor device field since the junction transistor. The tunnelling effect in a novel form which results in a characteristic showing negative resistance was first reported by Esaki in 1958 and already a number of manufacturers in various countries, including Great Britain, have announced that devices are available. (England.)

Semiconductors—Fabrication of Silicon Transistors. "El. Tech." Apr. 1960. 2 pp. (England.)

TELEVISION

Color Bar Generator for NTSC Television Standard, G. Bolle. "El. Rund." Mar. 1960. 2 pp. Color-bar generators are used to test color TV receivers. In the generator described, the color-bar signal is directly derived from the luminance and the chrominance signals. (Germany.)

Methods for Planning Optimum Television Transmitter Networks for Bands IV and V (Description of the Methods and Indications for Use), H. Eden, et al. "Rundfunk." Feb. 1960. 19 pp. The paper described in detail methods for determining optimum transmitter networks and channel distributions and illustrates them by means of tables. It is endeavored to attain distributions which involve the smallest possible interference within the network. (Germany.)

Theoretical Investigations Relating to Sync Separators in TV Receivers, H. Reker. "Nach. Z." March 1960. 8 pp. The coupling network between the video output stage and the sync separator in TV receivers has a substantial effect on the performance and the noise sensitivity of the synchronization of the received picture. (Germany.)

Observations of Band-IV Television Reception, U. Dietz, et al. "Rundfunk." Feb. 1960. 8 pp. The paper reports on propagation tests undertaken during the summer of 1959 by the Institute for Rundfunktechnik, in collaboration with the Norddeutscher Rundfunk and with the Sudwestfunk. (Germany.)

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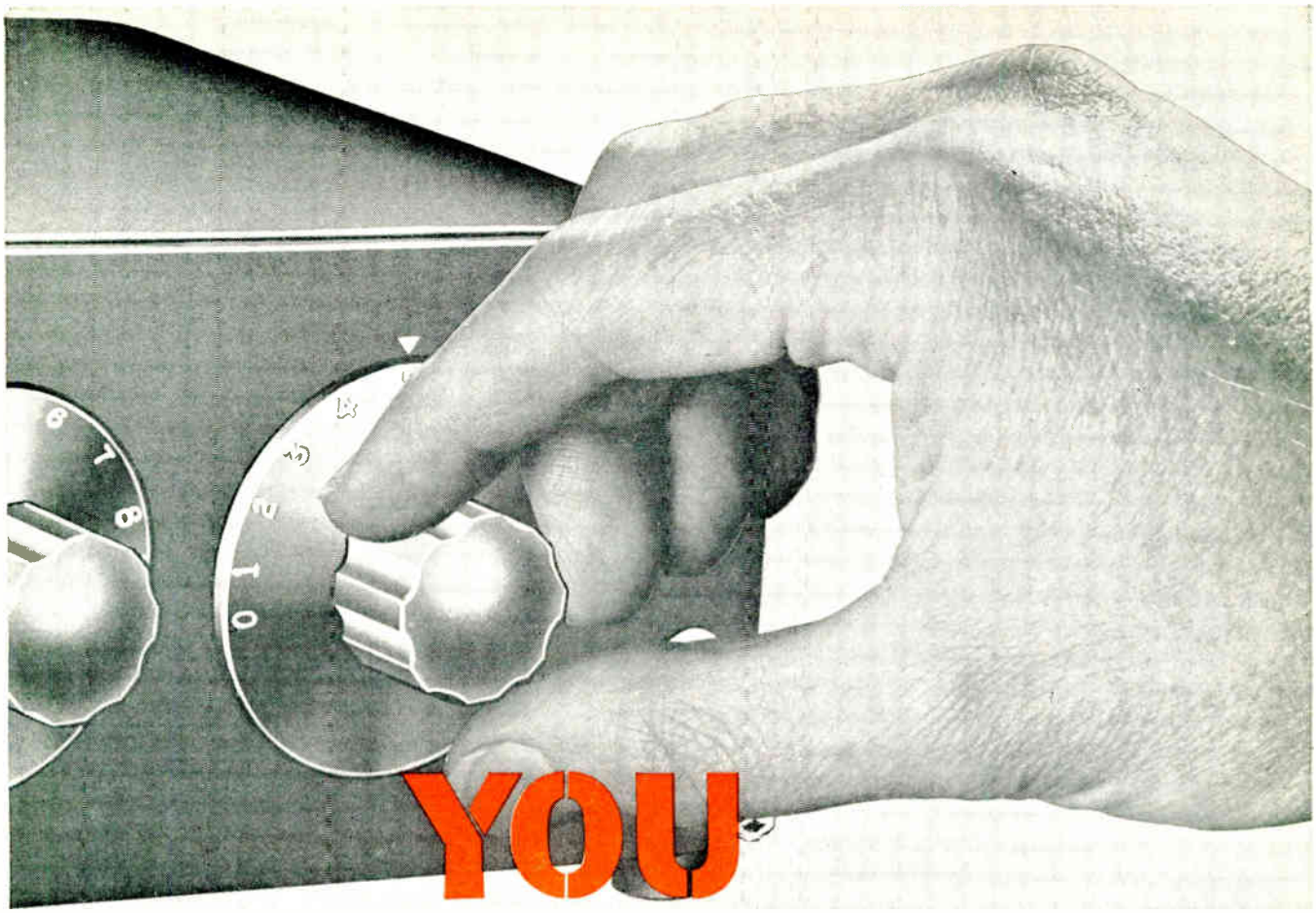

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20 Allen-Bradley Co.—Potentiometers

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95 AMP Incorporated—Rack and panel connectors

121 Amperite—Thermostatic delay relays and ballast regulators

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62 Amplifier Corp. of America — Flutter meter

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76 Arnold Magnetics Corp.—Toroidal coil winder

101 Avnet—Environment resistant connectors distribution

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15 Bendix Corporation, Red Bank Division—Driver transistors

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90 Dale Products, Inc.—Power resistor

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66 Fairchild IN906—Ultra-fast silicon diode

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61 Fairchild IN905—Ultra-fast silicon diode

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118 Fairchild FD-100—Ultra-fast silicon diode

83 Fairchild IN904—Ultra-fast silicon diode

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131 Freed Transformer Co., Inc. — Transformers

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93 Sprague Electric Company—Capacitors

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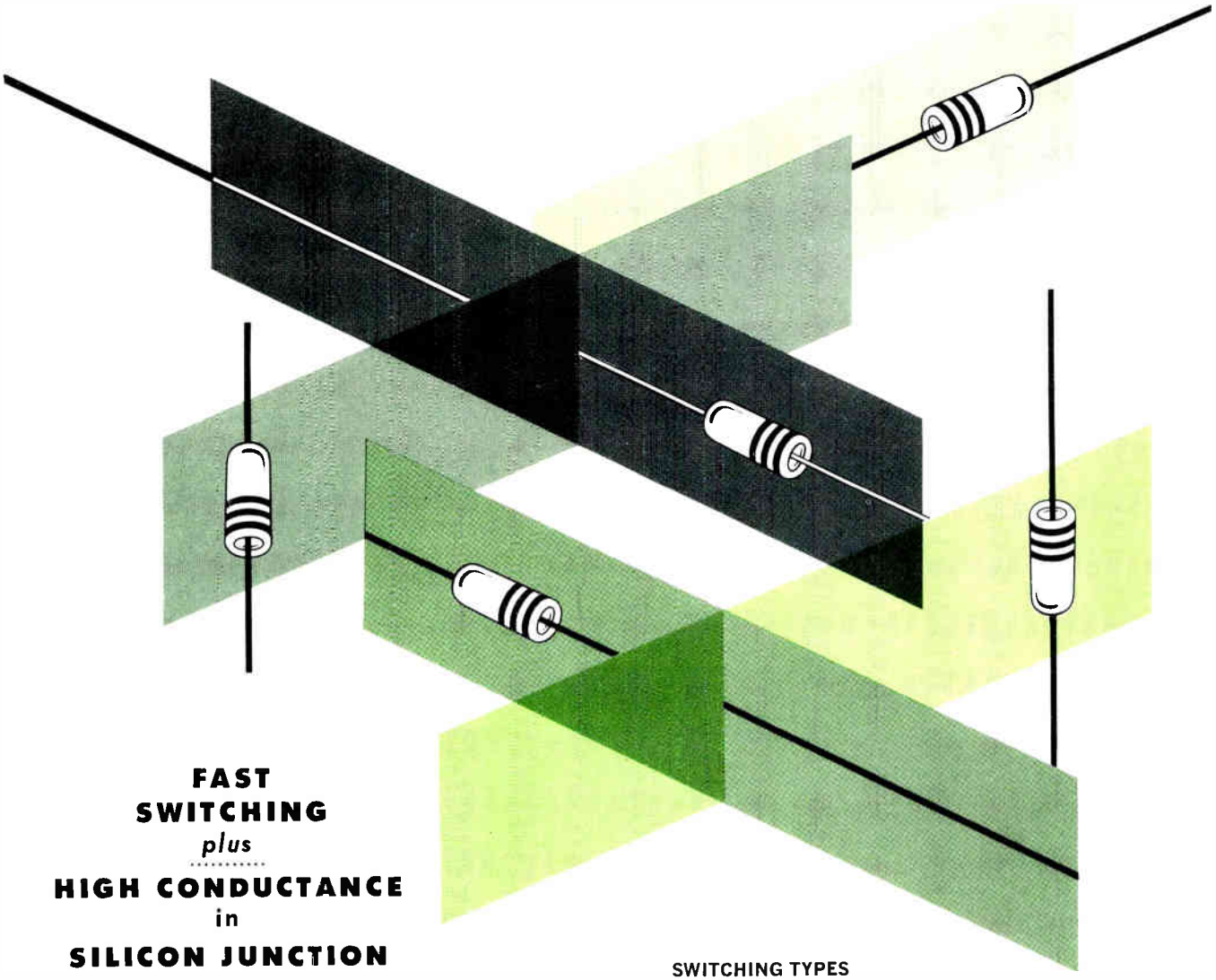

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New circuit possibilities for low impedance, high current applications are opened up by Clevite's switching diodes. Type CSD-2542, for example, switches from 30 ma to −35v. in 0.5 microseconds in a modified IBM Y circuit and has a forward conductance of 100 ma min @ 1 volt.

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1N459 –	MIL-E-1/1028	1N658 –	MIL-E-1/1160
		1N643 –	MIL-E-1/1171

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WASHINGTON News Letter

SPACE FREQUENCY NEEDS—A limited reopening of the FCC's over-all microwave policy case, specifically to bring the record up to date on "frequency requirements for space communications," has been ordered by the Commission. Written statements by the communications companies and organizations in the proceeding were to be filed by Friday, July 8. The FCC also directed an oral presentation before its en banc body on July 18. Witnesses are being selected by the Commission to give 15-minute summaries of their presentations or to answer cross-examination by the FCC Commissioners and staff.

EIGHT ISSUES LISTED — The written statements by the proceeding's participants submitted by July 8 will encompass eight listed topics. These range from the "nature and extent" of experiments conducted involving utilization of space communications frequencies; what segments of the spectrum are now known to be required for space communications functions; whether space communications frequencies can or should be shared with other radio services; present plans of "non-government entities for launching either active or passive communications satellite"; whether separate frequency allocations are required for government and non-government space communications; the distribution throughout the U. S. of receiving sites for space communications systems; and the purposes to be served by space communications which are not met by other communications systems.

NEW DEFENSE AGENCY—A Defense Communications Agency, which will be responsible for "all the long-haul" communications requirements of the armed services, has been established by Defense Secretary Thomas S. Gates. The new agency through its programming is expected to effect long-range economies and efficiencies. Particularly since the military requirements for communications facilities—wire, radio and electronics—will continue to increase. The action climaxed work and studies that had been conducted in the Defense Department for over a year. The military communications networks now encompass 79 major relay stations throughout the world with a plant investment of more than $2 billion. To provide an idea of the magnitude of the military traffic, the Air Force high-frequency radio network alone is fourteen times greater than the Radio Corp. of America system, and handles twenty times as much traffic.

