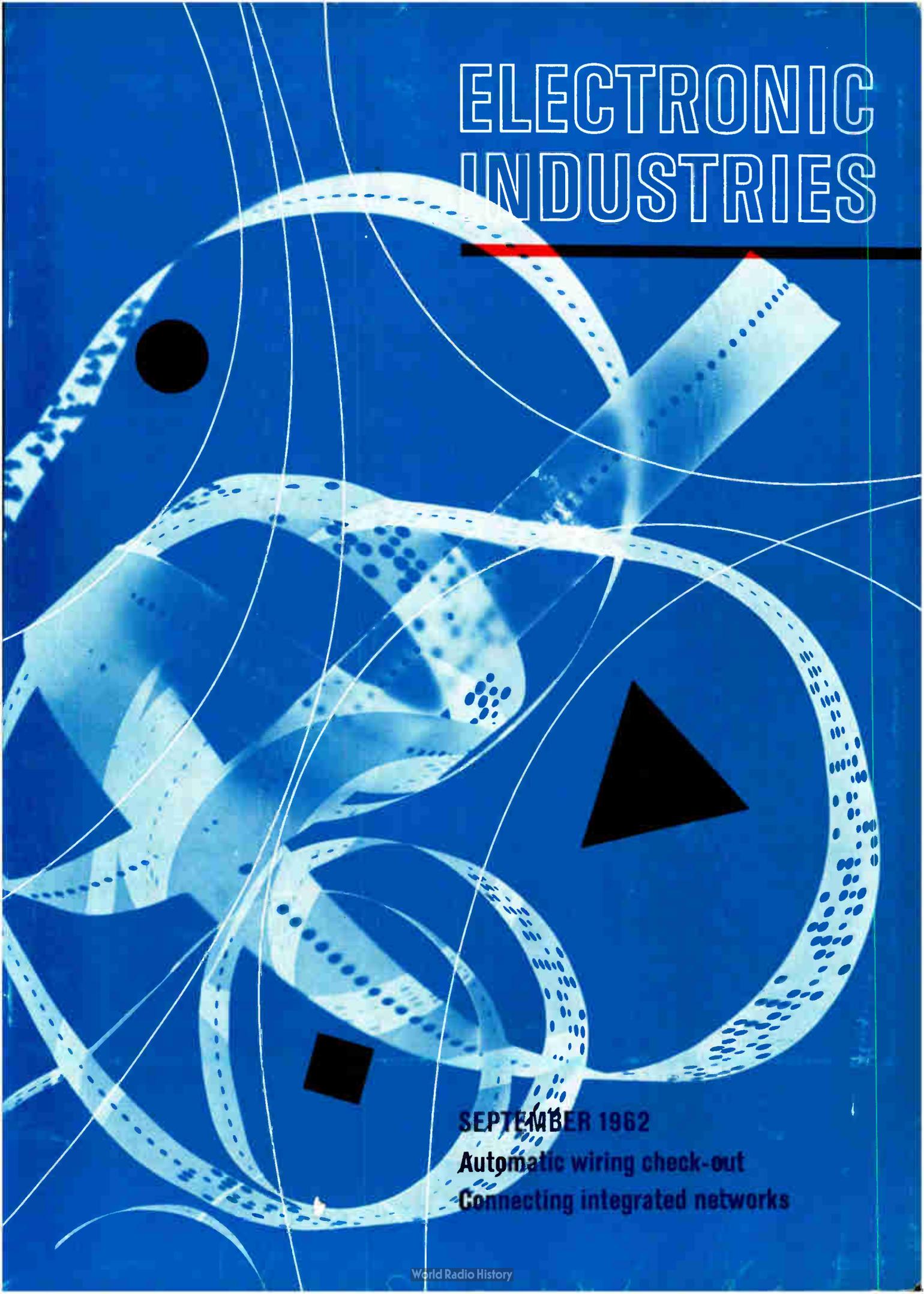


ELECTRONIC INDUSTRIES



SEPTEMBER 1962

Automatic wiring check-out
Connecting integrated networks



Reliability

Stability

Performance

RMC TYPE **JF** DISCAPS

- Characteristic frequency stability—superior to similar types.
- Working voltage rated at 1000 V. D. C.
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SHELBY A. McMILLION,
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ELECTRONIC INDUSTRIES

LAST MONTH, we gave you a preview of our "New Look" in the distinctively designed cover. This September issue is the first that has been completely redesigned, from cover to cover.

Lester Beall, one of this country's leading designers, has been working with us for more than six months. Our new styling represents the latest concepts in graphic arts. Some of the type faces are so new that they have been used only sparingly in the U. S. This issue marks their first use on a regular basis by a publication.

The general appearance of the magazine will seem more "open." Type sizes are larger, and there is more space between the lines. The individual characters of type, too, are more rounded and designed for easier reading.

Layouts are distinctive. Headlines are all capital letters, and white space is used liberally. Variety is achieved by the treatment of the illustrations, and by judicious use of color.

Columns of type are narrower, and not quite so long, improving readability.

Distinctive headings have been designed for all the departments in the magazine. These headings are con-

IT'S HERE...

sistent—a combination of large open letters and heavy rules—that provide continuity for editorial material. In time this unique treatment will come to be characteristic of ELECTRONIC INDUSTRIES.

We have taken a new departure in our cover designs as well. Using photograms as our basic presentation enables our cover designer to create a wide range of unusual treatments of technical subjects. The technique is subtle and sophisticated, in keeping with the increasing complexity of the electronic arts. The cover this month, for example, uses a few feet of paper tape to convey the theme of automatic control—automation.

From cover-to-cover ELECTRONIC INDUSTRIES will be aiming at quality—the finest technical articles, clearly and logically presented, and chosen for their value to the working electronic engineer.

DURING the past ten years the design of power supplies has become increasingly specialized and power supply manufacture has become an industry of its own. From very feeble beginnings, the field has now grown to more than 450 manufacturers.

Rather obviously, power supplies came into their own because of the needs of the industry—for higher stability, improved regulation, lower ripple and other sophisticated requirements. Advanced military systems and electronic computers are primarily responsible for creating these requirements.

We believe that engineers want to know more about specifying and buying these equipments, and for this reason we have made this the subject of an extensive editorial staff study. Managing Editor Jack Hickey and Assistant Editor Lou Gomolak have been in contact with leading manufacturers in the field, talking to

POWER SUPPLIES

the engineers who are designing power supplies. They will point out some of the common mistakes made in ordering units and in specifying the reasonable limits on supply performance. Leading authorities in the field have contributed significant data that will help the working engineer understand new developments in this field.

What our editors have found out in calling on some two dozen companies and in interviewing more than fifty engineers will be reported next month in "Power Supplies . . . Definitions to Design." We are sure you will be interested!

ELECTRONIC INDUSTRIES

Vol. 21 No. 9

September 1962



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HIGHLIGHTS

of this issue

Registering Thin-Film Memory Masks page 96

Present methods are inadequate to produce masks containing hundreds of fine lines 8 or 10 inches long which may be required to register with thousands of magnetic bits within a tolerance of a few ten-thousandths of an inch. Here are four ways to make masks to these registration tolerances.

Packaging and Interconnecting Integrated Networks page 100

As semiconductor Integrated networks become smaller, the problems of packaging and interconnecting these devices become major design considerations. The more important problems being faced are discussed and some suggested solutions evaluated.

Automatic Check-Out For Automated Wiring page 104

Complexity and reliability are demanding automated production. But accurate testing for quality control of machine-wired modules has been done manually—creating a bottleneck. Here's a system for high-speed quality control.

Analyzing Data By Least Squares page 110

Least squares is a very useful statistical method of analyzing data having a common factor. In describing the characteristics of gyros, potentiometers, and displacement transducers, it can determine the most probable true value of a common factor with a maximum of accuracy.

Gravitation . . . for the EE page 113

Satellites and ultraprecise measuring instruments have renewed interest in gravitational experiments—for better understanding . . . for possible control. Here's how to develop an intuitive picture of what is being done . . . without having to learn Einstein's General Relativity.

Electroless Copper Deposition page 117

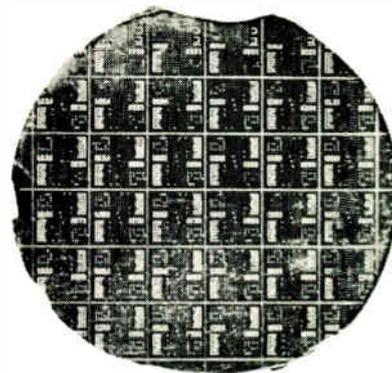
Two-sided printed circuits need reliable cross-overs. Electroplating provides this reliability, if the hole sides are first rendered conductive. Here's a way to make them conductive—and test results to prove it's good.

Ceramic Reduces Grid Emission page 120

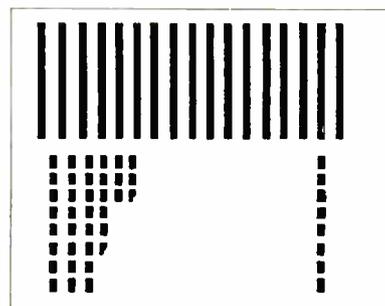
High power electron tubes are essential for many military applications. Often, output power is limited by grid emission. Ceramic grids offer one method of reducing this detrimental effect.

Measuring Coefficient of Friction page 126

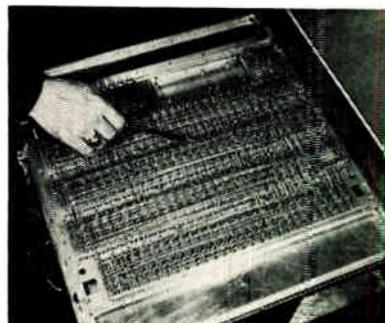
A dynamometer for continuously measuring the coefficient of friction between a test sample and a rotating drum is described. Also described are the principles of the instrument along with design information for related equipment.



Integrated Networks

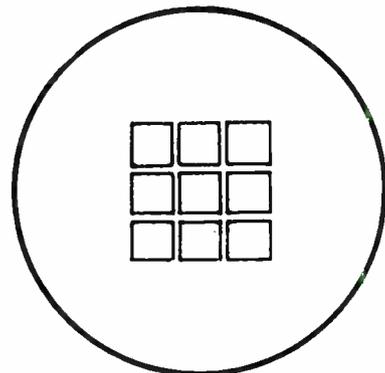


Thin-Film Memory Masks



Automatic Checkout

Ceramic Grid



RADARSCOPE

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



SUN-SEEKER

Goodyear engineer G. J. McKeel inspects a 6-oz. solar sensor developed by the firm for the Army. The sensor permits unattended operation of solar energy conversion power units by automatically directing solar cell panels toward the sun.

LASER POWER is said to be multiplied as much as 1,000 times through a new modulation technique developed by General Dynamics Corp. The laser is surrounded by a non-uniform magnetic field which forces it to store up its energy. When the field is removed the laser releases the stored up energy in a concentrated pulse many times more powerful than in a non-modulated discharge.

THIN-FILM intermediate frequency amplifier, believed to be the first successful linear integrated circuit, has been developed by G.E. It represents a successful departure from using thin-film integrated electronic techniques for digital circuits only. Company spokesmen foresee linear integrated circuits being used increasingly in space guidance, navigation and communication applications because of weight, size and reliability advantages.

FREQUENCY SPACE allocated for airline telephone is being criticized as much too narrow. However, the airline industry is going ahead, urging the Airline Electronic Engineering Committee to develop an Equipment Characteristic describing the air-borne equipment.

NEW TECHNIQUES of fetal electrocardiography that determine the existence of congenital cardiac malformation in unborn infants has opened up exciting new possibilities in heart research.

ELECTRICAL ENGINEERING is in a state of crisis because of its increasing emphasis on scientific theory and corresponding decreasing emphasis on background knowledge of "ordinary things, materials, facts and principles." This warning was voiced to the AIEE Education Committee from University of Michigan Professor A. D. Moore. Simple lab demonstration equipment should be developed, he said, to present the simplest principles of electronics and physics. Experimentation should be encouraged, he said, and the chief encouragement will come from being exposed to simple, easily understood, experiments.

ANTI-SUB MISSILE

ASROC launcher, shown installed on the destroyer leader Norfolk (DL-1) is one of many already delivered to the Navy by Unidynamics Div., Universal Match Corp. The launchers aim and fire the ASROC missiles, which carry torpedoes or depth charges to destroy submarines.



EXPORTS OF ELECTRONIC PRODUCTS

from the United Kingdom to the U. S. reached a record total of \$22.3 million in 1961, a 14% advance from 1960. Exports of record playing mechanisms accounted for 49% of the total. These increased by 34% while exports of record players, radios, and radio-phonographs dropped sharply. United Kingdom electronic exports to all countries in 1961 totaled \$193.6 million, a 19% increase over 1960. The United States was the largest single market followed by Netherlands, Canada, West Germany, Australia, Italy, Sweden, and France.

MAGNETICALLY TUNABLE FILTER has been developed at Stanford Research Institute, using an yttrium-iron-garnet crystal. SRI electronics engineer, P. S. Carter, said the device uses a 1/16-in. diameter sphere of the material. The essential property of the filter is that the frequency at which it resonates is almost directly proportional to the strength of a direct current magnetic field directed across it. A microwave filter with an yttrium-iron-garnet resonator in it can be tuned or scanned for the right transmitter wavelength, over wide bands as large as 2-1 ratio, simply by varying the magnetic field.

SMALL BUSINESS ADMINISTRATION points to savings to the government of \$4.5 million and employment for about 1,360 workers resulting from certificates of competency issued by SBA during the past fiscal year. The agency issued 292 certificates covering contracts valued at \$71.2 million to low-bidding small firms. SBA certificates of competency are issued to low-bidding small companies to attest to their ability to perform certain defense contracts.

NEW GALLIUM ARSENIDE DIODE has been developed at MIT which converts modulated electric current directly into modulated light beams. An experimental model has successfully transmitted a high quality television picture over a distance of 275 feet. The researchers see no reason why the devices cannot transmit for 30 miles. Commenting on possible applications, the Lincoln Lab scientists said the new device makes possible "early realization" of many uses originally proposed for the laser.

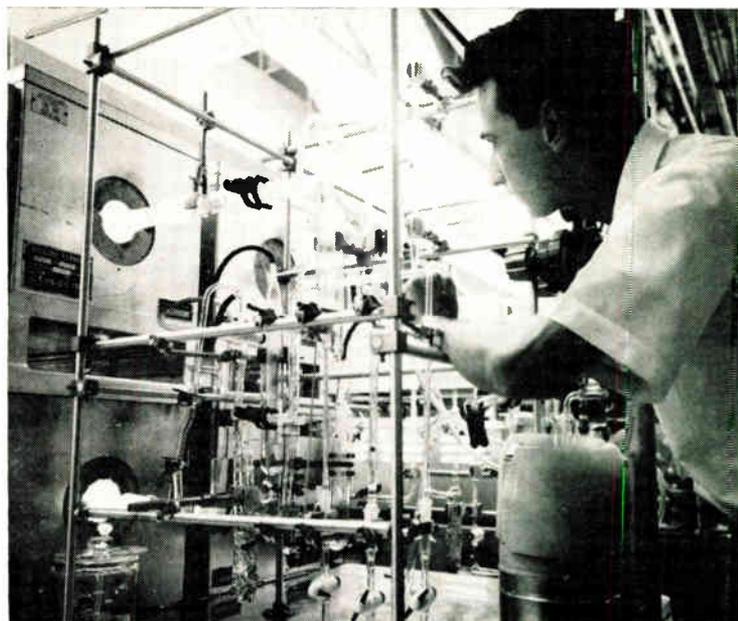
THE AEROSPACE INDUSTRY is expected to have more engineers and technicians than production workers in 1970. During World War II 9 out of 10 industry employees were production workers. A recent survey estimates that at the turn of the decade only 29% of the work force will be production workers while 32% will be technicians.

SATELLITE TELECASTING directly to home TV receivers has been studied by various agencies, with different conclusions. RCA scientists have completed five separate studies which reportedly showed that telecasting from space satellites is highly feasible. But NASA-financed study undertaken by Stanford Research Institute concluded that direct space casting was "extravagant, unnecessary and virtually impossible."

SRI sentiments agreed generally with the statement by FCC commissioner Craven that satellites' only near-future TV value was in the field of relaying to and from ground station broadcast centers. It seems unlikely that however, space telecast is developed, there will be any direct transmission to homes. The problems of differing time zones, language channel assignments, and the enormous power needed for transmission seem to rule out direct telecasting in the foreseeable future.

SEMICONDUCTOR MANUFACTURING

Bank of diffusion furnaces is a critical factor in the manufacture of planar transistors and diodes at Sperry Semiconductor Div., Norwalk, Conn. The planar production process is a "batch" process and differs from previous manufacturing techniques in which each semiconductor device is tailor-made.



AS WE GO TO PRESS

IEEE HEAD



Donald G. Fink, Director of Philco Science Labs, has been named General Manager of the Inst. of Electrical and Electronic Engineers. The IEEE will be formed when the IRE-AIEE merger is effected Jan. 1. The new society will have 160,000 members, will be world's largest engineering society.

NEW FAA RADAR SERVICE

An expanded terminal radar service to segregate aircraft controlled from uncontrolled aircraft will be offered by the FAA for the first time at Atlanta, Ga. It begins Nov. 15. Such separation is a major recommendation of the FAA's Project Beacon for improving air traffic control.

Aircraft under visual and instrument flight rules will be controlled in an airspace from 2,000 to 6,000 ft. within 15 miles of the Atlanta Airport. This allows enough room below the space for non-participating aircraft. Expanded control facilities and FAA research make the service possible.

POSSIBLE 'RADIO BLACKOUTS' INVESTIGATED

Army scientists at Fort Monmouth, N. J., have created a flashing column of "plasma." They are beaming radio signals through it to explore a communications problem that may plague inter-planetary space ships of the future.

Plasma is difficult to produce in high concentrations on earth. It makes up 99.9% of the substance in the universe. It can distort and block radio waves—even cause a radio blackout that could isolate a space ship from communicating with civilization for extended periods.

An eight-foot-tall condenser bank that delivers a 10,000,000 amp jolt of electricity that lasts for a millionth of a second is used to create high-concentration, high-temperature plasma for the experiments.

The experiments not only give valuable information on communications phenomena, but also give new basic knowledge about the structure of plasma, and how it forms and decays.

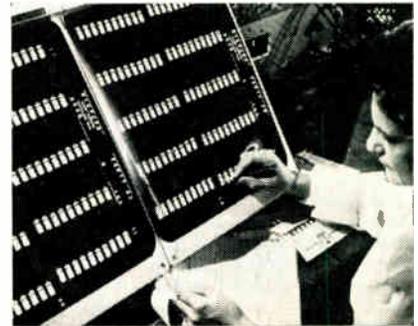
MISSILE RADAR TO BE UPDATED

Sperry Gyroscope Co., Great Neck, N. Y., has announced that the Navy has awarded it a \$3-million contract to update Talos missile radars. Sperry will improve SPG-49 radar receivers with equipment developed since the original design was completed. Talos is the Navy's shipboard guided missile for long range air defense.

OPTICAL 'WORKHORSE'

This Itek Space Tracking Telescope showed TV viewers close-ups of Astronaut Scott Carpenter's "Friendship 7" up to 70 miles into space. The 240-in. focal length, all-mirror telescope is highly mobile, has been airlifted many places to spot objects in space. At Atlantic Missile Range they call it an optical "workhorse."

CAPACITOR CHECK



Technician at Union Carbide's plant in Cleveland, Ohio, reads X-ray plates for some of the 36 different types of solid tantalum capacitors made specifically for the "TEL-STAR" satellite. Each of the capacitors was X-rayed twice. A record was kept of the measurements of the characteristics of each capacitor over a range of environmental conditions.

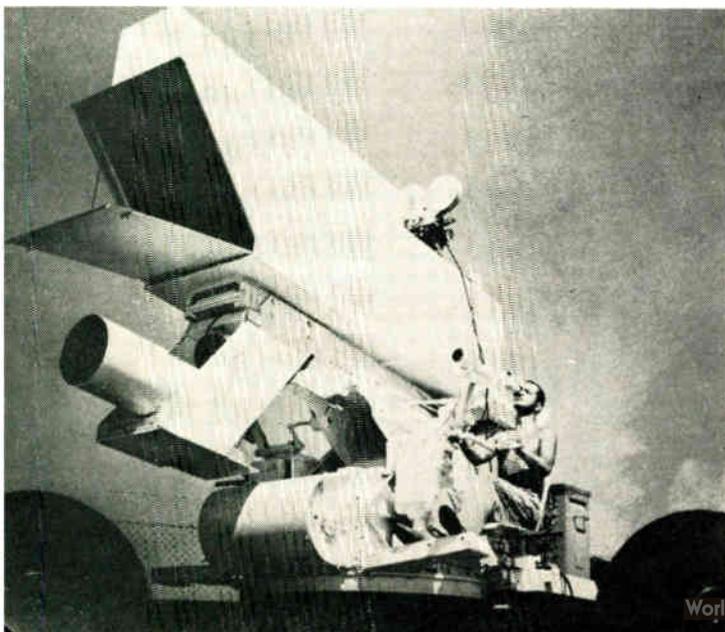
NEW NERVOUS SYSTEM THEORY IS PROPOSED

A new theory of the nervous system has been proposed by Victor H. Fischer of Battelle Memorial Institute and Dr. Paul W. Watkins, staff psychiatrist of Columbus (Ohio) State Hospital.

It is the theory of Fischer and Watkins that information is transferred, integrated, and selected in the central nervous system—much like an FM radio transmitter and receiver. Present theories rest on the assumption that the electrical current in the nervous system performs its functions by variations in the level of the signal, that is to say, amplitude modulation (AM).

Under the sponsorship of the State of Ohio's Div. of Mental Hygiene, the Columbus scientists conducted studies with an FM version of an electroencephalograph. The standard electroencephalograph is an instrument used to record electrical signals from the various areas of the brain. The new device, called a hyper frequency electroencephalograph (hyfreeg), was used to record the brain's electrical signals from 100 mental patients. As compared with the standard instrument, the hyfreeg equipment produced a type of data that provided much more information about the mental activity of the subject.

More News on Page 11



Capacitors for Power Supplies (and other applications requiring extremely large values of capacitance)

WHICH DO YOU NEED -- FINE...or... SUPERFINE?



POWERLYTIC® CAPACITORS for 65 C Operation

With metal cases ranging from 1 1/8" diameter x 2 1/8" long to 3" diameter x 4 1/4" long, Type 36D capacitors pack the highest capacitance values available in these physical sizes. Their maximum capacitance values range from 150,000 μ F at 3 volts to 1000 μ F at 450 volts.



COMPULYTIC® CAPACITORS for 85 C Operation

The Type 32D Series offers the ultimate in reliable long-life electrolytic capacitors for computer service. With case sizes similar to those of Type 36D, these higher-temperature units have maximum capacitance values ranging from 130,000 μ F at 2.5 volts to 630 μ F at 450 volts.