NASA AND BELL LABS REPORTS—The NASA's Goddard Space Flight Center reported that the Goddard Center expects to have in operation by next December, a network of radio tracking and data acquisition stations for satellites using the 136 MC band authorized at last year's Geneva administrative radio conference. Dr. J. R. Pierce, Director of Research-Communications Principles, at Bell Laboratories, emphasized that satellite systems must be highly reliable and have long life. They also must have the most highly-developed repeaters so as to provide means for supplementing radio and cable overseas telephone circuits and trans-oceanic television circuits. The Project Echo communications test will be conducted on 960.05 MC for east-west transmission and 2390 MC for west-east transmission, another Bell Labs scientist reported.

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ROLAND C. DAVIES

SPY SATELLITE FUNDING—The U. S. Senate has been presented a bill requesting an additional $83.8 million for our SAMOS program. Senator John Stennis told the senate that this program is vital to our national security and should be pushed vigorously. The additional money will permit a greater number of component tests. It will also permit comprehensive engineering studies to capitalize on improvements discovered in the course of the R & D program. Even with this money only the minimum essential R & D will be possible according to the senator.

TELECOMMUNICATIONS PROJECT—A new project in Cambodia, estimated to cost $1.2 million, has been opened to U. S. bidders. The contract calls for the supply and installation of automatic equipment for a 2000-line addition to Phnom Penh exchanges, 1000 lines for Sihanoukville and other small automatic exchanges. Bids should reach Ministry of Public Works, Posts and Telecommunications, Phnom Penh by July 22. Complete specifications available from Bureau of Foreign Commerce's Trade Development Div., U. S. Department of Commerce.

ASW REPORT—A series of recommendations to the Navy on the vital underseas area of the nation's defense was contained in a major report from the ASW Advisory Committee of the National Security Industrial Assoc. In its recommendations to the Navy, the committee proposes that: 1. Industry "acquire and operate its own target submarines"; 2. Navy torpedoes be pre-packaged for immediate use without further testing in the fleet; 3. Provisions be made for new special-purpose manned, mobile, sonar underwater vehicles; 4. The Navy establish an anti-submarine information center to eliminate much repetitious work in the Navy and industry. The report is in three volumes, two of which are unclassified.

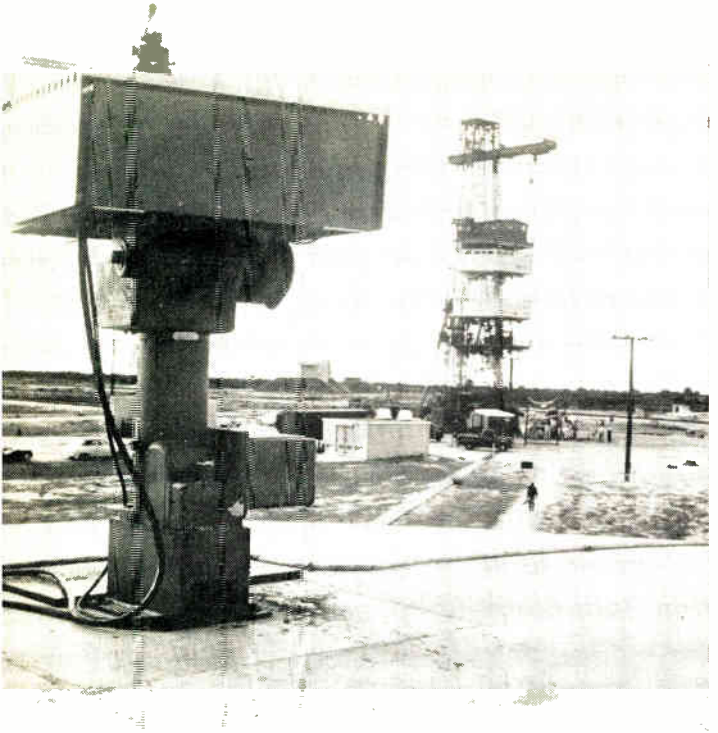


Fig. 1: Special housing on this camera protects it against the shock of missile launching.

By RICHARD J. CLARK,
Defense Electronics Division,
General Electric Co.
Mountain View Rd.,
Lynchburg, Va.

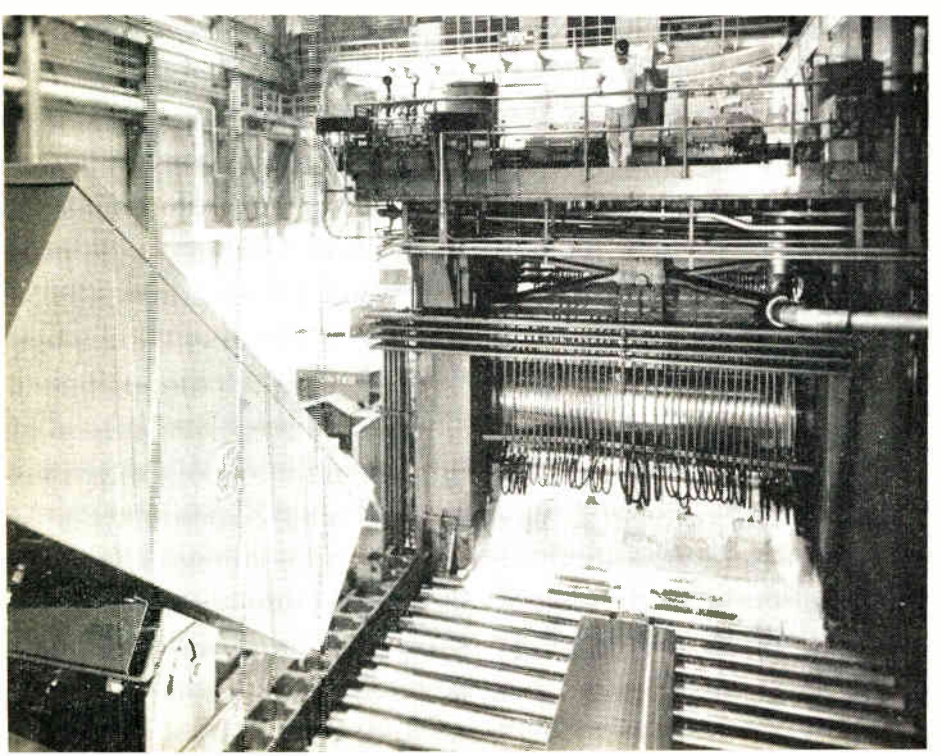
Design For a Transistorized

A LARGE segment of the closed-circuit television market consists of military and heavy industrial applications. These range from rocket-launching-site complexes to an individual camera monitoring of an ingot hot line at a large aluminum plant.

At the launching site, the need is for extremely rugged and reliable cameras that can continuously monitor a missile launching complex from all sides and relay information to personnel safely located behind concrete walls. The equipment must be rugged enough to operate throughout the long countdown, during the tremendous shock waves just prior to lift-off, and then during lift-off and the beginning of its flight.

In missile launching surveillance, the camera's attitude must be remotely controlled—also, its angle of view, and its ability to function under high light levels. (Fig. 1.) Often, it is enclosed in explosion-proof, acoustical, or weatherproof enclosures. These enclosures will often be used to protect the optical devices to be used with the camera. These include a wide variety of fixed and variable focal length lenses mounted singly or on a lens turret. In some designs, devices for motorizing the focus, iris control, and turret change are located externally to the camera and in the past have necessitated modifications of the camera or, in some cases, the use of space consuming drive mechanisms for their operation.

Fig. 2: Enclosed camera mounted over an ingot hot line at one of the large aluminum plants.



Since it is usually desirable to place all operating controls at the viewing location, the control box and cable must be carefully designed for optimum operation of the camera and its accessories. Furtheromre, the reliability of the system is improved by keeping the number of camera controls to a minimum. The monitor at the viewing point is subjected to much less stringent operating conditions and is usually a standard television monitor providing a high-resolution picture. When many cameras are used, they are all locked together from a common synchronizing generator to provide fast change-over from scene to scene without picture roll.

As with the more complex system, the single-camera system is

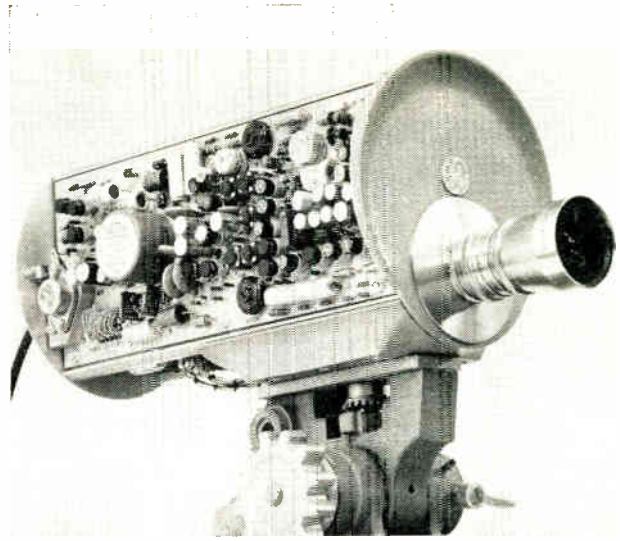


Fig. 4: Side is easily removed to permit quick maintenance.

Closed-Circuit TV Camera

The rigid requirements of military and heavy industrial applications demand a high level of reliability, maintainability and performance. These goals are attained here by designing around new components, using time-tested assembly methods that also permit easy testing.

Fig. 3: Camera uses modular construction

required to operate continuously in a rugged environment. (Fig. 2.) This camera is, for example, mounted over the hot line at a large aluminum processing plant. It gives the operator an unobstructed view as the ingots are scalped of cast roughness, heated, broken into a slab, and rolled to paper thinness.

Because the operator can see only the near side of the mill, he relies on the closed-circuit television system to monitor the far side. When the slab being rolled is on the blind side of the mill, the operator can tell by a glance at the television monitor whether or not it is off camber.

The camera housing is subjected to dust, fog, oil, and vibration, operates 24 hrs. a day, seven days a week, and requires little or no maintenance.

Design Criteria

With these and many other typical applications in mind, the following set of design criteria were compiled at the start of the new design:

1. Reliability—The unit should be trouble-free and capable of operation for long periods of time with little or no maintenance.
2. Ruggedness—The unit should be able to be operated under extreme conditions of vibration, shock, and acoustical noise.
3. The unit should be small in size and light in weight.
4. The unit should be of a modular design. The chassis should be able to be plugged in and should be interchangeable with units of similar design.
5. Focus, iris, turret, and douser accessories should be able to be mounted internally.
6. The unit should be self-contained and require no external circuits.
7. The unit should require no external operating controls.
8. It should be readily adaptable to various system applications.
9. It should conform to certain military specifications.
10. It should be compatible with existing vendor closed-circuit television accessories.

These design criteria provided the basis for the design of the camera system we are about to consider. As we go through the various design functions and parts of the camera, we can see how these criteria were met.