Both Powerlytics and Compulytics have all of the qualities you expect from Sprague electrolytic capacitors—low equivalent series resistance, low leakage currents, excellent shelf life, and high ripple current capability. They are available with tapped terminal inserts, often preferred for strap or bus bar connections, as well as solder lugs for use with permanently wired connections.



Popular ratings of Type 36D Powerlytics are now available for fast delivery from your Sprague Industrial Distributor.

For complete technical data on Type 36D Powerlytics, write for Engineering Bulletin 3431. For the full story on "blue ribbon" Type 32D Compulytics, write for Bulletin 3441B to the Technical Literature Section, Sprague Electric Company, 233 Marshall St., North Adams, Mass.

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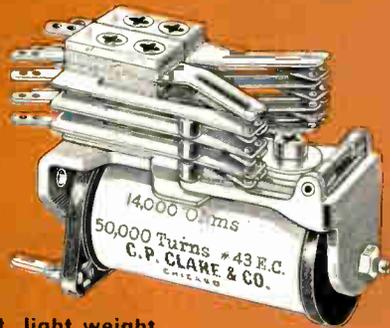
ELECTRIC WAVE FILTERS

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THE MARK OF RELIABILITY

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Specifically engineered for each application

CLARE TYPE J RELAYS



Clare originated the compact, light weight telephone-type relay...and has supplied over 10,000,000 for exacting users.

customized for optimum reliability!

You get exactly the telephone-type relays you need—precisely adjusted, and 100% tested for adjustment, dielectric strength and operating characteristics...when you specify the *original* compact industrial telephone-type relay.

For applications which require a conventional telephone-type relay, the CLARE Type J offers a versatility of performance and flexibility of installation that meet the requirements of the widest variety of industrial designs.

Contact failure is precluded by the use of independent twin contacts. Stable operation and adjustment are maintained by the largest possible armature bearing surface. Fine adjustment is also aided by an extremely rigid heel-piece. Tests (discontinued after 70,000,000 operations) showed no contact failure whatsoever.

For more complete information write or call C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Illinois. Cable Address: CLARELAY. In Canada: C. P. Clare Canada Ltd., 840 Caledonia Road, Toronto 19, Ontario. In Europe: Europelec, Les Clayes-sous-Bols (S.et O.) France.

FAST OPERATE FAST RELEASE LONG LIFE

Standard coils provide fast operate and fast release:

Operate: 5 to 60 ms
Release: 5 to 125 ms

Power Type J Relays—
Heavy-duty contacts riveted to springs. $\frac{3}{16}$ " diameter (silver). Rated current-carrying capacity: 7 amperes, 28 vdc. or 110 vac.

Type J Video relays for switching video and other high-frequency currents.

C. P. CLARE & CO.

Relays and related control components

AS WE GO TO PRESS

PERSONAL SHIELDS TERMED BEST FOR LUNAR FLIGHT

Personal shielding around each astronaut on a lunar mission is needed to give adequate radiation protection from solar flares—and at the same time keep the space vehicle's weight unexcessive—a GE space expert recently stated.

Dr. George R. Arthur told a meeting of the Institute of Aerospace Sciences in Los Angeles that adequate radiation shielding for a Project Apollo spacecraft would add 3,500 lbs. He contrasted this with 1,200 lbs. which he said would be added by personal shielding for the three man crew.

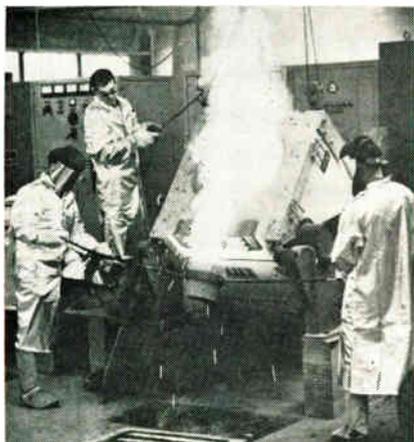
Dr. Arthur said the 3,500 lb. load would make it impossible for the rocket booster to perform the desired functions.

COMPUTER SHARING PLAN

An experimental plan for sharing computer equipment has been instituted among Federal Government agencies in the Philadelphia, Pa., area. It was developed by the Bureau of the Budget, assisted by other government agencies.

Under the plan the Post Office is operating an area computer sharing exchange. This exchange expedites the sharing by enabling the 65 Federal agencies in the area to register their computer needs and resources.

MELTING FURNACE



Electronically-controlled melting furnace is a feature of new Cleveland casting plant of Arwood Corp. Several such furnaces installed at plant, the company's sixth, facilitates production of ceramic shell castings larger than those produced by any other plant.

(Continued on page 11)

ELECTRONIC SHORTS

■ Engineers of the Sperry Gyroscope Co., Great Neck, N. Y., have demonstrated the feasibility of a laser doppler radar that can detect and measure motion 10,000 times more accurately than the best microwave systems. A working laboratory model using a movable mirror as a target has shown that a radar can measure velocity with equal and absolute precision from orbital injection speeds of five mi/sec. down to less than one ten-thousandth of an in./sec.

■ Three firms, Aeronutronic Div. of Ford Motor Co., General Dynamics/Astronautics, and Lockheed Missiles and Space Co., have been awarded contracts by NASA to carry out studies of early manned planetary exploration. The studies, known as EMPIRE (Early Manned Planetary-Interplanetary Roundtrip Experiment) will last six months. Lockheed and Ford will investigate Mars "fly-by" missions, while General Dynamics will study a Mars orbiting mission.

■ The communications network linking Turkey, Iran and Pakistan will be completed by Television Associates of Indiana, Inc., Michigan City, Ind. Work will be done under a contract awarded by the State Dept.'s Agency for International Development (AID). Known as the CENTO Regional Telecommunications Project, the 600-channel system will be the longest contiguous microwave network in the world. The system is part of the economic program of the Central Treaty Organization. It will link Ankara, Teheran and Karachi.

■ USAF has contracted U. S. Sonics Corp., Cambridge, Mass., to build an experimental Acoustic Energy Converter capable of transforming the sound of jet engines into electricity that can be directly used by the jet aircraft. In their final form these converters will be able to produce enough electricity to service the entire electrical system of a four-engine jet.

■ A \$3,100,000 contract for the design and production of transportable communications systems has been awarded Adler Electronics, Inc., New Rochelle, N. Y., by the USAF. Known by the code name of "Project Highball" these high frequency, single sideband systems are compatible with the Air Force's Global Aircom Communications Network.

■ A nuclear-energy-operated gyroscope, with greater long-time accuracy than conventional models, is under development by Republic Aviation Corp., Farmingdale, N. Y. Called a magnetic induction gyroscope, the new gyro will not have any moving parts. Instead it will employ spinning protons and electrons, aligned by a magnetic field. It is expected to have a drift rate lower than that of the best existing gyros, and its design will eliminate the complexity and fabrication precision required of mechanical gyroscopes.

■ General Dynamics/Electronics, San Diego, Calif., has designed a radar using lightweight materials so that the entire system can be flown or floated into battlefield positions easily. It has a 300-mile detection range and is contained in two watertight packages of 3,500-lbs. each. It can be assembled in two hours. Assembly under tactical conditions is aided by such features as sequential unloading, "braille" part identification and minimum tool requirements.

■ A solid-state photomixer diode that can demodulate laser outputs has been introduced by the Philco Corp., Lansdale, Pa. The device, designated L-4500, is a silicon planar epitaxial diode that detects the difference frequency between two closely spaced optical laser frequencies. The L-4500 provides high quantum efficiency, and operates for information bandwidths up to 5 KMC. Its quantum efficiency is estimated at a minimum of 65% (typical performance 85%) at 7,000 angstroms.

■ R & D work on spacecraft thermal radiation guides for power transmission will be conducted by Electro-Optical Systems, Inc., Pasadena, Calif., for the USAF. Transmission of radiant energy through tubes with highly reflective internal walls will be investigated. By this technique the energy can be transmitted directly to thermal consuming devices such as ion engine emitters or electron tube cathodes. Successful adaptation of this technique would avoid the complexity and inefficiency of converting heat into electricity to perform this function.

New from Sprague!

2 x μ F

Get nearly twice the capacitance of older designs in Sprague's new high-gain etched-foil TANTALEX[®] Capacitors

IMPROVE FILTERING EFFICIENCY WITH NO SACRIFICE IN RELIABILITY, SIZE, OR WEIGHT!

HIGH CAPACITANCE Tubular Tantalex Capacitors with almost double the capacitance of standard etched-foil tantalum capacitors have been developed by the Sprague Electric Company to meet the needs of design engineers.

A new etching technique, the result of an intensive research program, gives considerably higher effective surface area to the capacitor electrodes *without sacrifice in reliability or in any of the electrical parameters* by which foil tantalum capacitors are usually judged.

Unlike other "high capacitance" foil tantalums, Sprague Tantalex Capacitors continue to maintain their rigid standards for shelf and service life under severe environmental conditions. Certain performance characteristics have actually been tightened. For example, allowable leakage current has now been halved, making the use of these capacitors possible in many new applications.

Etched-foil Tantalex Capacitors are available in two operating temperature ranges—polarized Type 112D and non-polarized Type 113D for -55 C to $+85\text{ C}$ operation, as well as polarized Type 122D and non-polarized Type 123D for -55 C to $+125\text{ C}$ operation.

The Foil-type Tantalex Capacitor Line also includes conventional low-gain etched-foil and plain-foil capacitors in both polarized and non-polarized construction, providing a foil tantalum capacitor for every application.



For complete technical data on 85 C capacitors, request Engineering Bulletin 3601B. For the full story on capacitors for 125 C operation, write for Engineering Bulletin 3602B. Address Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

SPRAGUE COMPONENTS

CAPACITORS
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CERAMIC-BASE PRINTED NETWORKS
PACKAGED COMPONENT ASSEMBLIES
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ELECTRIC WAVE FILTERS



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48-602

Circle 4 on Inquiry Card

ELECTRONIC INDUSTRIES • September 1962

World Radio History

SOVIETS OPPOSE U. S. SATELLITE FREQUENCY PLAN

The problem of allocating frequencies for global satellite communications, made a practical one by the advent of America's Telstar, has become another bone of contention between the United States and Soviet Union.

Both nations are trying to influence members of the International Telecommunications Union, the body which controls such matters, in favor of their respective and opposing plans.

This 113-member body will meet in Geneva in the Fall of 1963 to take up the whole problem of determining satellite frequencies.

The U. S. plan would set aside almost 3,000 MC for satellite communications. The Russians, who have not yet entered the space communications field, would allocate only 950 MC for this purpose.

In devising their plan, the Soviets have included frequencies which "accidentally" fall within bands presently used by U. S. military radar.

World nations outside the Communist bloc have generally favored the U. S. proposal. Some, however, have questioned setting aside so much of the radio spectrum for this use.

One reason for this is that the U. S. Defense Dept. is developing its own satellites. Some countries object to setting aside the 3,000 MC asked by the U. S. when part of it would be used by the U. S. military.

Under the U. S. plan the following frequencies would be set aside: 3,700 to 4,200 and 5,925 to 8,400 MC. These bands would be shared with ground microwave systems, except for two small portions: 7,650 to 7,700 and 8,350 to 8,400 MC. The Soviets would set aside the following bands: 3,550 to 3,650, 4,350 to 4,700 and 5,670 to 6,170 MC.

U. S. and Soviet scientists agree on one thing: that there can be sharing of frequencies by communications satellites and ground microwave point-to-point radio and telephone systems. A radio-quiet area would be needed around the ground receiving stations for the satellites.

International agreement is needed, however, to prevent frequencies assigned satellites from being used for such other purposes as high-powered radar and tropospheric scatter communications.