Mechanical Design

The General Electric Type TE-9-A transistorized camera is a self-contained unit approximately 5½ in. in diameter and 11¾ in. in length and weighs slightly under 9 lbs. (Fig. 3.) It is enclosed within a heavy-duty, spun aluminum, dustproof cover and is painted with a tough, baked vinyl paint that protects all exposed surfaces. The cylindrical shape

Transistorized TV Camera

(Continued)

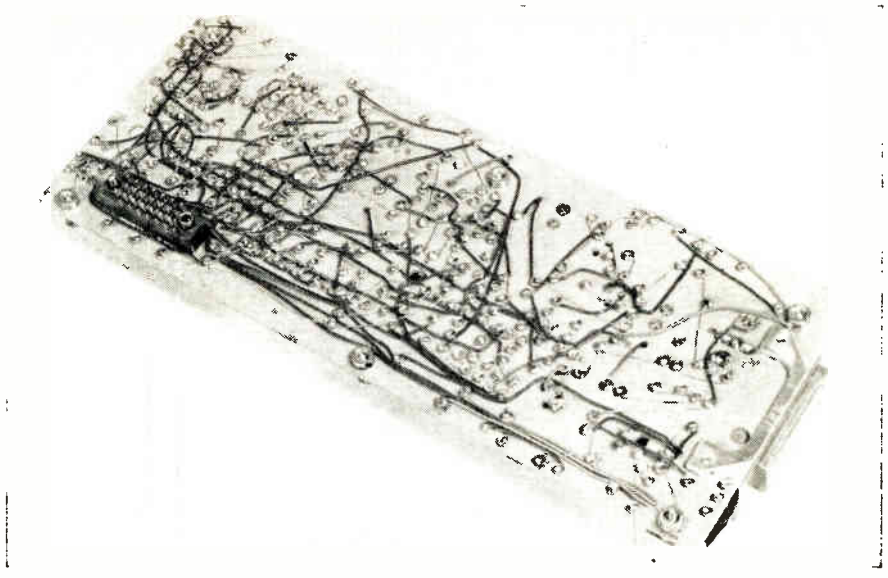


Fig. 6: Board employs unique wiring, using eyelets and conductors that eliminate the crossover problems of printed wiring. Insulated wires are teflon covered.

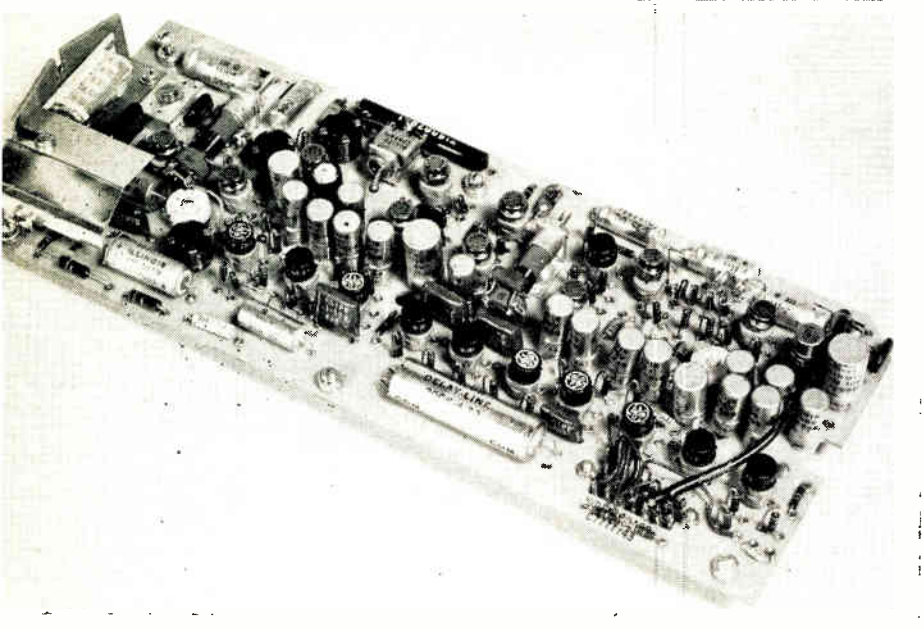
was chosen to provide the maximum strength and ruggedness in a minimum weight unit. It is also so designed that all of its available space is used in the most efficient manner. The front of the camera is an aluminum investment casting that provides a rugged mounting surface for any optical device used with the camera. The base of the camera, also a precision investment casting, provides both a functional base as well as a clean appearance to the design. The side panels of the camera are aluminum extrusions that provide more than adequate strength with the minimum weight. The aluminum rear panel assembly and the precision slide assembly complete the camera structure. Each part of the structure was carefully chosen to provide maximum utility with minimum space and weight. All aluminum parts in the camera are finished with iridite, and all brass parts are cadmium plated and then given a cronak treatment for added protection against corrosion. Stainless steel parts are all passivated and are used wherever a strong non-ferrous material is needed.

The cover of the camera is removed by loosening two captive fasteners and sliding it off the rear of the unit. The component side of all chassis is thus exposed to permit circuit checking at the component eyelets. (Fig. 4.) An individual chassis can be removed by releasing the captive screws on each chassis and unplugging it.

Chassis Construction

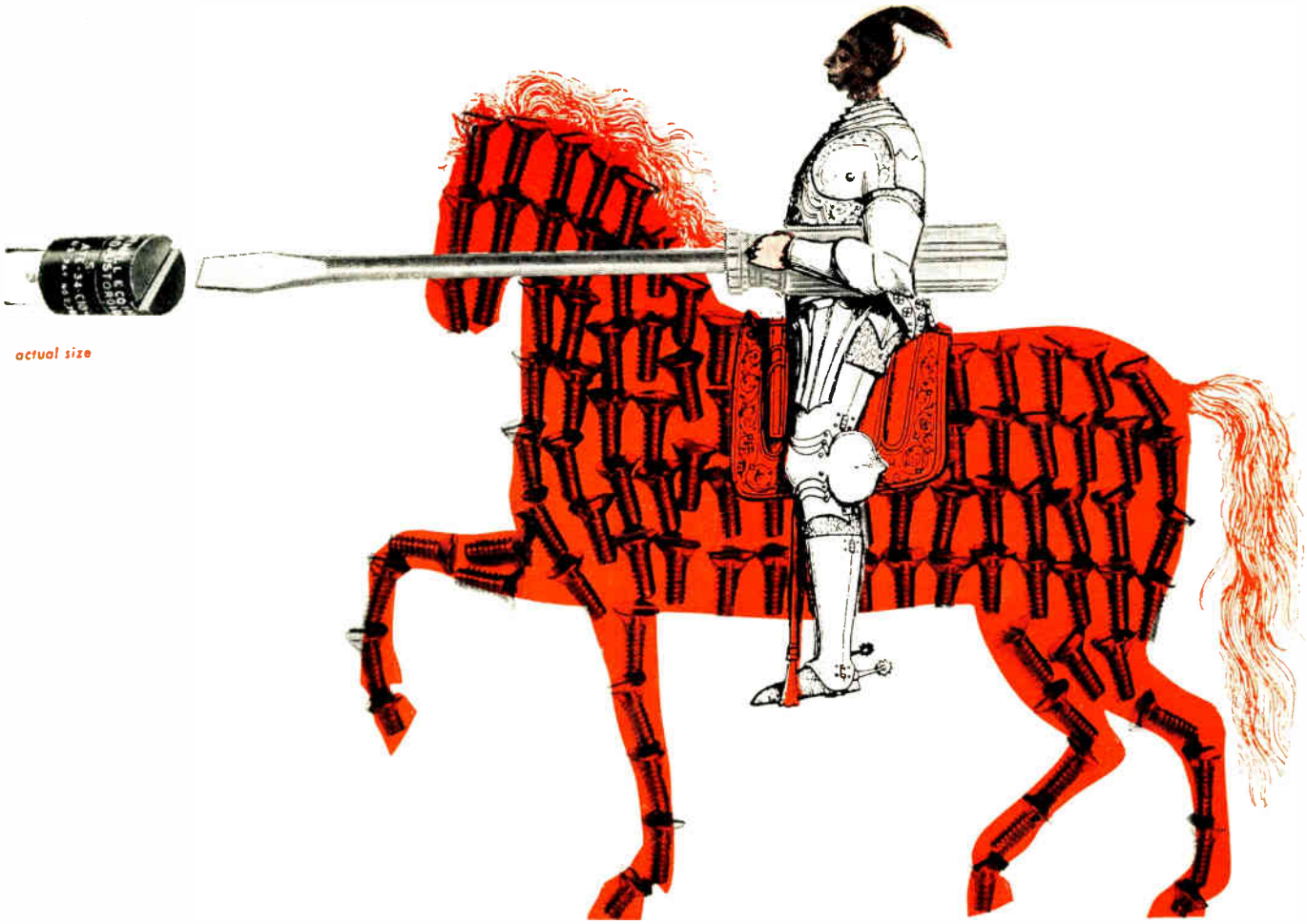
The unique chassis construction uses a .090 epoxy paper textolite board in which eyelets are spun at required locations. The front surface of the board is entirely free of wiring and permits maximum use of board space for component placement. (Fig. 5.) The rear of the board is used to make bus wire runs from eyelet to eyelet as required. (Fig. 6.) The wire used is teflon covered to permit it to be passed through the solder bath without damage. The tinned funnel eyelets provide a rigid support around which the bus wire can be wrapped, and the component lead is passed through the center of the eyelet.

Fig. 5: Front view of video board, showing component layout and marking.



After assembly of all the components, the board is passed through a flow solder machine and all connections soldered. The wetting action of the solder gives a continuous flow around the bus wire, up through the eyelet, and around the component lead. (Fig. 7.) The solder joint obtained by this method is very reliable. Since no copper plating is used for solder joints or lead runs, there is no reliability problem with delamination, incomplete flow-through, or any of the other problems encountered with printed wiring. Better electrical design is also achieved by judicious routing of the wiring for best circuit operation, and crossovers can be made when desired on the rear of the board to minimize special video problems.

(*Continued on page* 182)



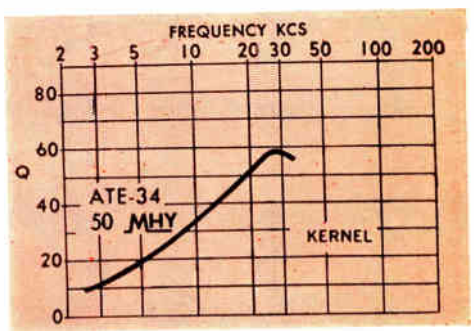
actual size

TAMING OF THE SCREW

Newest additions to the Burnell Adjustoroid® line, the microminiaturized Kernel ATE 34 and the miniatures ATE 11, ATE 0, ATE 4, represent an important contribution to printed circuit design.

These new Adjustoroids possess the exclusive advantage of flush-slotted heads which serve to eliminate adjusting screws – provide maximum economy of height – insure ease of adjustment. Besides high Q, they also offer high stability of inductance versus dc.

The new microminiature Kernel ATE 34 and the miniature ATE 11, ATE 0 and ATE 4 Adjustoroids are variable over a 10% range of their inductance. Fully encapsulated, they will withstand high acceleration and vibration environments. These Adjustoroids meet specifications MIL-T 27 Grade 4, Class R and MIL-E 15305 A as well as MIL-E 5272 for humidity and thermal shock. Write for Adjustoroid Bulletin ATE-7.



SEND NOW FOR HANDY 24" x 36" TOROIDAL INDUCTOR WALL REFERENCE CHART

Lists more than 100 types of toroidal inductors and adjustoroids. Gives performance characteristics, mechanical specifications, including case sizes, types of sealing, etc. Attach coupon to company letterhead. And if you haven't already done so – send for your free membership in the Space Shrinkers Club.

Burnell & Co., Inc. Dept. I-34
10 Pelham Parkway, Pelham, New York

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name.....

title.....

company.....

address.....

CUES for Broadcasters

Visual Telephone Signalling

MORTON MORRISON, Dir. Tech. Operations
WPAC, Patchogue, L. I., N. Y.

Like many other radio stations, WPAC is faced with having the announcer in the control room answer telephones a good part of the day. As we can not use bells, either pilot lights or bee hive lamps supplied by the Telephone Company are used for signaling. This in general, proves to be inadequate.

We asked the Telephone Company for a different type of signaling, and found that we could have, as part of the standard equipment, a relay rather than a lamp which would be accuated by the incoming ringing signal. We could use the relay contacts as we saw fit. The relay given is a type D relay KS-16301, list 7. It comes equipped with a short standard ac line cord and standard ac receptacle. When it is plugged into a 115 vac line, the ac receptacle will provide 115 volts when the telephone line to which the relay is connected is being signaled.

As our studios were under construction, we installed a 150 watt bullet spot lite on the front walls of the control room, which is aimed directly at the announcer. In this way, the announcer on duty knows exactly which one of our four incoming lines are ringing. Standard ac line switches were placed in the system to disable all of the lamps during such times that a telephone operator is on duty. Since we use low voltage control circuits, we used 24 vdc on the relay and a second relay to control the light as per Fig. 2. Where studios are in operation, Fig. 1 can be used with the 150 watt lamps mounted on a pole lamp.

Modification Simplifies Drive Wheel Changing

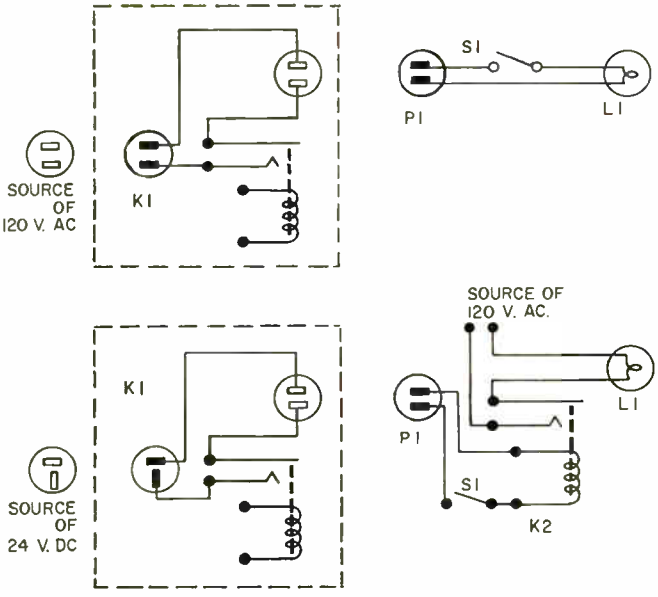
V. HOFFART, Ch. Eng.
KNEW, Spokane, Wash.

As most broadcast engineers know, changing drive wheels on PT6 Mechanisms can be quite a time-consuming chore. To facilitate changing the pucks, we at KNEW cut out the metal between the two 2 in. diameter holes in the bottom of the machine. This results in one large hole about 5⅝ in. long by 2 in. wide. The pucks and their mounting brackets can be removed through this opening very easily.

Proceed as follows: Remove the nut from the drive motor switch on the back of the mechanism and push the switch out of its mounting hole. This allows free access to the screws holding the drive wheel mounting plates. Hold the screw nuts on the inside of the machine with a long-nosed pliers and turn out the screws with a screwdriver. Unhook the springs that hold the pucks against the motor shaft and capstan drive. The drive wheels can now be removed through the elongated hole.

It is not necessary to remove any other part from the machine, however, we find it easier to replace the tension springs by pulling the takeup spindle from the machine. This requires only the loosening of one allen set screw that holds the takeup slip-clutch assembly to the shaft. This modification was executed on four mechanisms in 1950 and all 4 machines are still in daily use, indicating that the strength of the mechanism has not been materially weakened. The aluminum frame can be cut easily with an ordinary hacksaw blade or other metal cutting saw. Placing paper inside the mechanism will catch the saw filings while cutting. Average time for replacing pucks on modified machines is 20 minutes.

Chassis cut-out will greatly facilitate drive wheel changing on record players.



Relay K1 can be supplied by the telephone company upon request. With this set-up, visual telephone signals can be easily seen.

PARTS LIST

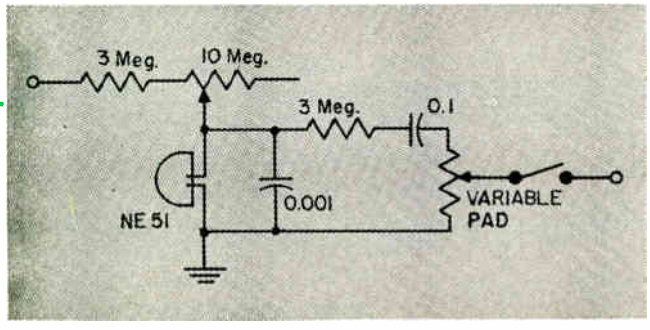
K-1 Wheelock Signals, Inc., Relay No. RX-1419, Telephone Comp. Type D, KS16301 List 7, Supplied by and connected to telephone line by local telephone company.
K-2 Relay, Potter & Brumfield, MH1501, 24 volt dc coil, contacts rated at 110 volts at 5 amps.
L-1 120 volt, 150 watt lamp.
P-1 Standard line plug.
S-1 Standard 110 volt 15 amp line switch.

Inexpensive Time Tone

DONALD M. WHEATLEY, Ch. Eng.
WJOY, S. Burlington, Vt.

To provide an inexpensive time tone for our console we found a simple relaxation oscillator made from a NE51 neon bulb works very well. It can be made from junk box parts. We tied ours into the input of the console program amplifier with a spring return key switch and took the supply voltage from a tube plate connection. After proper resistors were found for the right tone a pot was inserted so that the tone could be varied to compensate for any voltage change. A variable pad was used to get the proper level to the program amplifier.

Parts for this time tone generator should be available in any station's "junk box."



Circle 121 on Inquiry Card

Transistorized TV Camera

(Continued)

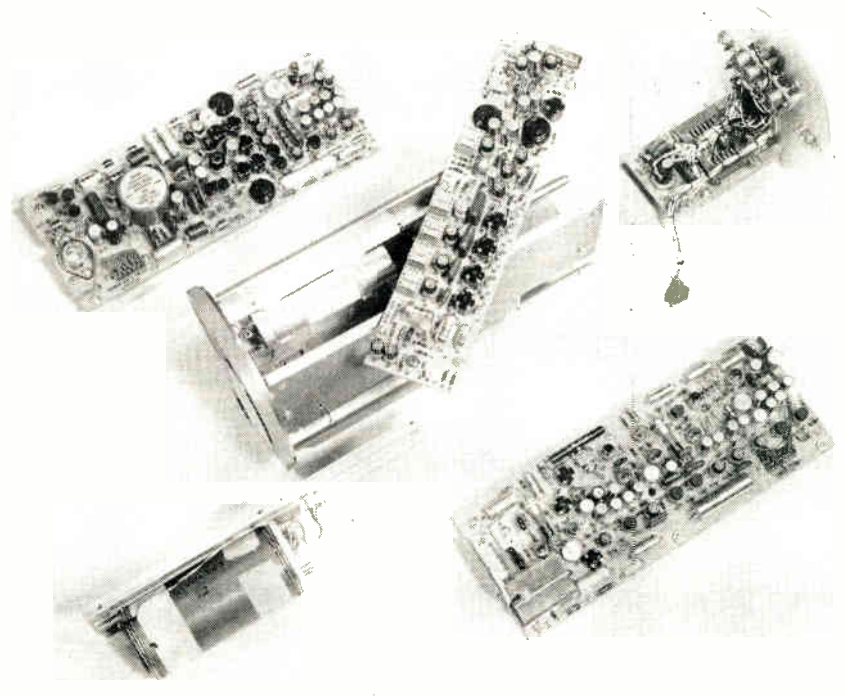
Electrical Design

The electrical design has provided many new features which again add to the reliability and to the ability of the camera to operate under extremes of environmental conditions. The synchronizing generator consists of a 31.5-kc master oscillator and four frequency dividers, yielding a 60-cycle trigger pulse that is locked to the master oscillator. The four division ratios are seven, five, three, five. All dividers, including the two-to-one count, are blocking oscillator circuits, with the timing networks in the emitter. It should be noted that the highest division ratio is seven-to-one, which provides a very stable network. The circuit uses reliable 2N396 and 2N526 transistors. The vertical drive output consists of a multivibrator that is started by a 60-cycle trigger and stopped by a 900-cycle trigger in the divider chain. This gives a vertical drive pulse that is stable and 17 lines wide. The frequency divider operates over a wide temperature range, and no adjustments of horizontal or vertical drive pulse widths are required. The AFC circuit uses a two-transistor clamp to compare the phase of the 60-cycle reference sine wave from the power line to the 60-cycle vertical drive pulse. The error voltage is buffered by two cascaded emitter followers and is used to control the master oscillator frequency. It is also used to control the frequency of the dividers to yield a wider hold-in range. The AFC circuit is fast acting and has a pull-in range of ±10% of 60 cycles. The circuit can be easily modified for a 625-line, 50 cycle field system.

Video Chassis

The video chassis uses a tube input stage followed by an 11-stage transistor amplifier. This amplifier includes a high peaker, gain control, aperture corrector, keyed clamp, black clipper, gamma corrector, and feedback output stage. The tube preamplifier with pre-peaking gives a much better signal-to-noise ratio than that provided by transistors or other tube circuits. A 250 to 1 peaking ratio is provided to decrease tube microphonics. The video amplifier is a high-gain, stable amplifier that produces normal output levels from an input of .05 microamperes. The aperture

Fig. 8: Camera uses modular construction.



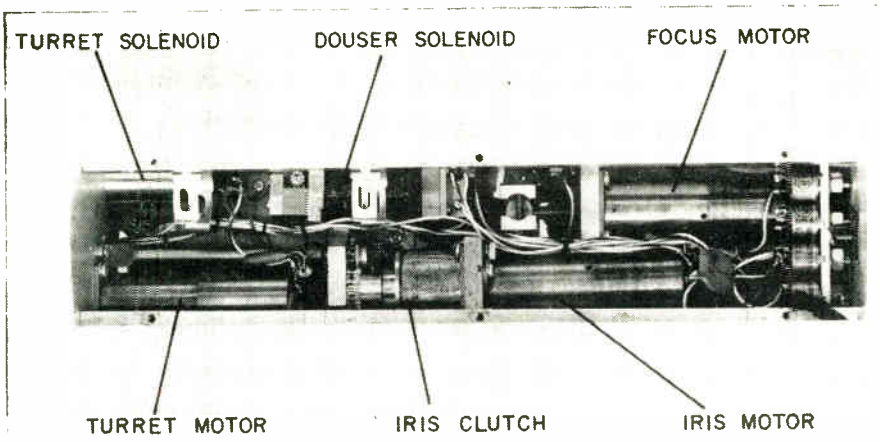


Fig. 9: Remote control functions are handled by these accessory motors.

corrector is of a delay-line type and is phaseless. A drift-free keyed clamp sets the black level and has less than 1% drift from 25 C (72 F) to 60 C. A constant current driven black clipper gives sharp clipping action. Also included on this chassis are the vertical drive buffer, vertical blanking stretcher, blanking adder, horizontal drive buffer, horizontal front-porch delay circuit, clamp keyer, and sync adder. The blanking system is so designed that on both horizontal and vertical rates, camera blanking starts after and ends before system blanking. This method eliminates the white edges on the raster caused by target storage. The horizontal interval has a two-microsecond front porch.