AIRBORNE ANALYZER HELPS LAUNCH X-15

Minneapolis - Honeywell Regulator Co. has developed an airborne analyzer to check out the self adaptive flight control system in the X-15 just prior to its launch from the B-52 mother aircraft.



Final GO-NO-GO check of the X-15's adaptive control system is accomplished by this airborne automatic checkout equipment.

The analyzer is used as a final GO-NO-GO check of the control system. It is programmed to perform 77 tests in 3½ min. including checks of the fixed gain, variable gain, redundant channels, fail safe, hold modes, trim and reaction control functions.

Mounted in the B-52, the analyzer is connected to the X-15 through an umbilical cable 150 ft. long and containing 110 leads. Checkout is controlled from the B-52.

SPACE VEHICLE HEAT SOURCE TO BE BUILT

An experimental five-foot diameter parabolic solar concentrator or mirror will be built by Fairchild Stratos Corp., Hagerstown, Md., for NASA.

Aim of the project is to produce a concentrator capable of efficient solar energy reflection and concentration for use as a heat source in solar thermionic power systems for space vehicles. Such a system requires a lightweight reflector having high optical accuracy which must be maintained under all the rigors of launching and space flight.

The concentrator will be built as an adhesive bonded aluminum honeycomb structure, using specialized, precision manufacturing and tooling methods.

HIGH-SPEED CAMERA USED

A camera which shoots 4,000 frames/sec. is used by Aerojet General scientists to monitor rocket engine test firings. The experts then show the film at 24 frames/sec. so they can study engine performances in detail.

AS WE GO TO PRESS

ELECTRIC ENGINES TERMED BEST FOR SPACE PROPULSION

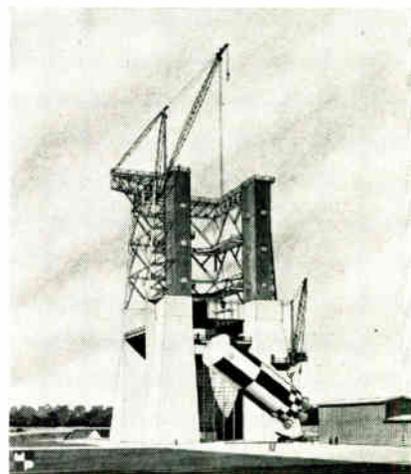
Spacecraft weighing hundreds of tons will probably be propelled by electric engines generating a few lbs. of thrust, stated a GE propulsion expert recently at a meeting of the Institute of Aerospace Sciences in Los Angeles.

The predictor was Arnold D. Cohen, of GE's Missile and Space Vehicle Dept. He claimed electric propulsion engines will exceed high-thrust chemical or nuclear rockets in ability to transport high tonnages to Mars and beyond. This would occur once spacecraft have been placed in earth orbit by conventional rocket systems.

A 14,000 lb. payload—earth-orbited by a Saturn C-1—could be sent up to Mars by an electric engine, while a chemical rocket could deliver only a 7,000 lb. payload. A nuclear rocket would be less desirable for this class of spacecraft, Cohen said.

The inherent advantage of the electric rocket is its very low fuel consumption. Electrical energy and magnetic energy are used to break up the atoms of a gas and hurl the resulting particles to develop thrust. Conventional rockets develop much higher thrust but they do not achieve nearly as much thrust-per-lb. of stored fuel.

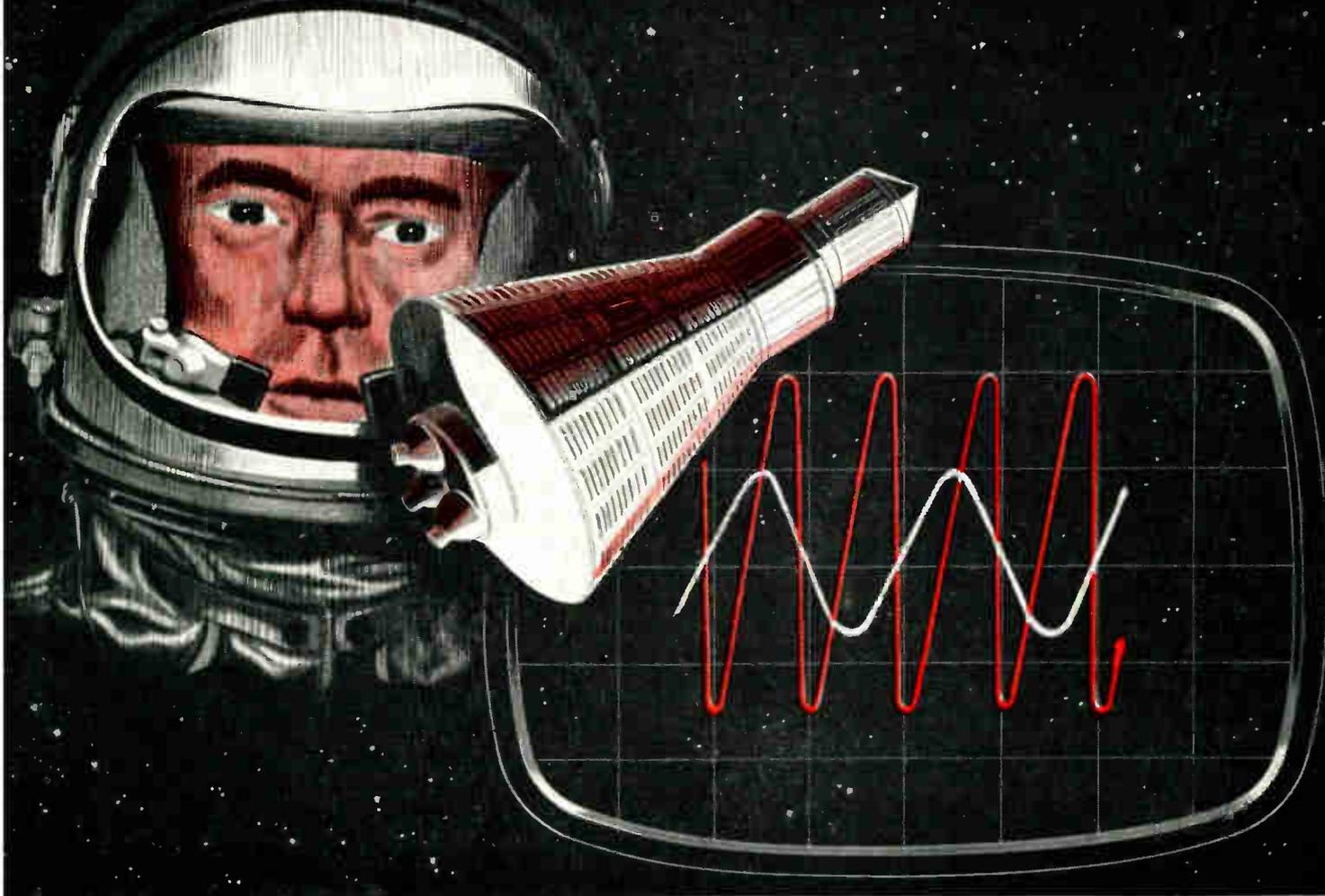
STATIC TEST TOWER



Artist's drawing of huge test tower to be built at NASA Marshall Space Flight Center, Huntsville, Ala. It is for captive-firing Saturn C-5 rocket booster and must withstand 7.5 million lbs. thrust. Tower will be 450 ft. high (with crane), 160 ft. sq. at base.

More News on Page 23

STEVENS *Certified* THERMOSTATS



*for electronic and aerospace applications**

If Space is your dimension, take the measure of Stevens *Certified* Thermostats. For in hostile aerospace environments, you can't take a chance on Reliability.

Since Stevens makes the broadest line of bimetal thermostats in the industry, you can get all the special features to fit your special requirements *exactly* right from a *proven*, standard production-line Stemco thermostat, or from a minor modification thereof. This also gets your product off the ground faster . . . by cutting lead time . . . by slashing engineering and development costs.

If reliability, weight, smaller size and cost are considerations, there's only the Stevens *Certified* Thermostat line to consider. Start the countdown sooner by putting us in your supplier orbit.

**Above Stemco Thermostats are designed and manufactured to meet most requirements of applicable MIL specifications.*



Type MX Hermetic

Snap-acting to open on temperature rise only. Highly responsive copper housing. Standard tolerance $\pm 3^\circ\text{F}$ with 2 to 6 $^\circ\text{F}$ differentials; 1 to 4 $^\circ\text{F}$ differentials on special order. Temperature 10 $^\circ$ to 260 $^\circ\text{F}$. Various terminals and mounting brackets. See Bulletin 6100.



Type AX Hermetic

Similar to Type MX but to close on temperature rise. Wide selection of terminals and mounting provisions, highly responsive brass housing, 2 $^\circ$ to 6 $^\circ\text{F}$ differential. Bulletin 3200.



Type C Hermetic

Field-adjustable, positive-acting. Electrically independent bimetal strip type for operation from -10 $^\circ$ to 300 $^\circ\text{F}$. Also supplied as double thermostat 'alarm' type. Turret terminals or wireleads. For ratings, etc., Bulletin 5000.



Type A Hermetic

Electrically independent bimetal disc and high-response brass case for quick, snap-action control from -10 $^\circ$ to 300 $^\circ\text{F}$. Various enclosures, terminal arrangements and mounting provisions, including brackets. Bulletin 3000.

A-7192A

STEVENS manufacturing company, inc.
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THERMOSTATS

COMING EVENTS

...in the electronic industry

SEPTEMBER

- Sept. 16-20: **Electrochemical Soc. Mtg.;** Statler-Hilton Hotel, Boston, Mass.
- Sept. 17-18: **Hydrofoil & Air Cushion Vehicles Mtg.,** IAS; Shoreham Hotel, Washington, D. C.
- Sept. 18-19: **"Rectifiers in Industry,"** 3rd Quintennial Industry-wide Mtg., Industrial Power & Semiconductor Rectifier Committees, AIEE; Deshler-Hilton Hotel, Columbus, Ohio.
- Sept. 18-20: **Ordnance Environmental Rsrch. Symp. (unclass.),** Environmental Rsrch. Ofc., Chief of Ordnance, U. S. Army; El Tropicano Hotel, San Antonio, Tex.
- Sept. 19-20: **11th Annual Joint Ind. Electronics Symp.,** IRE (PGIE), AIEE, ISA; Sheraton-Chicago Hotel, Chicago, Ill.
- Sept. 19-21: **6th Nat'l Conf. on Tube Techniques,** Advisory Grp. on Electron Devices, Ofc. of Defense Rsrch. & Eng., Dept. of Def.; Western Union Audit., New York, N. Y.
- Sept. 24-26: **Nat'l Power Conf.,** ASME, AIEE; Lord Baltimore Hotel, Baltimore, Md.
- Sept. 25-28: **Space Power Systems Conf.,** ARS; Miramar Hotel, Santa Monica, Calif.
- Sept. 25-28: **1962 Iron & Steel Conv. & Exp. (Computer Control of Steel-making Operations),** AISE; Cleveland Public Audit., Cleveland, Ohio.
- Sept. 26-27: **Symp. on Physics of Failure in Electronics,** USAF, ARF; Ill. Inst. Tech., Chicago, Ill.
- Sept. 26-29: **Fall Mtg.,** Materials, Eqpt. & White Wares Divs., ACS; Bedford Sprgs. Hotel, Bedford, Pa.
- Sept. 28-29: **12th Annual Broadcast Symp.,** IRE (PGB); Willard Hotel, Washington, D. C.
- Sept. 30-Oct. 5: **4th Pacific Area Nat'l Mtg.,** ASTM; Statler-Hilton Hotel, Los Angeles, Calif.

OCTOBER

- Oct. 1-2: **Annual Mtg. Engrs. Council for Prof. Develop.;** Bellevue-Stratford Hotel, Philadelphia, Pa.
- Oct. 1-3: **8th Nat'l Communications Symp.,** IRE (PGCS); Municipal Audit. & Hotel Utica, Utica, N. Y.
- Oct. 1-4: **Nat'l. Fall Mtg.,** AWS; Hotel Schroeder, Milwaukee, Wisc.
- Oct. 1-5: **West Coast Testing Exh. & 4th Pacific Area Nat'l. Mtg.,** ASTM; Statler-Hilton Hotel, Los Angeles, Calif.
- Oct. 1-5: **Northeast Commerce & Ind. Exp.,** U. S. & Mass. Depts. of Commerce, 11 Northeast & Middle Atlantic states; Commonwealth Armory, Boston, Mass.
- Oct. 1-5: **Semiannual Western Eng. Conf. & Tool Exp.,** ASTM; Pan Pa-

- cific Audit., Los Angeles, Calif.
- Oct. 2-4: **Nat'l. Symp. on Space Electronics & Telemetry,** IRE (PGSET); Fountainebleau Hotel, Miami Beach, Fla.
- Oct. 3-6: **Annual Mtg.,** OSA; Manger Hotel, Rochester, N. Y.
- Oct. 4-5: **Joint Solid Fuels Conf.,** ASME, AIME; Penn-Sheraton Hotel, Pittsburgh, Pa.
- Oct. 4-6: **Refractories Div. Fall Mtg.,** ACS; Bedford Sprgs. Hotel, Bedford, Pa.
- Oct. 7-9: **Basic Science Div. Fall Mtg.,** ACS; Battelle Mem. Inst., Columbus, Ohio.
- Oct. 7-12: **1962 Fall Gen'l. Mtg.,** AIEE; Pick-Congress Hotel, Chicago, Ill.
- Oct. 8-10: **18th Annual Nat'l. Electronics Conf. & Exh.,** IRE, AIEE, Ill. Inst. Tech., Northwestern Univ., Univ. of Ill.; McCormick Place Exp. Hall Chicago, Ill.

'63 Highlights

- IRE Int'l. Conv., Mar. 25-28; Coliseum and Waldorf-Astoria Hotel, New York, N. Y.
- WESCON, Western Electronic Show and Conf., Aug. 20-23, IRE, WEMA; Cow Palace, San Francisco, Calif.
- NEC, Nat'l. Electronics Conf., Oct. 28-30, IRE, AIEE; McCormick Place, Chicago, Ill.
- NEREM, Northeast Research and Eng'g Mtg., Nov. 4-6, IRE; Boston, Mass.

- Oct. 9-12: **Electronics Div. Fall Mtg.,** ACS; Statler-Hilton Hotel, Boston, Mass.
- Oct. 10 - 11: **Magnetohydrodynamics Conf.,** Mich. State Univ.; E. Lansing, Mich.
- Oct. 10-12: **20th Annual Aerospace Exp./Report,** AES; Pan-Pacific Audit., Los Angeles, Calif.
- Oct. 11-12: **Southeast Reg. Conf.,** NACE; Birmingham, Ala.
- Oct. 11-12: **18th Annual SPI New England Sec. Conf.;** Wentworth-by-the-Sea, Portsmouth, N. H.
- Oct. 12-13: **Reg. Conf.,** AIEE; El Cortez Hotel, San Diego, Calif.
- Oct. 12-13: **Photographic Electronic Symp.,** SPSE; Washington, D. C.
- Oct. 14-17: **Conf. on Electrical Insulation,** Nat'l. Academy of Sci. & Nat'l. Rsrch. Council; Hershey Hotel, Hershey, Pa.
- Oct. 15-16: **NAB Fall Reg. Conf.;** Dinkler-Plaza, Atlanta, Ga.
- Oct. 15-17: **1962 URSI-IRE Mtg.;** Ottawa, Ont., Canada.
- Oct. 15-18: **Int'l. Symp. on Space Phenomena & Measurement;** IRE (PGNS), AEC, NASA; Statler-Hilton

- Hotel, Detroit, Mich.
- Oct. 15-19: **1962 AES Fall Conv.;** Barbi-zon-Plaza Hotel, New York, N. Y.
- Oct. 15-19: **17th Int'l. Instrument-Automation Conf. & Exh. & ISA Annual Mtg.;** N. Y. Coliseum, New York, N. Y.
- Oct. 15-20: **Pacific Coast Reg. Mtg.,** ACS; Olympia Hotel, Seattle, Wash.
- Oct. 16-19: **South Central Reg. Conf. & Exh.,** NACE; Granada Hotel, San Antonio, Tex.
- Oct. 18-19: **Reg. Conf.,** AIEE; Hotel Lafayette, Buffalo, N. Y.
- Oct. 18-19: **NAB Fall Reg. Conf.;** Biltmore Hotel, New York, N. Y.
- Oct. 21-26: **Semiannual Fall Conv. & Eqpt. Exh.,** SMPTE; Drake Hotel, Chicago, Ill.
- Oct. 22-23: **NAB Fall Reg. Conf.;** Edgewater Beach Hotel, Chicago, Ill.
- Oct. 22-24: **9th East Coast Conf. on Aerospace & Navigational Electronics,** IRE (PGANE); Emerson Hotel, Baltimore, Md.
- Oct. 24-25: **Computer Applications Symp.,** ARF; Morrison Hotel, Chicago, Ill.
- Oct. 24-26: **Annual Mtg.,** Soc. for Experimental Stress Analysis; Schroeder Hotel, Milwaukee, Wisc.
- Oct. 25-26: **NAB Fall Reg. Conf.;** Statler-Hilton Hotel, Washington, D. C.
- Oct. 25-27: **1962 Electron Devices Mtg.,** IRE (PGED), Sheraton-Park Hotel, Washington, D. C.
- Oct. 26-27: **Midwest Quality Control Conf.,** ASQC; Statler-Hilton Hotel, Denver, Colo.
- Oct. 29: **4th Annual AIEE Western Tech. Conf.;** Biltmore Hotel, Los Angeles, Calif.
- Oct. 29-31: **15th Int'l. Systems Mtg. of Systems & Procedures Assoc.;** Statler-Hilton, Sheraton-Plaza Hotels, Boston, Mass.
- Oct. 29-31: **Mtg.,** Soc. of Rheology; Johns Hopkins Univ., Baltimore, Md.
- Oct. 29-31: **Symp. "Dynamics of Manned Lifting Planetary Entry,"** AFOSR; Phila., Pa.
- Oct. 29-Nov. 2: **World Metal Show & 44th Nat'l. Metal Cong.,** ASM; Coliseum, New York, N. Y.
- Oct. 30-31: **Nat'l Spaceborne Computer Eng. Conf.,** IRE (PGEC); Disneyland Hotel, Anaheim, Calif.
- Oct. 30-Nov. 1: **8th Tri-Service Conf. on Electromagnetic Compatibility,** ARF; Ill. Inst. Tech., Chicago, Ill.

NOVEMBER

- Nov. 1-2: **Annual Instrumentation Conf.,** La. Polytech. Inst.; Ruston, La.
- Nov. 1-2: **Chemtronics Conf.,** ASQC; Statler-Hilton Hotel, New York, N. Y.
- Nov. 1-2: **6th Nat'l. Conf.,** IRE (PGPEP);

(Continued on page 15)

ARNOLD PULSE TRANSFORMER CORES... INDIVIDUALLY TESTED UNDER ACTUAL PULSE CONDITIONS

The photograph below shows a big Silectron 4-mil pulse transformer core on test in the Arnold plant, before shipment for use in the missile program.

It also illustrates a special Arnold advantage: a 10-megawatt pulse-testing installation which enables us to test-prove pulse cores to an extent unequalled elsewhere in the industry.

For example, Arnold 1 mil Silectron "C" cores—supplied with a guaranteed minimum pulse permeability of 300—are tested at 0.25 microseconds, 1000 pulses per second, at a peak flux den-

sity of 2500 gauss. The 2 mil cores, with a guaranteed minimum pulse permeability of 600, receive standard tests at 2 microseconds, 400 pulses per second, at a peak flux density of 10,000 gauss.

The test equipment has a variable range which may enable us to make special tests duplicating the actual operating conditions of the transformer. The pulser permits tests at .05, .25, 2.0 and 10.0 microsecond pulse duration, at repetition rates varying anywhere from 50 to 1000 pulses per second.

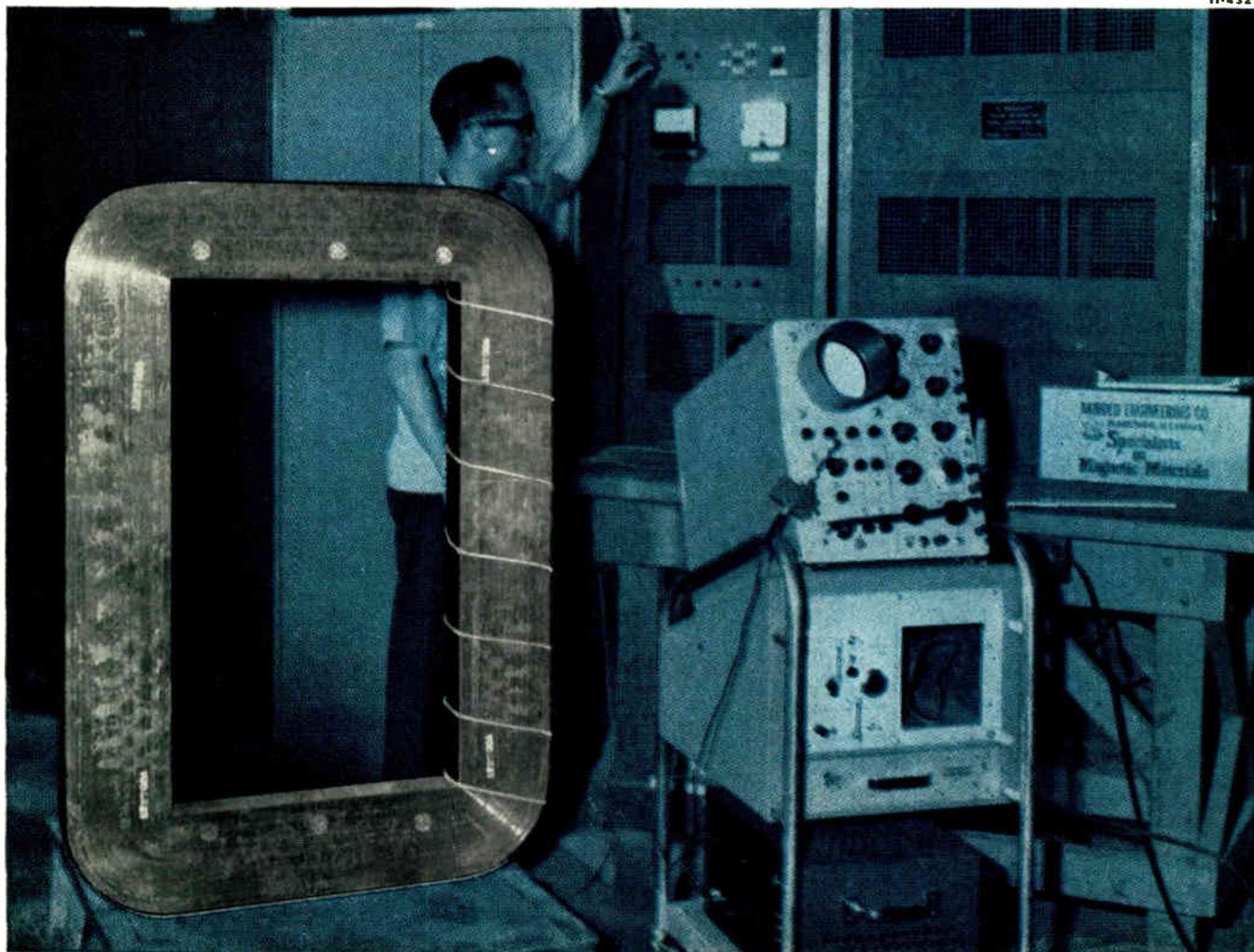
This is just another of Arnold's facilities for better service on magnetic materials of all description. • Let us supply *your* requirements. For design information on Arnold Silectron Cores, write for Bulletin SC-107A. Address *The Arnold Engineering Company, Marengo, Ill.*