Sweep-Power Chassis

The sweep-power board contains a four-stage regulator to regulate the +20 volts supplied to the DC-to-DC converter. The converter output is a 1-kc square wave at various voltages. These are rectified and filtered to give the following voltages: —20 volts, —160 volts, +160 volts, +350 volts, and +6.3 volts. All of these are regulated against variation of supply voltage to within ±1%. A three-stage focus-current regulator holds the vidicon focus current to within ±0.25%. Also on the power board are the horizontal sweep circuits, including horizontal size and centering controls. The vertical sweep circuit contains a vertical drive-pulse delay circuit. Vertical size, centering, and linearity are included. The camera blanking function and sweep failure protect circuits are combined into a five-transistor circuit. If the horizontal or vertical sweep fails, the vidicon is held at the blanked condition. No relays are necessary in this circuit. Electrical horizontal and vertical centering is provided, as well as electrical alignment. The beam, target, focus, and setup blanking controls, located at the rear of the camera under the protective cover, can be remoted if desired by the use of the standard remote control panel. As mentioned previously, the focus, deflection, and alignment coils are all potted into one assembly as a rugged unit. Because of the design of the power supply of this unit, it can be operated on either 24 volts d-c or 50-, 60-, or 400-cycle, 115-volt a-c.

* * *

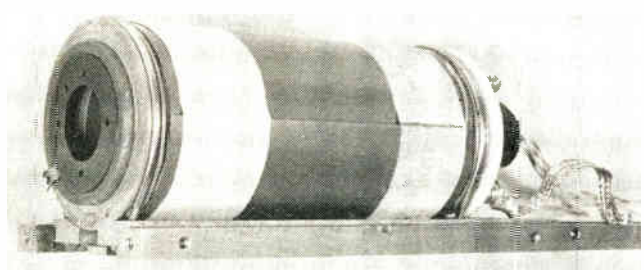
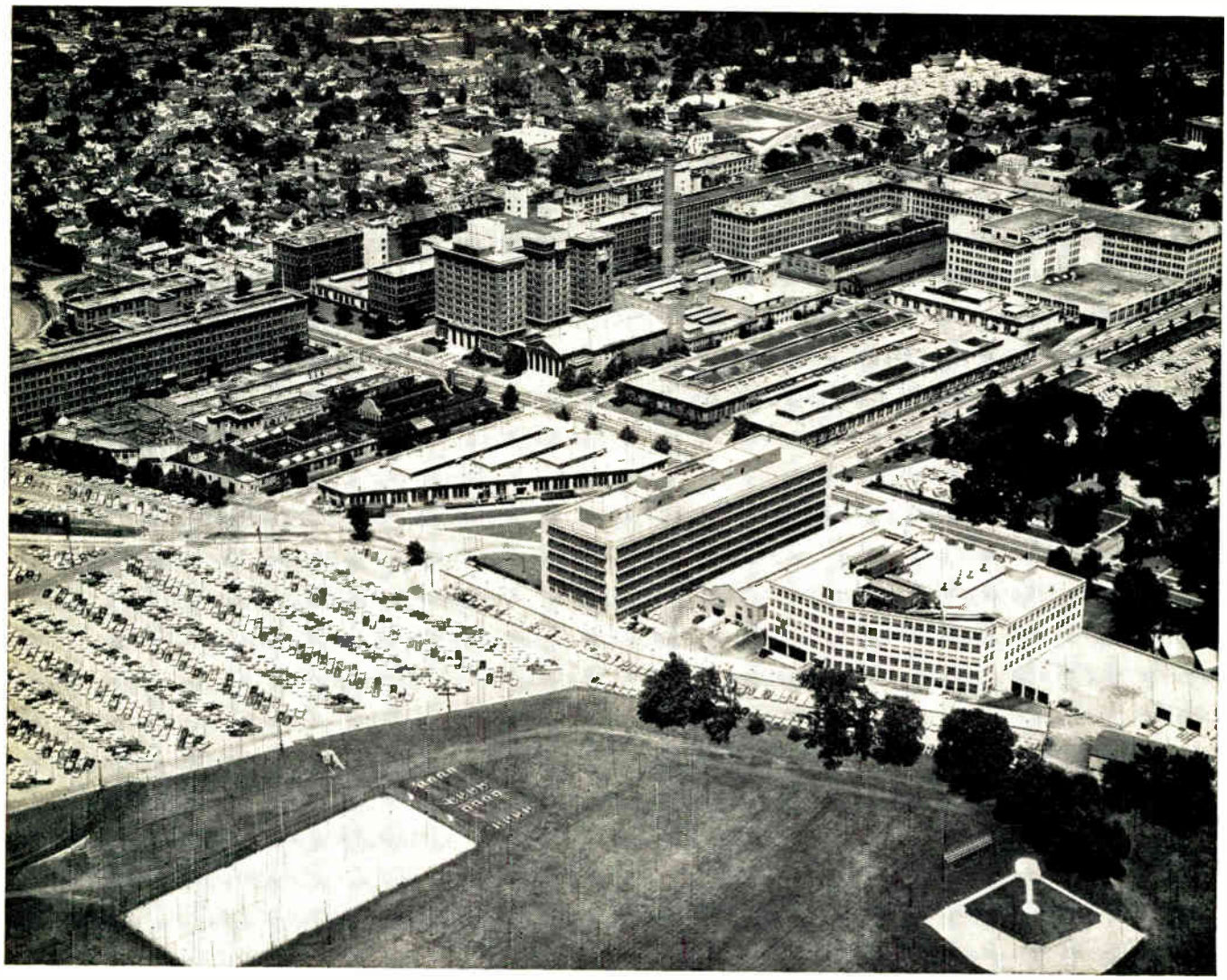


Fig. 10: Rugged unitized deflection assembly.



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Circle 501 on "Opportunities" Inquiry Card

PROFESSIONAL OPPORTUNITIES

Reporting late developments affecting the employment picture in the Electronic Industries

Design Engineers • Development Engineers • Administrative Engineers • Engineering Writers
Physicists • Mathematicians • Electronic Instructors • Field Engineers • Production Engineers

General Electric's Davis Elected EIA President

L. Berkley Davis, Vice President of the General Electric Co. and Manager of the Electronic Components Div., is the new President of the Electronic Industries Association. He succeeds David R. Hull, a Vice President of Raytheon Co., Waltham, Mass., who has served two terms. Davis is the 36-year-old association's 28th President.

EIA is a national trade association which represents all major manufacturing segments of the electronic industry. EIA's main office is at 1721 DeSales St., N.W., Washington 6, D. C.

Invent Something—Need Patent Help?

Do you have an idea for a better way to do something? If you're like most of us, you probably want to make some money out of the idea and are probably considering a patent. How do you go about getting a patent? Should you keep your idea a secret? How do you know the idea is "patentable?"

These and many other very important questions are answered in a booklet, "Preparing for Patent-Hood" written by Elton T. Barrett, President of CGS Laboratories, Inc. Copies are available from Trak Electronics Co., Div. of CGS Laboratories, Inc., 49 Danbury Road, Wilton, Conn.

The booklet tells what to do with your invention idea; when to talk with a patent attorney; importance of dates and a verifier; about the patent office; application handling; revising claims; claims and patents; economic importance of patents; foreign patents, etc. It is cleverly illustrated.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 169.

Table-top electrical engineering lab is used in a combined servo-mechanism and machinery lab course. Machine characteristics can be studied both in isolation and in a system.

Condensed EE Lab

This complete laboratory for demonstrating electrical machinery characteristics and engineering practices fits on a table top. A laboratory using conventional equipment could cost a college upwards of $40,000 in equipment plus $100,000 in facilities.

The table top lab comes in kit form and features compact 1/15 hp machines including: dc machines for use as motor, generator, or tachometer; wound rotor ac machines for use as induction or synchronous motor, generator or synchro; squirrel cage ac motors as mechanical drive sources; miniature torque sensors for measuring magnitude and direction of static and dynamic torque between motors and loads.

The equipment is made by Lebow Associates, 14857 West 11 Mile Road, Oak Park 37, Mich.

Engineers Reject Union—NLRB Defines 'Professional'

The National Labor Relations Board has announced that Engineers of the Western Electric Co., Inc., have rejected union representation in the largest election ever conducted by the NLRB among professional employees. Over 6750 Western Electric Engineers were eligible to vote; 3970 voted against the union; 2603 voted for. One

(*Continued on page* 192)

IRE's Tuller Award to O'Meara—Hughes Co.

Dr. Thomas R. O'Meara, Hughes Aircraft Co., Culver City, Calif., has been named to receive the first Dr. William G. Tuller Memorial Award. The award is "in recognition of the most outstanding technical paper dealing with electrical component parts published in professional journals in 1959." It consists of a scroll and $250.00.

Dr. Thomas R. O'Meara, first winner of the Dr. William C. Tuller Memorial award.

Dr. O'Meara's paper was described as "one of the first general studies of the common methods of extending low frequency transformation to high frequency, wide band operation using a lumped parameter, wide band, high frequency transformer." The paper was published in the June 1959 issue of the Transactions of the Professional Group on Component Parts (IRE).

Engineer's Importance Overlooked—A. H. Flax

The increased recognition accorded to the scientist "has had some unfortunate side effects," including a decline in the public mind of the importance of the engineer, says, Dr. Alexander H. Flax, Chief Scientist of the U.S. Air Force.

(*Continued on page* 192)

There is really no "easy" way to write instruction manuals—but a good outline will help. It can help you lay out your work quickly, and still be fairly sure that you have left out nothing that is important.

How To...

Write Instruction Manuals

THE outline is divided into Sections and Paragraphs. The sequence of items in each paragraph should be tabulated; this makes the manual easier to read and easier to write. Short words, short sentences, and active verb forms should be used. Write it the way you'd talk it.

1—DESCRIPTION

A: Functional Description

Tell what the product is, what it does, how it does it, why it does it, what it's used with, etc. Be sure to identify by model number.

B: Characteristics

Talk about sensitivity, drift, noise, frequency range, weight, dimensions, temperature limits, ventilation required, etc. Call out differences between different models and groups of serial numbers.

C: Control Data

Name, describe, and give the function of each control, meter, connector, test point, adjustment, switch, indicator, etc.

2—OPERATION

A: Introduction

Outline the steps the operator must follow. Give warnings, descriptions, theory, etc., needed by the operator to run the equipment.

B: First Operating Step

This step could be WARMUP, or TURNING ON THE EQUIPMENT, or whatever the first operating step happens to be.

C: Second Operating Step

Same thing, only one step further on—such as BALANCING, or CALIBRATION, etc.

D: Third Operating Step

Same thing again, only further on. Could be MEASUREMENT, or SAMPLE PROBLEM, or so on. Continue for as many steps as needed.

E: Operation

Now the equipment is actually doing the job it was built for—this is the step for which the others have been only a preliminary. Continue with steps 6, 7, 8, etc., as needed, for any other alternate modes of operation.

3—SPECIAL OPERATION

This Section is not always needed, but sometimes there are odd-ball ways to use the equipment. Instructions should be given, but where. Put them here.

4—THEORY OF OPERATION

A: Overall Description

Relate the equipment to the things outside it—use the "black box" approach. It is convenient here to write in terms of "inputs" and "outputs," and of the effects the "black box" and its controls have upon them.

B: Functional Description

Now go inside the equipment. Break it down into its elements (like oscillators, amplifiers, modulators, etc., in electronic gear), and draw block diagrams to show how these elements are related and how they work together.

Name the first element, and draw a simplified diagram to help you explain how this element works.

Name the next element, and draw a simplified diagram to help you explain how this element works.

Name the next element, and draw another simplified diagram to help you explain how this element works.

Explain how this element works, in the same way. Continue with as many numbered paragraphs as needed for the whole equipment.

By HECTOR E. FRENCH
Chief Publications Engineer
Sanborn Company
175 Wyman St.
Waltham 54, Mass.

5—MAINTENANCE

A: Periodic Maintenance

Also called "Preventive Maintenance." Tells how to keep the equipment going, such as by 500-hour checks.

B: Maintenance Adjustments

Instructions on all the adjustments which are not a part of normal operation.

C: Trouble Shooting

How to repair after a failure. Suggested form: a three-column table, with the first column naming the fault, the next column giving the possible causes, and the third column telling how to check out or repair each cause.

D: Check Chart

Instructions on checking out the equipment, so that the maintenance personnel can be sure they've returned the equipment to within its original specs.