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SPECIALISTS IN MAGNETIC MATERIALS

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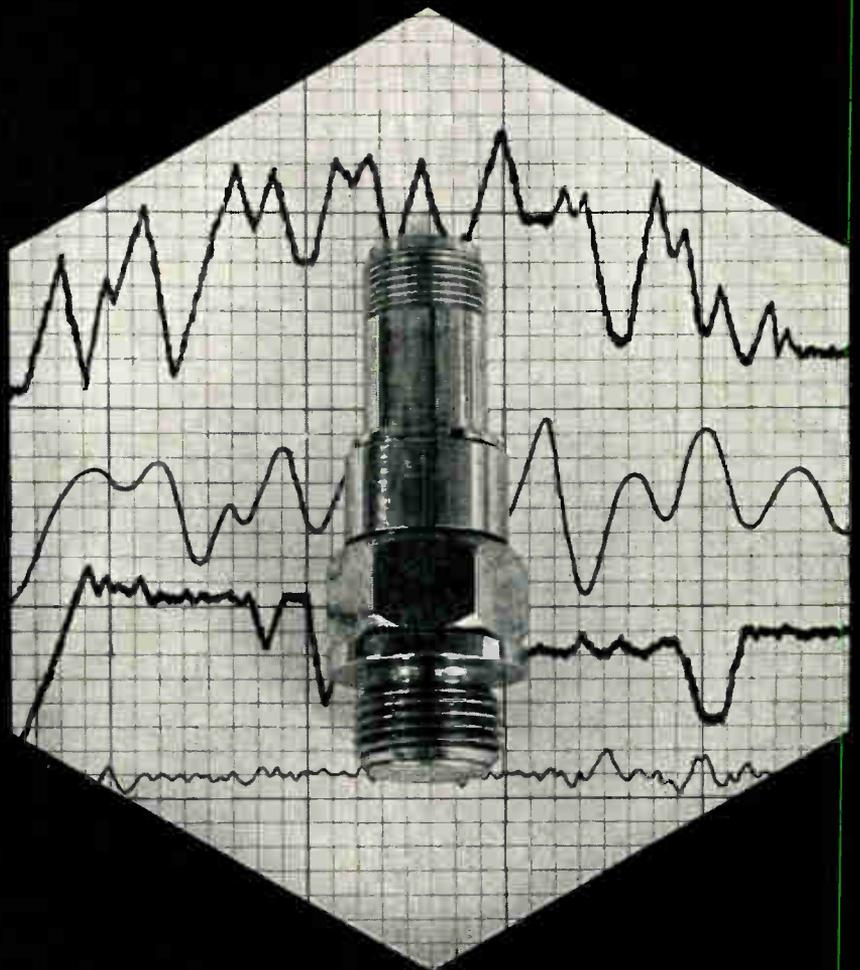
COMING EVENTS

- Jack Tar Hotel, San Francisco, Calif.
Nov. 1-2: Reg. Conf., AIEE; Deauville Hotel, Miami Beach, Fla.
Nov. 1-3: Reg. Conf., AIEE; Shoreham Hotel, Washington, D. C.
Nov. 1-3: Fall Mtg., Nat'l. Soc. of Prof. Engrs.; Hotel Westward Ho, Phoenix, Ariz.
Nov. 4-7: 15th Annual Conf. on Eng. in Medicine & Biology, IRE, AIEE, ISA; Conrad-Hilton Hotel, Chicago, Ill.
Nov. 5-7: 1962 Northeast Electronics Rsrch. & Eng. Mtg., IRE; Commonwealth Armory and Somerset Hotel, Boston, Mass.
Nov. 5-9: Fall Mtg., AIME, MS; Chicago, Ill.
Nov. 7-10: Fall Mtg., ASA; Olympia Hotel, Seattle, Wash.
Nov. 8-9: NAB Fall Reg. Conf., Sheraton-Dallas Hotel, Dallas, Tex.
Nov. 8-9: Nat'l. Mtg. Operations Rsrch. Soc. of America; Sheraton Hotel, Phila., Pa.
Nov. 8-9: Reg. Tech. Conf., SPE; Hotel Essex House, Newark, N. J.
Nov. 10-25: World Economic Progress Assembly & Exp., Ctr. for Int'l. Economic Growth; McCormick Place, Chicago, Ill.
Nov. 12-13, 1962: NAB Fall Reg. Conf.; Muehlbach Hotel, Kansas City, Mo.
Nov. 12-15: 8th Annual Magnetism & Magnetic Materials Conf. & Exhib., AIEE, AIP; Penn-Sheraton Hotel, Pittsburgh, Pa.
Nov. 12-18: Annual Mtg. & Astronautical Exp., ARS; Pan Pacific Audit., Los Angeles, Calif.
Nov. 15-16: NAB Fall Reg. Conf.; Brown Palace, Denver, Colo.
Nov. 19-20: 1962 Mid-American Electronics Conf.; Kansas City Section, IRE; Continental Hotel, Kansas City, Mo.
Nov. 19-20: NAB Fall Reg. Conf.; Sheraton-Portland Hotel, Portland, Ore.
Nov. 23-24: Thanksgiving Mtg. of APS; Cleveland, Ohio.
Nov. 25-30: Winter Annual Mtg., ASME; Statler Hilton Hotel, New York, N. Y.
Nov. 26-28: Machine Tools Conf., AIEE; Statler-Hilton Hotel, Detroit, Mich.
Nov. 26-28: Winter Mtg. & Atom Fair, ANS, AIF; Sheraton-Park & Shoreham Hotels, Washington, D. C.
Nov. 26-29: Atom Fair-62, ANS; Shoreham Hotel, Washington, D. C.
Nov. 27-29: EIA Mtg.; Jack Tar Hotel, San Francisco, Calif.
Nov. 28-30: 1962 Ultrasonics Symp., IRE (PGUE); Columbia Univ., New York, N. Y.

DECEMBER

- Dec. 2-6:** Annual Mtg., AIChE; Conrad-Hilton Hotel, Chicago, Ill.
Dec. 4-6: Fall Joint Computer Conf., IRE (PGEC), AIEE, ACM, Simulation Councils, Inc.; Sheraton Hotel, Phila., Pa.
Dec. 6-7: PGVC Conf., IRE (PGVC); Dis-
(Continued on page 16)

Circle 7 on Inquiry Card →



HIGH FIDELITY PRESSURE TRANSDUCER

ATL Norwood pressure transducers "follow the music." The output stays in tune with the input whether the pressure is at zero or fluctuating up to 20,000 cycles per second. The secret is the small mass and minute deflection of the sensitive element—precision-wound 2-axis strain gauges bonded to a strain tube, opposing a specially formed flush diaphragm of stainless steel.

Neither tempo nor temperature fluctuations affect the sustained high accuracy and repeatability (better than 0.1%) of ATL Norwood pressure transducers, even under the conditions encountered in rocket combustion chambers, "hot-shot" tunnels, and explosive detonation tests. Their performance is virtually unaffected by extremes of shock, vibration, and acceleration—they'll take 100 g in any direction with only a 1% change in output. Linearity is better than 0.5%, and resolution is limited only by the readout equipment.

ATL Norwood pressure transducers are available in models for operation from 25 to 60,000 psi, for temperatures to 5,000°F, in a variety of configurations—standard, air-cooled, and water-cooled. Complete technical data sheet information is available.

ADVANCED TECHNOLOGY LABORATORIES



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COMING EVENTS

- neyland Motel, Los Angeles, Calif.
Dec. 26-29: Winter APS Mtg.; Stanford, Calif.
Dec. 26-31: Space Physics Conf., ARS; Phila., Pa.
Dec. 26-31: Annual Nat'l. Mtg. & Exp. of Sci. & Ind., Amer. Assoc. for Advancement of Sci.; Phila., Pa.

INTERNATIONAL

- Sept. 10-19, 1962: 1st Int'l. TV Programmes and Eqpt. Fair, Lyons Int'l. Fair, RTF; Palais des Congres Int'l., Lyons, France.
Sept. 19-28, 1962: Int'l. Factory Equip. Exh., Manchester C. of C.; Manchester, England.
Sept. 29-Oct. 5, 1962: Stockholm Tech. Fair; Stockholm, Sweden.
Oct. 6-14, 1962: 2nd Exh.—Seminar of Chemical Appliances-MAC '62, UNCI; Palazzo dell'Arte, Milan, Italy.
Oct. 8-12, 1962: 1st Int'l. Conf. on Lead, LIA, Lead Dev. Assoc. of Eng., European Lead Dev. Committee; Connaught Rooms, London, England.
Oct. 22, 1962: Regional Tech. Conf., SPE; Toronto, Ont., Canada.

"CALL FOR PAPERS"

4th Joint Automatic Control Conf., June 19-21, 1963, Univ. of Minn., Minneapolis, Minn. Papers to deal with control theory, applications and components. Abstracts (100 words) should be submitted by Sept. 30, 1962, papers by Nov. 15. Further details will be supplied when abstracts are received. Abstracts and papers may be submitted through the headquarters of one of the sponsoring societies (AIEE, AICHE, ASME, IRE and ISA), marked "for 1963 JACC." Or they may be sent to the program chairman, Prof. Otis L. Updike, Dept. of Chemical Eng., Univ. of Va., Charlottesville, Va.

ENGINEERING EDUCATION

Short courses of interest to engineers.

Space Vehicle Reliability

"The Third Annual Seminar on Reliability in Space Vehicles" will be held Oct. 26, 1962, in the Rodger Young Auditorium, Los Angeles, Calif. It is jointly sponsored by the PGCP, PGED and PGROC of the IRE, Los Angeles Section. The seminar is to inform engineers of strides made to design and develop reliable systems for space and reliable electronic parts suitable for space applications. For more information, contact IRE Headquarters, 1 E. 79th St., New York, N. Y.

EIA GATHERING



This gathering at the recent EIA-NAMM Consumer Electronics Symposium in New York consisted of (l. to r.): E. Taylor, Pres., Motorola Consumer Products, Inc.; Morris Sobin, Chairman, EIA Consumer Products Div.; U. S. Sen. Gale W. McGee (D., Wyo.); Ivan Nestingen, Undersecretary, Health, Education and Welfare; and Ted Kortzen, NAMM Pres. McGee told symposium Congress intended "narrow authority" for FCC in recent all-channel TV law.

Environmental Testing

A seminar on "Environmental Testing" will be offered by *Gulton Industries, Inc.*, at Metuchen, N. J., Oct. 26-30, 1962. The course has been arranged for engineers in the instrumentation field. Seventeen lectures will concentrate on shock, vibration and pressure applications and techniques, including high-intensity sound measurements. The seminar will also be valuable to engineers engaged in structural analysis and design. For more information, contact: A. Orlacchio, Asst. General Manager, Instrumentation Div., Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.

Government Contracting

A series of 12 quality control and procurement education meetings for small businessmen is being conducted throughout the Southeast by the *Orlando (Fla.) Division of the Martin Co.* Lectures scheduled in the near future will be in Miami, Oct. 19, 1962, and Birmingham, Ala., Nov. 15, 1962. In succeeding months Jacksonville, Pensacola-Mobile, Baton Rouge—New Orleans, Charlotte (N. C.), Knoxville, Columbia-Florence (S. C.), and Jackson (Miss.) will be visited. The lectures are designed to give small businessmen a chance to learn how to do business under rigid government and national defense prime contractor specifications. Experts from the Orlando Div. will brief the businessmen on government and Martin quality control and procurement requirements. For more information, contact E. J. Cottrell, Public Relations Director, Orlando Div., Martin Co., P. O. Box 5837, Orlando, Fla.

Save this information about BOURNS TRIMPOT POTENTIOMETERS



This illustrated summary brochure contains technical specifications, dimensions, and prices for the complete line of Bourns adjustment potentiometers.

(If someone else got here first, circle the reader service card for your free copy

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in a
breeze
with
one
quick
squeeze

even tough Teflon* covered wire...for precise electronic production required to pass high-confidence level inspections

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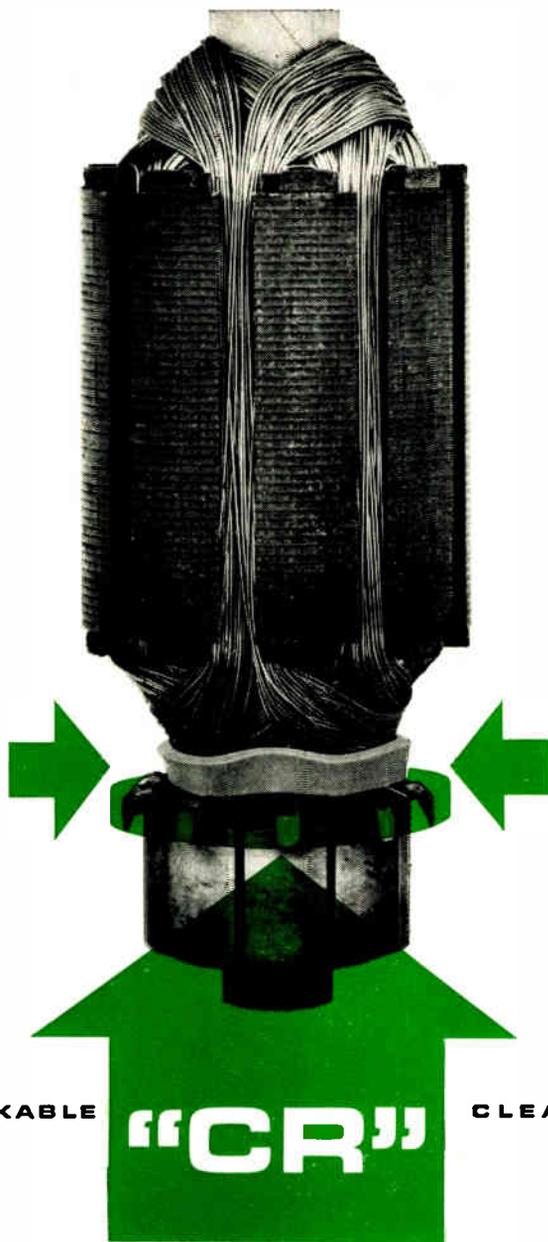


IDEAL CUSTOM *Stripmaster*®

Strip solid or stranded wire easily — with no wire nicks, insulation scratches — no waste or rejects. Unique matched blades, drilled to exact wire size on watchmaker's equipment, plus colleting action, help you meet high-confidence standards even on toughest insulation. Three models — for Type E Teflon, Type EE Teflon and general purpose plastic and fibre-glass insulation. Sizes for 10 to 14, 16 to 26, or 26 to 30 wire. Optional transparent wire stop adjusts to strip exact insulation length. Send coupon for full information.

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CLEAR SLEEVING

T H E R M O F I T

Thermofit, the tubing with a memory, can be used to dress the leads on fractional horsepower electric motors to replace a costly hand-tying operation. It provides mechanical and physical protection of the leads against the centrifugal force of the armature rotation. The insulation of the Thermofit part can be accomplished quickly and materially reduces assembly time. Engineering assistance for unusual and difficult insulating problems is available upon request.



RAYCLAD TUBES
INCORPORATED
REDWOOD CITY, CALIFORNIA

NEWS BRIEFS

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

EAST

HELI-COIL CORP., Danbury, Conn., has acquired for cash the assets of **GAR PRECISION PARTS, INC.**, Stamford, Conn. Gar Precision will become a wholly owned subsidiary of Heli-Coil Corp. Heli-Coil's subsidiaries now number three, including the **GRIP NUT CO.**, So. Whitley, Ind., and the **PHELPS MFG. DIV.** at Danbury.

FREQUENCY ENGINEERING LABORATORIES div. of **HARVARD INDUSTRIES, INC.**, Asbury Park, N. J., has been awarded a U. S. Navy contract for countermeasures equipment valued at \$4,325,671. Preliminary engineering has been started at the company's Monmouth County facility.

GENERAL ELECTRIC CO., LIGHT MILITARY ELECTRONICS DEPT., ARMAMENT & CONTROL PRODUCTS SECTION, has been awarded 2 contracts totaling more than \$2 million for armament equipment for the F-104G. Contracts call for production of sight display-computer systems used for firing the aircraft's missiles and guns. One contract, for G.E.'s **APPARATEN INDUSTRIE DEFENSE ELECTRONICS** of Holland, is for \$1.1 million and the second contract is with **LOCKHEED AIRCRAFT CORP.** for \$1 million.

GENERAL INSTRUMENT CORP., Newark, N. J., has received a military contract awarded by the Ordnance Ammunition Command, Boston Ordnance District, totaling approximately \$2.3 million for production of electronic fuzes to be used in defense weapons systems. Fuses will be manufactured by company's **F. W. SICKLES DIV.** plant at Chicopee, Mass.

SPERRY GYROSCOPE CO., Great Neck, N. Y., has received a \$9,004,533 award from the U. S. Navy for continued engineering and production work on submarine navigation equipment for the Polaris Fleet Ballistic Missile program. The award is on installment an equipment and management funding for 10 new Polaris subs scheduled to join the fleet by the end of 1964.

HUGHES AIRCRAFT CO.'S MICROWAVE TUBE DIV., Los Angeles, Calif., has established a new field office at 30 Linden Place, Red Bank, N. J. The office will cover the areas of New Jersey, New York and Pennsylvania.

JERROLD CORP., Philadelphia, Pa., has acquired **ANALAB INSTRUMENT CORP.**, Cedar Grove, N. J. Jerrold purchased the assets of Analab for an undisclosed number of shares of Jerrold common stock. The purchase is subject to ratification by Analab stockholders. Operations will continue under the name "Analab Instrument Corp." Other Jerrold subsidiaries include: **JERROLD ELECTRONICS CORP.**, Phila.; **HARMAN-KARDON, INC.**, Plainview, N. Y.; **TECHNICAL APPLIANCE CORP. (TACO)**, Sherburne, N. Y.; and **PILOT RADIO CORP.**, Long Island City, N. Y.

SYLVANIA ELECTRIC PRODUCTS INC., subs. of **GENERAL TELEPHONE & ELECTRONICS CORP.**, has received a \$369,000 contract from Gentile Air Force Station, Dayton, Ohio to manufacture tunable X-band magnetrons. The units, Type 6543 will be manufactured at Sylvania's plant in Williamsport, Pa.

ACCURACY, INC., Waltham, Mass., has made a second acquisition of the current fiscal year with the purchase of **ALLOY WELDING-NUCLEAR PRODUCTS CORP.**, Lynn, Mass. Alloy Welding will operate as a division of Accuracy.

MARTIN CO., AEROSPACE DIV. of **MARTIN MARIETTA CORP.**, Baltimore, Md., has begun

construction on a new facility at their Middle River plant for conducting verticle test of the **TITAN II** vehicle which will launch the 2-man **GEMINI** spacecraft. The facility requires construction of a 70-ft tall addition to an existing 85-ft building. The complete structure which will be about 14 stories high will house 2 fully erect, 103-ft **TITAN II-GEMINI** launch vehicles.

RADIATION INC., Melbourne, Fla., and **DYNATRON LABORATORIES**, Camarillo, Calif., have announced affiliation. This is a move to provide each with increased facilities and access to coastal missile markets. Radiation has acquired a substantial interest in Dynatron and under terms of an agreement, may at its option, acquire not less than 80% interest over a period of time.

SINGER MFG. CO., FINDERNE, N. J., and **PANORAMIC ELECTRONICS, INC.**, Mt. Vernon, N. J., have announced tentative agreement for the acquisition by Singer of Panoram's assets. The purchase price consists of approximately 104,000 shares of Singer common stock and Singer would assume Panoram's liabilities.

SURFACE RADAR and NAVIGATION OPERATION, RAYTHEON CO., North Dighton, Mass., has received a \$5,603,000 contract from the U. S. Navy's Bureau of Weapons for additional fire control radars. The radars, designated **AN/SPG-51** will be used to direct the Navy's Tartar missile.

The formation of **ALPHOMEGA RESEARCH LABORATORIES, INC.**, Carle Place, N. Y., has been announced. The organization is currently engaged in the basic design of a new concept in End-Fire antennas.

CLEVITE TRANSISTOR, Waltham, Mass., has established a new field sales engineering office at 5635 Yale Blvd., Dallas 6, Tex. The opening of the Dallas office, the 10th field sales office now in operation, is part of a continuing program to expand Clevite Transistor's nationwide customer service facilities.

MID-WEST

IDEAL INDUSTRIES INC., Becker Place, Sycamore, Ill., has opened its new \$750,000 office and Engineering Center. The 35,000 sq. ft., 2-story structure will contain engineering laboratories and model shop facilities, along with engineering design and development offices and general corporation offices.

MOTOROLA INC., COMMUNICATIONS DIV., Chicago, Ill., has received an order from the **COMMONWEALTH EDISON CO. OF ILLINOIS**, for equipment to replace 2-way radio systems operated by the Commonwealth's Northern and Southern Divisions. The equipment includes nine 60-watt base stations and 230 specially designed transistorized **MOTRAC** mobile radios.

THE VICTOREEN INSTRUMENT CO., Cleveland, Ohio, has received contracts amounting to \$2,355,000 for radiation monitoring instruments from the General Services Administration.

MINNEAPOLIS-HONEYWELL REGULATOR CO., ELECTRONIC DATA PROCESSING DIV., has been awarded a \$2 million contract, for delivery of 3 electronic computers for use in connection with Project Apollo, by NASA. One Honeywell 800 and two Honeywell 400s are scheduled to be in operation by Oct. 1, in the data computing center at Slidell, La. near NASA's Michoud facility.

WEST

MOTOROLA'S SEMICONDUCTOR PRODUCTS DIV., Phoenix, Ariz., has announced expansion plans totaling \$3 million which include the completion of additional production facilities as well as construction of a new building. Approximately 100,000 sq. ft. will be completed and turned into working production space and the new building, which will be two stories, will encompass 55,000 sq. ft. and is scheduled for completion by April 1963.

BECKMAN INSTRUMENTS, INC., Richmond, Calif., has received a \$300,000 contract from **PRATT & WHITNEY AIRCRAFT**, div. of **UNITED AIRCRAFT CORP.**, for an analog computer system to be used in solving rocket engine design problems. The system will consist of 2 analog computers and related components and will be built by Beckman's **BERKELEY DIV.** and delivered to Pratt & Whitney's Florida R&D Center, West Palm Beach, Fla.