6—PARTS LIST

You'll want some or all of these: schematic diagram, list of replacement parts, suggested items for stock for 2,000 hour operation, vendor code of parts, manufacturer's code of parts, component location, voltage and resistance diagrams, exploded views of mechanical assemblies.

Professional Opportunities *(Continued)*

Honorary Sc.D Degree To Varian's Stearns

H. Myrl Stearns, President of Varian Associates, has received an honorary Doctor of Science degree from the University of Idaho, his alma mater (advanced electronic degree in 1939).

Stearns joined Russell and Sigurd Varian, the inventors of the klystron tube, and other scientists in founding Varian Associates, 611 Hansen Way, Palo Alto, Calif., in 1948.

Name New NEMA Wire & Cable Heads

Vernon W. Heimberger, Manager of Electrical Sales, American Steel and Wire Div., U. S. Steel Corp., has been elected Chairman of the newly organized Wire and Cable Div. of the National Electrical Manufacturers Assoc. H. W. Clough, Vice President, Belden Manufacturing Co., has been elected Vice Chairman.

The new division consists of these sections: Magnet Wire; High Temperature Insulated Wire; Paper Power Cable; Rubber, Thermoplastic and Varnished Cable; Building Wire and Flexible Cords; and the Armored Cable Section. Information on activities can be obtained from: NEMA, 155 East 44th St., N. Y. 17, N. Y.

McDonnell Aircraft Enters Commercial EDP Field

Establishment of a new division of McDonnell Aircraft as a commercial operation offering complete electronic data processing services to industry and commerce in both scientific and administrative work has been announced. The new division, the McDonnell Automation Center, P.O. Box 516, St. Louis 66, Missouri, is the company's first venture in the commercial field, and is an effort to diversify its operations.

The company has an organization of 253 specialists in data processing and systems work and has ordered equipment which will increase capacity by five times. They are offering a complete data processing service including the development of systems and procedures for other business firms and the training of their personnel.

Equipment includes an IBM 709 and 705, as well as smaller computers. An advanced IBM 7090 and an IBM 7080 are on order. Richard A. Gilbert, formerly manager of administrative services, will be operating manager of the Automation Center.

FOR MORE INFORMATION . . . on positions described in this section fill out the convenient inquiry card, page 169.

Engineer Overlooked

While science is achieving public recognition and support as an important factor in our economy and our national security, "the importance of engineering has to some extent been eclipsed."

Because of the loose usage of the term, scientist, in connection with space vehicles, the public image of the man responsible for space vehicles is that of a physicist or chemist rather than that of an engineer. He says the acclaim accorded to Soviet science on the basis of the demonstrated large payload capacity of Soviet rocket engine boosters is an indication of a tendency to attribute to science what is largely the result of technology. He believes that the Russian space launchings did little to show informed persons that Soviet science improving, but did not show that they had made very substantial progress in technology.

"The importance of engineering science and engineering are certainly not diminished by the steadily increasing output of science and the speed with which this output can be put to practical use," he says, "To the contrary, the richer supply of raw material in the form of basic knowledge is making the job of the engineer more demanding, more interesting, and more important."

Dr. Flax made these comments before the Awards Dinner of the Institute of Aeronautical Sciences' 1960 Northeastern Student Conference.

Engineers Reject Union *(Continued)*

hundred eight votes were challenged and 12 voided.

The Council of Western Electric Professional Employees—National, an affiliate of Engineers and Scientists of America had petitioned NLRB for the election. It was directed after a lengthy Labor Board case which hinged on the professional status of employees.

In the case before the Board (the hearings lasted more than a year), a specific formula proposed by the Council that educational and experience requirements be used as the governing standards for professional engineers at Western Electric was rejected. The dispute, what constitutes a professional engineer, arose while the Council was negotiating a fourth one-year agreement. The Council had asserted that subprofessionals it deemed ineligible for Council membership were assigned professional engineering work.

The Board held that the predominant factor in determining whether individuals are professional employees is the character of the work they perform rather than their individual qualifications, background, and experience.

The Board added: "This is not to say that the background of individuals within a disputed group is an irrelevant consideration, for background is examined for the purpose of deciding whether the work of the group satisfies the 'knowledge of an advanced type' requirement within the Labor Management Relations Act's professional employee definition."

Science Education Handbook

The National Science Foundation has published a "Statistical Handbook of Science Education (NSF-60-13)." It is a compilation of statistical material on the education and training of scientists and engineers in the U. S.

The publication deals with human resources data (population, educational levels of the population, college degrees awarded, qualifications of teachers) with institutional and financial data (number and types of schools, expenditures, tuition costs, financial aid) and with general appendix tables containing more detailed information on all these subjects.

Copies may be obtained from: The Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price is 55 cents.

engineers • scientists • mathematicians • statisticians

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Offering Outstanding Growth Opportunities

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As prime contractor to the Atomic Energy Commission, the X-Ray Department is responsible for developing and manufacturing advanced-generation electronic systems, sub-systems, and vacuum tubes for *highly-classified* uses under extreme environmental conditions.

Only limited information can be divulged about these priority programs. We may state only that they involve new discoveries in electronics, physics, chemistry—that they employ automated and semi-automated processes to maintain rigidly controlled precision manufacturing—that a large quality control group is using advanced statistical and measuring methods to attain an unprecedented degree of product refinement.

Recently accelerated activities have created new openings for well-qualified professional men. Among the considerable rewards available here are rapid professional growth in advanced areas . . . unusually interesting projects . . . a relaxed life in a year-round resort right on the Gulf of Mexico.

OPENINGS ARE IN THESE AREAS: Quality Control-Test Equipment Engineering / Quality Control-Statistics / Quality Control-Systems Analysis & Reliability / Quality Control-Field Engineering Vacuum Tubes / Industrial Chemistry / Production Engineering / Statistical Engineering.

A high order of original thinking is the first qualification.
Further information may be obtained by writing of your experience and interests to:

MR. L. R. WILLIAMS, DEPT. 24-MG, X-RAY DEPARTMENT

GENERAL ELECTRIC

P.O. BOX 11508 • ST. PETERSBURG, FLORIDA

Circle 503 on "Opportunities" Inquiry Card

News of Mfrs'
Representatives

Networks Electronic Corp., Van Nuys, Calif., has appointed 3 sales representatives. **The B. B. Taylor Corp.**, Baldwin, N. Y., will cover the Metropolitan New York area, Long Island and Northern New Jersey. **Johnson Assoc.**, Casselberry, Fla., will cover Florida and the **Emory Design and Equipment Co.**, Birmingham, will handle Alabama, Georgia and Tennessee

Don McPherson is now District sales representative of the Cleveland territory for the Magnet Wire Div., Essex Wire Corp., Ft. Wayne, Ind.

Appointment of manufacturers' representatives in Texas, Montana, Maryland and Indiana for RCA's mobile communications equipment have been announced. They are: **Texas Gulf Electronics, Inc.**, Houston, Tex.; **Leslie E. Olsen Co.**, Lewistown, Mont.; **Communications Sales Co.**, Salisbury, Md.; and **Industrial Communications of Indiana**, Indianapolis, Ind.

Television Communication Products, Inc., Dallas, Tex., has been named representative for Adler Electronics in Texas, Oklahoma, Kansas, Missouri, Arkansas and Louisiana.

M H D Research, Inc., is now sales representative for Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington and Wyoming for the Thermal Dynamic Products Div., Waltham Precision Instrument Co., Waltham, Mass.

Valley Forge Assoc., Arno Bldg., Devon, Pa., have been named sales representatives for National Beryllia Corp., North Bergen, N. J., in Pennsylvania, Delaware, Maryland and Southern New Jersey.

New sales representative organizations for the Ideal Precision Co., Inc., Brooklyn have been announced. **Fred Wamble Sales Co.**, Montgomery, Ala., will service Alabama, Georgia, North and South Carolina and Eastern Tennessee. **M. F. Klicpera Co.**, Houston, Tex., has been appointed in Texas, Oklahoma, Arkansas, Mississippi, Louisiana and as far east as Western Tennessee.

Selection of an Eastern area manufacturer's representative by Lear, Inc., has been announced. **Tek-Sel, Inc.**, Paramus, N. J., is representative in lower New York state, New Jersey, Delaware and the eastern half of Pennsylvania.

J. Scribner Allen is now sales representative in Washington, D. C., for the Edison Electric Institute Sales Div.

Plug-in Instruments, Inc., Nashville, Tenn., has appointed sales representatives in these states: Illinois and Wisconsin—**Berndt & Associates**, Glencoe, Ill.; New York, North New Jersey, and N. E. Pennsylvania—**J. S. Kempf Co.**, Inglewood, Calif.; Tennessee—**Ridge Instrument Co.**, Oak Ridge, Tenn.; Alabama, Delaware, Florida, Georgia, Maryland, So. New Jersey, North Carolina, S. E. Pennsylvania, South Carolina and Virginia —**William M. Jones Co.**, Towson, Md.; Louisiana and East Texas—**Robert B. Stockdale Associates**, Houston, Tex.; and Indiana, Michigan, Ohio, Western Pennsylvania, West Virginia — **The Satullo Co.**, Royal Oak, Mich.

Maxwell S. Symon, formerly Eastern Div. Sales Manager for Electric Regulator Corp., Norwalk, Conn., has formed **Symon Associates**, an Electronic Engineering representative firm with offices at 550 Fifth Ave., New York City. They will specialize in electronic components and instruments covering the Metropolitan New York area for OEM accounts.

MECO, a new electronic manufacturers' representative organization has been formed in Wakefield, Mass., to serve the electronics and related industries in the New England area. The firm is founded by Donald A. Jenkins and John Riley. The company will specialize in microwave instrumentation and systems components, laboratory and special purpose power supplies, signal sources, and digital equipment. For information: Measurement Equipment Co., Inc., P. O. Box 267, Wakefield, Mass.

The Sanford Co., Wichita, Kans., has been named sales representative by Task Corp., Anaheim, Calif., in Texas, Oklahoma, Kansas, Missouri and Iowa.

A new representative in the semiconductor and electronic field for Anchor Alloys, Inc., is: the **A. V. Doren Co.**, St. Louis, Mo., in Missouri, Arkansas, Oklahoma, Kansas, Nebraska, Mississippi, and Texas.

The Erie-Pacific Div., Hawthorne, Calif., of the Erie Resistor Corp., has announced the appointment of **Design Sales & Engineering Co.**, St. Louis, Mo., as field representative for the company in Iowa, Kansas, Nebraska, Missouri and Southern Illinois.

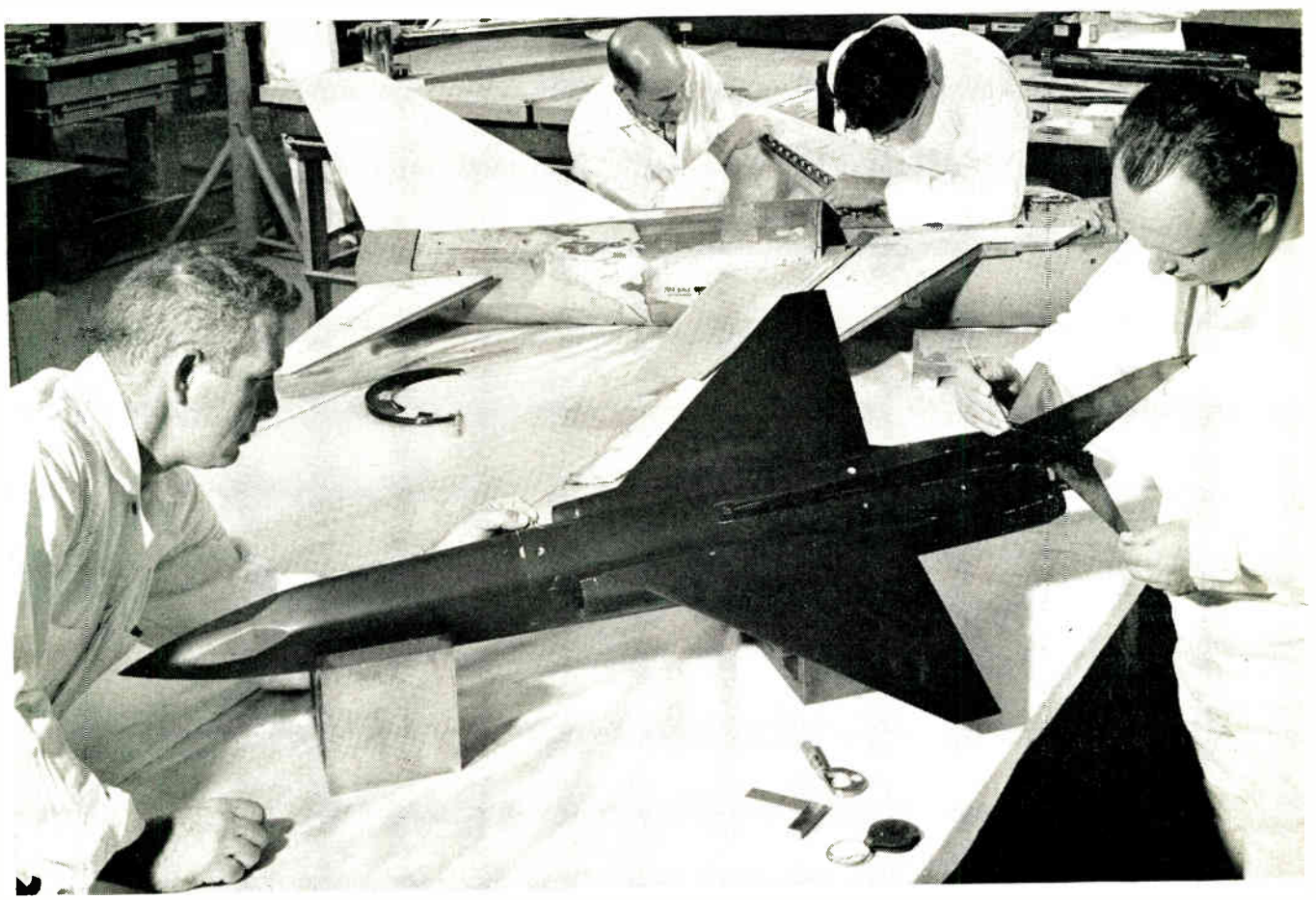
R. Sol Puleo, Lynbrook, N. Y., has been appointed Applications Engineering representative for Moore Associates, Inc. He will represent the company in the Metropolitan New York City area including Northern New Jersey, Southern Connecticut, Westchester County, and Long Island.

BIG THINGS ARE HAPPENING AT BOEING WICHITA AND WE NEED THE MEN TO MATCH THEM

..particularly in the area of New Product Design. We are looking for Senior Engineers who can step right into the most challenging opportunities in our history. One of them may be **you.**

- If you're the kind of man with a truly inventive turn of mind.
- If you have really big ideas about end products and processes.
- If you can sense the challenge in joining one of the world's largest companies in an accelerated diversification push . . .

YOU BELONG WITH BOEING WICHITA. We invite you to write in confidence to Mr. Melvin Vobach, Dept. E7, Boeing Airplane Co., Wichita, Kansas.



BOEING WICHITA

Circle 507 on "Opportunities" Inquiry Card

Industry News

Samuel L. Greene has been promoted to Data Systems' Eastern District Manager for the Stromberg Div. of General Time Corp., New York City.

James H. Brewster is now Vice President - Operations, of Sylvania Electronics Systems, a Div. of Sylvania Electric Products, Inc., New York, it has been announced. He was previously Divisional Vice President.

A new Director for the West Coast office of the Crosley Div., Avco Corp., has been appointed. He is Maurice E. Heidbrink. He was formerly with the Emerson Radio & Phonograph Corp.

Alfred D. Masters has been appointed Manager of the DuKane Corp., St. Charles, Ill., Commercial Sound Div.

Everett F. Wagner has been named Vice President of an expanded international division of Bell & Howell Co., Chicago, Ill. He was formerly Vice President of Manufacturing of the Company's Photo Products Div.

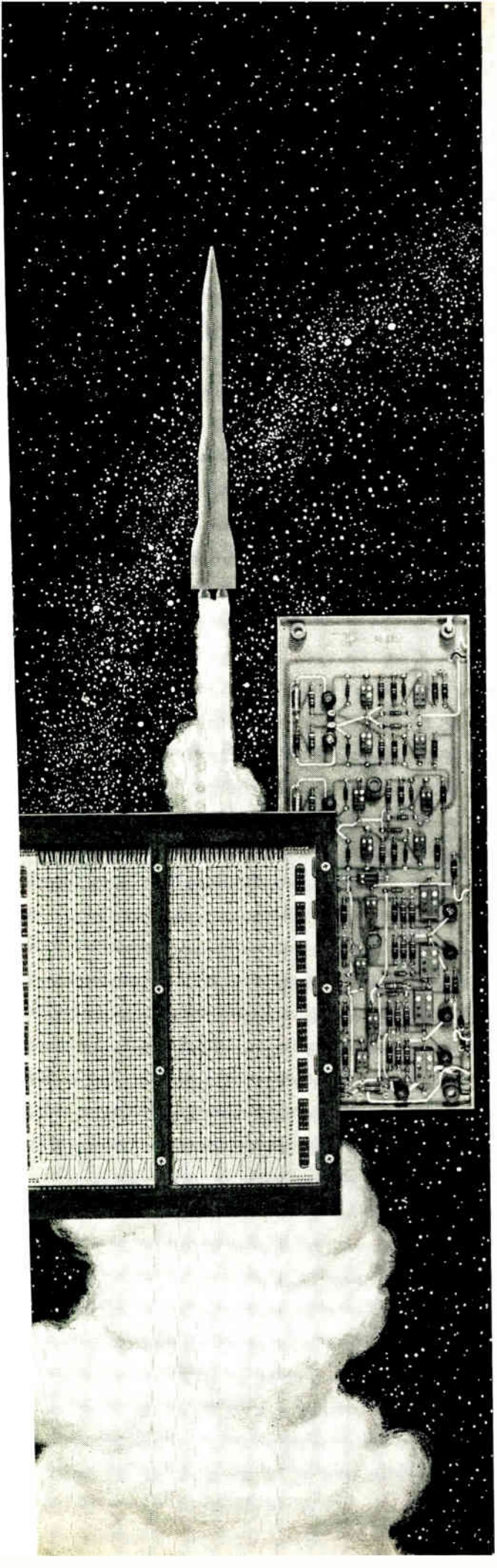
L. E. Sabine, Acting Manager of the Components, Materials, and Processes Engineering Dept., Remington Rand Univac, St. Paul, Minn., is the new chairman of the twin city chapter of the Professional Group on Engineering Management, IRE.

L. Sabine

C. Huestis

Charles B. Huestis has been appointed Treasurer of Hughes Aircraft Co., Culver City, Calif. He was formerly Director of Finance for the Company.

Don Dickson formerly Product Manager of the Diode Dept. of Motorola Semiconductor Div., has formed the Dickson Electronics Corp. Initial efforts of the new company will be in the development and production of diffused junction silicon zener diodes and rectifiers. Office and production facilities are at 248 Wells Fargo Ave., Scottsdale, Ariz.



Expanding the Frontiers of Space Technology in

COMPUTER DEVELOPMENT

Space Vehicle Command – An important advance in the control of space vehicles has been accomplished with the development by Lockheed scientists of space-borne, command decoders and sequence programmers. Basically, the programmers store information and, at a predetermined time when the vehicle is out of contact with ground stations, cause commands to be executed by the various subsystems. In this way, versatility of vehicle missions can be markedly expanded.

In addition, when the vehicle comes in range of ground command stations, the programmer can be given new instructions for either future or immediate action. All of the programmer's components are solid state devices. There are no moving parts nor vacuum tubes. The ferrite core memory in which information is stored is a two core-per-bit matrix.

A primary design goal was to reduce power requirements. Although the Lockheed programmer is highly complex and employs over 600 transistors, the average power consumption is only 3.5 watts, less than a Christmas tree light bulb. The development of such complex circuitry that will withstand the shock, vibration and a temperature range from −40°C to +85°C is in itself a significant achievement.

The highly precise timing necessary for the execution of the various programmed assignments is accomplished by means of a crystal oscillator – maintained at an exact temperature by means of a two phase mixture of solid and liquid inert chemical.

Engineers and Scientists: Lockheed's capability in design and development of computers is contributing to the advancement of the state of the art in a number of areas. Work is being carried on in research and development of ultra reliable digital circuitry, ferrite logic systems, and millimicrosecond switching techniques; radically new devices for pattern recognition operations; high speed digital plotters; self-organizing systems; large scale systems for the automatic storage and retrieval of information; microminiature packaging techniques; and systems research and engineering of large scale information handling complexes.

If you are experienced in work related to logical design or computer development, you are invited to inquire into the interesting work being conducted and planned at Lockheed. Write: Research and Development Staff, Dept. G-48, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed

MISSILES AND SPACE DIVISION

Systems Manager for the Navy POLARIS FBM;
the Air Force AGENA Satellite in the DISCOVERER,
MIDAS and SAMOS Programs; Air Force X-7 and Army KINGFISHER

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA
CAPE CANAVERAL, FLORIDA · ALAMOGORDO, NEW MEXICO · HAWAII

Industry News

Robert B. Stauffer has been appointed Training Director for the Mishawaka Div., of Bendix Corp. at Mishawaka, Ind.

Donald B. Sinclair, formerly Vice President and Chief Engineer of the General Radio Co., West Concord, Mass., has been appointed Executive Vice President and Technical Director. **Arthur E. Thiessen**, formerly Vice President, has been named Chairman of the Board. **Ivan G. Easton**, formerly Engineering Manager, was appointed Vice President for Engineering, and **Harold M. Wilson**, formerly Manufacturing Manager, was named Vice President for Manufacturing.

James E. Heywood, formerly with International Business Machines Corp., has joined Ford Motor Company's Aeronutronic Div., Newport Beach, Calif., as Assistant General Operations Manager of Computer Operations.

J. Heywood

A. Sonnenschein

Appointment of A. H. Sonnenschein as Director of Planning, Polarad Electronics Corp., Long Island City, N. Y., has been announced. He was formerly Chief Systems Engineer.

The Kearfott Div., General Precision, Inc., has announced appointments of three men to top posts in the concern's Gyrodynamics operation, they are: **Walter J. Krupick**, appointed General Manager; **William Supina**, named Manager and Chief Engineer of the Precision Gyro Dept.; and **John J. Daly**, named Manager and Chief Engineer of the Gyro Reference Dept., Gyro Dynamics.

Francis M. Ryan, former head of the Radio Section of the Headquarters Organization of the American Telephone & Telegraph Co., has been elected Vice President and Director of Engineering at Page Communications Engineers, Inc., Washington, D. C.

William C. Adams has joined the Lockheed Electronics Co., Plainfield, N. J., as Manager of the Computer Systems Div. of Information Technology.

Industry News

Clifford A. Lionbarger has been appointed Manager of Quality Assurance for Fairchild Semiconductor Corp.'s Diode Facility in San Rafael, Calif. He was formerly Manager of Quality Control in Charge of the Diode Manufacturing Quality Control Program at Hughes Products Co., Semiconductor Div.

C. J. Moore, former Sales and Marketing Manager of Exide Industrial Div., The Electric Storage Battery Co., Phila., Pa., has been promoted to Vice President—Marketing of the Division.

C. Moore

J. Manley

John P. Manley has been named Vice President and General Manager of the General Ceramics Div., Indiana General Corp., Valparaiso, Indiana. He had been Vice President of Sales. He will be responsible for operations at the Keasbey, N. J. Div.

Kenneth Young Knight is now Manager of the newly formed Manufacturing Services and Controls Dept. at Hughes Aircraft Co.'s Ground Systems Group, Culver City, Calif.

William W. Crossman is now Manager, and **Robert J. Martin** Sales Manager of Hitemp Inc., a newly formed subsidiary of Hitemp Wires Inc. The subsidiary is located in Monrovia, Calif.

Kenneth V. Tindall, has been appointed Systems Marketing Specialist for Data-Control Systems, Inc., Danbury, Conn. He was formerly Sales Manager for Arnoux Corp.

Donald J. Tricebock is now Vice President and General Manager of Advanced Ross Electronics Corp., Chicago. He was formerly Manager of the Electronics Div. of Diamond Power Specialty Corp.

The Ampex Data Products Co.'s Instrumentation Div., Redwood City, Calif., has announced three new appointments: **E. J. Keane** will serve as Manager of the Eastern region. **Joseph Hines** and **Herman Norwood** have respective positions as Federal Agency and Central Atlantic District Managers.

"Compactrons"

(*Continued from page* 81)

permitting adequate isolation of the plate from other electrodes in high-voltage operation. This isolation, with two "blank" pins on either side of the plate connection, provides an arc (high voltage) rating in the order of 10,000 volts D-C.

The use of an integral heater supplying as many as three separate cathodes eliminates four heater welds and translates to lower production costs and inherently greater reliability in the device. While the integral heater is not a new development, this is the first large-scale application where elements with three heater functions have been combined in one continuous unit.


General Electric Development Engineer, Earl Bond, plans typical layout for a small radio using new compactrons. Two of the devices replace five con-miniature electronic tubes. Case under his left hand shows how a compactron radio may look—virtually all speaker.

Some single-function compactrons for television will also be manufactured to replace conventional single-function tubes. This is because certain television functions have power requirements close to maximum limits, or operate under relatively high voltages. The advantage of single-function compactrons lies in their relatively smaller size compared to tubes—size reductions that enable equipment builders to offer smaller, more compact receivers.

Though compactron prices have not been established, the first ones

(*Continued on page* 204)

ELECTRONIC INDUSTRIES Advertisers — July 1960

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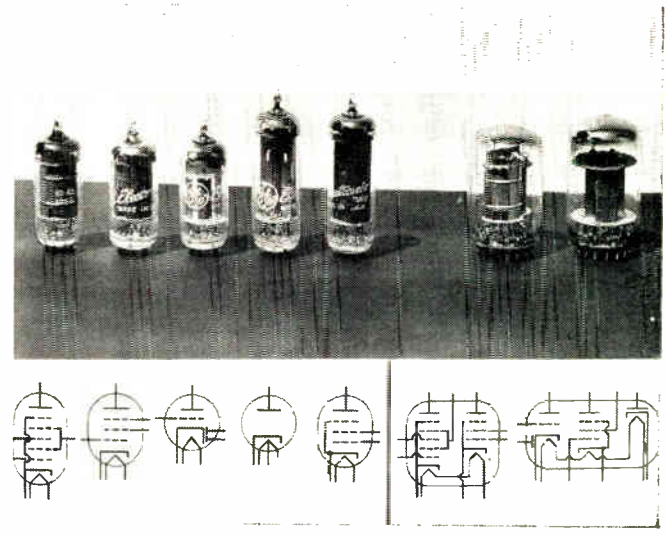


Two compactrons (right) replace five miniature tubes (left). Compactrons combine several electron tube functions in one tube.

"Compactrons"

will be slightly lower in cost than tubes. Eventually, savings in material and labor would bring compactron prices down 20% power per function than tubes and considerably lower than transistors.

To the consumer, the compactron will bring several advantages. according to General Electric:

1. More compact home-entertainment equipment, performing at efficiencies equal to the best now obtainable.
2. Availability of television sets using compactrons rather than tubes, and at prices lower than those now in effect. This lower cost would result from the multi-function capabilities of compactron, which reduce manufacturing and assembly costs.
3. Less-frequent failures and lower repair costs on home-entertainment electronic facilities, since fewer components are involved, and since those used would be operating at greater efficiency.

THE INTERNATIONAL AIR TRANSPORT ASSOCIATION is highly enthusiastic over the possibilities that Doppler radar will supply a self-contained dead reckoning aid for long distance navigation of jet aircraft which will make better use of air space in short flight times.

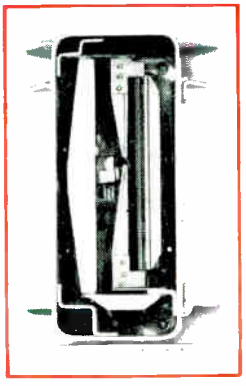
LIGHT COMMUNICATION is being investigated by ARDC's Wright Air Development Div. as a simple and economical system of communicating under specialized space conditions. The system works on the heliograph principle. The sun's rays will be collected, run through a modulator and the result light directed in the control beam to a receiver. There the wave will be put through a detector, transposed into a electrical impulse and amplified to a speaker. Either digital or voice messages can be sent. The most difficult operation will be lining up the transmitter and receiver. Several methods of solving this are being investigated. Light communication has considerable advantages over radio; it is simpler, less cumbersome and virtually jam-proof.

The most precise, sturdiest thermal relay ever built... best for missile applications

... from the leader in thermal relay design!

Now, for missile environments and for all applications where greater precision is necessary, G-V Controls offers the revolutionary new PT Thermal Relay—the most **precise** thermal relay ever built!

And the PT's **sturdiness** is unequalled in thermal relays. It withstands missile vibration and shock far better than any other thermal relay.



SPECIFICATIONS

Time Delay: 3 to 60 seconds (Factory Set)

Setting Tolerance: ±5% (±¼ sec. min.)

Temperature Compensation: Within ±5% over —65°C. to +125°C. range (±¼ sec. min.)

Heater Voltages: 6.3 to 115 v. for delays up to 12 sec.; 6.3 to 230 v. for longer delays.

Power Input: 4 watts. Rated for continuous energization at 125°C.

Contacts: SPST, normally open or normally closed. Rated 2 amps. resistive at 115 v. AC or 28 v. DC.

Insulation Resistance: 1,000 megohms

Dielectric Strength: 1000 v. RMS at sea level. 500 v. RMS at 70,000 ft.

Vibration: Operating or non-operating, 20 g up to 2000 cps

Shock: Operating or non-operating, 50 g for 11 milliseconds

Unidirectional Acceleration: 10 g in any direction changes delay by less than 5%, 50 g by less than 10% with proper orientation.

Weight: 2 to 2¼ ounces.

Write for Product Data Bulletin #PD-1015

G-V CONTROLS INC.
Livingston, New Jersey

G-V

Circle 139 on Inquiry Card

Communications

Instruments

Controls

Radar

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Missiles

Mobile Electronics

RCA's new family of ten INDUSTRIAL DRIFT FIELD TRANSISTORS

specifically matched to your design requirements . . . for superior high frequency performance—up to 50 Mc and above as rf amplifiers . . . up to 125 Mc and above as oscillators.

RCA now offers a comprehensive group of industrial drift field transistors specifically designed for industrial and military high-frequency communications, instrumentation, controls, navigation and mobile equipment.

These application-tailored types capable of operating up to 50 Mc and above in rf amplifier service and 125 Mc and above in oscillator service will permit a large safety factor in your equipment designs and assure long-term operating reliability. They feature a maximum junction temperature rating of 100°C; a maximum transistor dissipation rating of 120 Mw in free air at 25°C, and higher ratings with heat sink; and maximum collector-to-base voltage rating of −40v, except for the 2N1226 which has a −60v rating and is intended for those critical military and industrial applications requiring such a high voltage. Millions of RCA drift field transistors now in use are your proof that RCA drift field types are today's number one answer to the designer requiring top performance and reliability at low cost.

Call your RCA Field Representative now and ask him about RCA Industrial Drift Field Transistors with performance specifications tailored to your specific needs. For additional technical data, write RCA Commercial Engineering, Section, G-50-NN, Somerville, N. J.

1.5 MC 12.5 MC 30 MC 50 MC

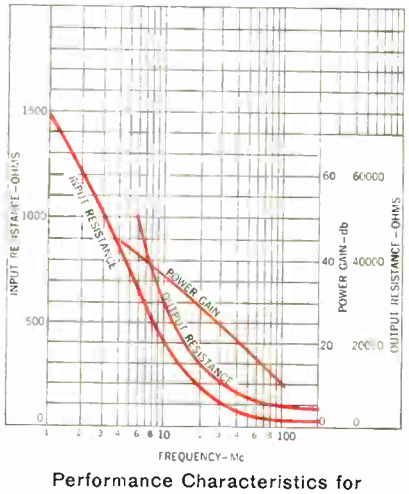
HIGH FREQUENCY AMPLIFIER PERFORMANCE

	RCA TYPE NUMBERS								
h_{fe} 20 to 175 (JEDEC TO-44)	2N1023			2N384			2N274		
h_{fe} 20 to 175 (JEDEC TO-33)	2N1066			2N1225			2N1224		
h_{fe} 50 to 175 (JEDEC TO-33)	2N1397			2N1396			2N1395		
50 Megacycles (sig. freq.) Common Base Circuit	Min.	Type	Max.	Min.	Type	Max.	Min.	Type	Max.
Power Gain (db)	18	21	24	15	18	21	—	—	—
Input Resistance (ohms)	—	25	—	—	30	—	—	—	—
Output Resistance (ohms)	—	8,000	—	—	5,000	—	—	—	—
30 Megacycles Common Emitter Circuit									
Power Gain (db)	20	23	26	16	20	24	—	—	—
Input Resistance (ohms)	—	100	—	—	50	—	—	—	—
Output Resistance (ohms)	—	8,000	—	—	5,000	—	—	—	—
12.5 Megacycles Common Emitter Circuit									
Power Gain (db)	—	—	—	24	28	32	17	22	27
Input Resistance (ohms)	—	—	—	—	250	—	—	150	—
Output Resistance (ohms)	—	—	—	—	16,000	—	—	4,000	—
1.5 Megacycles Common Emitter Circuit									
Power Gain (db)	—	—	—	—	—	—	40	45	50
Input Resistance (ohms)	—	—	—	—	—	—	—	1,350	—
Output Resistance (ohms)	—	—	—	—	—	—	—	70,000	—

2N1226—High Voltage Transistor for Video Amplifier and General Instrumentation Service is identical to 2N1224 except maximum collector-to-base and punch-through voltage rating 60v.

RCA Drift Field Transistors can be supplied to meet MIL-S-19500B specifications

Common-Emitter Circuit, Base Input.
Ambient Temperature = 25° C
DC Collector-to-Emitter Volts = −12.
DC Emitter Milliamperes = 1.5.



Performance Characteristics for Types 2N1023, 2N1066, 2N1397

ANOTHER WAY RCA SERVES YOU THROUGH ELECTRONICS

RADIO CORPORATION OF AMERICA

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East Central: 714 New Center Building, Detroit 2, Michigan, TRinity 5-5600 • Central: Suite 1154, Merchandise Mart Plaza, Chicago, Illinois
Whitehall 4-2900 • West: 6355 East Washington Boulevard, Los Angeles, California, RAymond 3-8361; 1838 El Camino Real, Burlingame, California, OXford 7-1620 • Southwest: 7905 Empire Freeway, Dallas 7, Texas, FLeetwood 2-8663 • Gov't: 224 N. Wilkinson Street, Daytan, Ohio, BAldwin 6-2366; 1725 "K" Street, N.W., Washington, D.C., FEderal 7-8500

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