ANACONDA WIRE AND CABLE CO., Hastings-on-Hudson, N. Y., has announced construction plans for a new warehouse facility which will provide 40,000 sq. ft. of warehouse plus a sales and service headquarters. The company also announced it would concentrate all of its manufacturing on the West Coast at its Orange, Calif. plant. This follows the closing of the sale of its Redwood City plant to the **SEQUOIA WIRE CO.**, a wholly-owned subsidiary of **RAYCHEM CORP.**, Redwood City, Calif.

HUGHES AIRCRAFT CO.'S SEMICONDUCTOR DIV., Newport Beach, Calif., has been awarded a \$300,000 contract by **GENERAL DYNAMICS/ASTRONAUTICS**, San Diego, Calif., for production of ultra high reliability transistors for the Atlas ICBM.

FAIRCHILD SEMICONDUCTOR, Mountain View, Calif., has announced the opening of a new sales office in Scottsdale, Ariz.

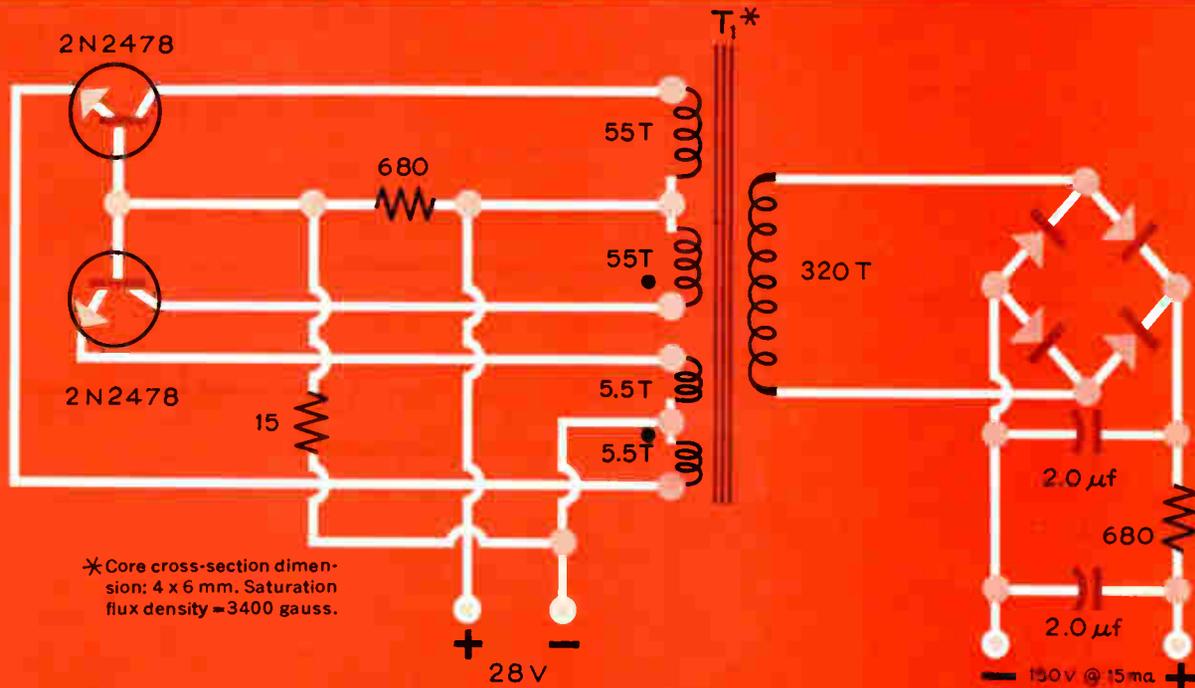
TELECOMPUTING SERVICES, INC. (TSI), sub. of **TELECOMPUTING CORP.**, Los Angeles, Calif., has received a 1-year contract from NASA for data-reduction services on the SATURN programs. The contract involves optical data-reduction studies on SATURN and advanced SATURN programs at George C. Marshall Space Flight Center, Huntsville, Ala.

EITEL-McCULLOUGH INC., San Carlos, Calif., has received two separate U. S. Army Signal Supply Agency research contracts, totaling some \$210,000. One of the contracts covers metallurgical research and development for ceramic electron devices, and the other contract covers research on a microwave window multipactor and its inhibition.

THE BENDIX CORP., BENDIX-PACIFIC DIV., Hollywood, Calif., has received a contract for underwater beacons from the **SPERRY RAND CORP.**, Long Island City, N. Y. The beacons will give positioning information to ships involved in tracking missiles and space vehicles in the Mobile Atlantic Range System (MARS). Contract calls for an undisclosed number of transponder beacons that can transmit sound waves over 3 miles through water.

GENERAL DYNAMICS/ELECTRONICS, San Diego, Calif., has received a \$100,000 study contract from the U. S. Army Signal Corps, Ft. Monmouth, N. J., to develop new techniques for effective employment of radar in battlefield situations. The study is expected to last over a year.

■ New Circuitry Made Possible by PHILCO Transistors



*Core cross-section dimension: 4 x 6 mm. Saturation flux density = 3400 gauss.

Philco high voltage, high speed epitaxial silicon mesa transistors make possible a compact, highly efficient medium power DC-to-DC power converter—shown in schematic. This solid-state converter can take an input of 28 volts and produce any desired output (circuit shown is for 150 V output). The same design similarly can convert inputs as high as 35 volts.

voltage advantage

	2N2087	2N2478	2N2479
V _{CBO} Rating (min.)	120 V.	120 V.	80 V.
V _{CE} Rating (min.) (R _{BE} =10 ohms)	80 V.	70 V.	60 V.
h _{FE} (min.) (V _{CE} =1v, I _C =150ma)	40	30	30
f _T (V _{CE} =10v, I _C =50ma) (min.)	150mc	200mc	150mc
PRICE (quantities 1 to 99)	\$11.55	\$7.13	\$3.75
PRICE (quantities 100 to 999)	8.47	5.23	2.75

Philco epitaxial silicon mesa transistors are available today from your Philco Industrial Semiconductor Distributor.

Philco types 2N2087, 2N2478 and 2N2479—all NPN epitaxial silicon mesa transistors in TO-5 cases—are industry's only high voltage, high speed, epitaxial devices. The combination of these parameters in the same device ideally suits these types to DC-to-DC power conversion, driving very large memory arrays, high voltage wide band video and pulse amplifiers, and 28 volt servo amplifiers. All 3 transistor types are available in production quantities. Consult table in this ad for prices.

Send for complete data on Philco high voltage epitaxial silicon mesa transistors. Write Dept. EI 962.

PHILCO®

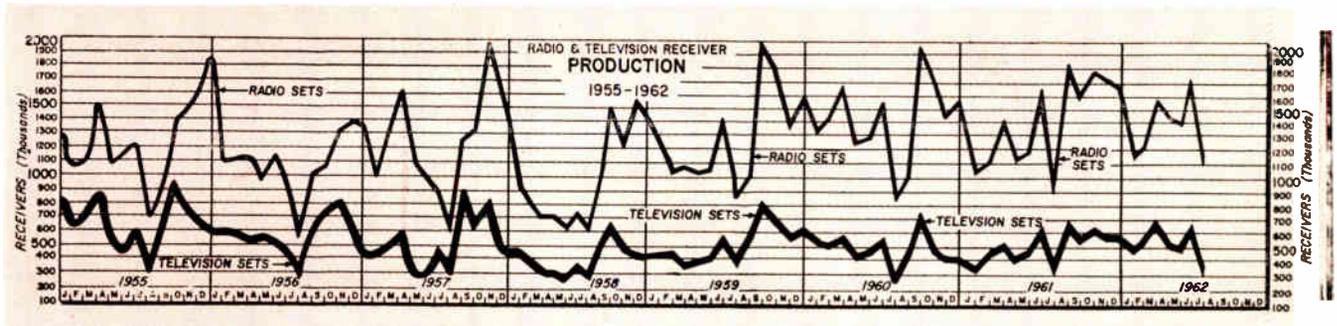
A SUBSIDIARY OF *Ford Motor Company*

LANSDALE DIVISION, LANSDALE, PA.



TOTALS

Facts and Figures Round-Up



GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government agencies in July, 1962.

Accelerometers	82,657
Amplifiers	3,563,299
Analyzers	601,338
Antennas	5,051,100
Batteries	1,105,020
Cable	464,831
Cable assemblies	205,554
Cable, telephone	226,381
Calibration equipment	754,539
Capacitors	50,504
Communication equipment	5,038,005
Comparators	186,994
Computers	1,622,916
Connectors	401,943
Controls	1,299,439
Converters	4,175,221
Countermeasure set	7,476,236
Couplers	915,229
Data conversion systems	2,920,324
Data transmission equipment	124,603
Digital trainer	59,248
Drone systems	5,000,000
Facsimile equipment	933,509
Filters	454,116
Guidance systems	7,500,000
Gyros	233,103
Hydrophones	58,132
Indicators	724,901
Loudspeakers	535,810

Measuring systems	1,981,226
Memory systems	435,000
Meters	1,475,410
Microphones	374,445
Multiplexers	60,800
Navigation equipment	5,521,075
Oscillators	1,039,858
Oscilloscope	36,407
Radar	20,263,171
Radiac equipment	923,909
Radio sets	10,437,930
Receivers	1,989,644
Recorders	1,483,581
Recorder/Reproducer	1,726,694
Recording systems	2,320,636
Relay armatures	156,382
Relay systems	1,057,262
Relays	119,710
Reproducer sets	318,104
Semiconductors	822,704
Signal generators	2,092,364
Simulators	1,088,549
Sonar	10,607,788
Switches	820,350
Synchros	415,743
Tape, recording	1,069,983
Telephone & telegraph equipment	2,610,452
Telemetry equipment	2,109,793
Teletype equipment	4,463,695
Test equipment	8,005,485
Transceivers	3,206,044
Transducers	197,406
Transmitters	3,081,115
Tube, electron	3,850,785
Tube, magnetron	345,785
X-Ray equipment	608,239

COMPONENT SHIPMENTS RISE TO \$3.6 BILLION

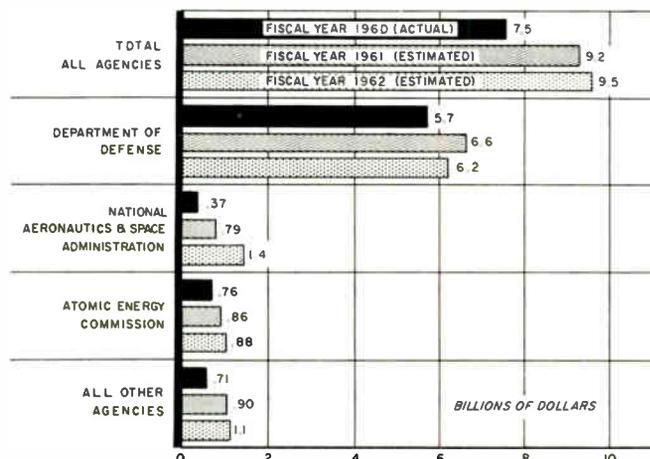
Shipments of electronic components in 1961 increased nearly 6% over the 1960 level to an estimated value of about \$3.6 billion, according to the Electronics Div., Business and Defense Services Admin., U. S. Dept. of Comm.

Sales of capacitors gained 18%, topping the \$300 million mark, while resistors rose nearly 16% to about \$286 million. Connectors were up 13% to \$190 million; quartz crystals, 30% to \$28 million and complex components, 32% to \$38 million. Relay sales declined about 2% to \$182 million and transformer shipments were down slightly to \$181 million.

Total sales of electron tubes remained virtually unchanged at \$860 million. A 13% increase in output of power and special purpose tubes was offset by declining sales of receiving tubes, and by a relatively low level of picture tube output in early 1961.

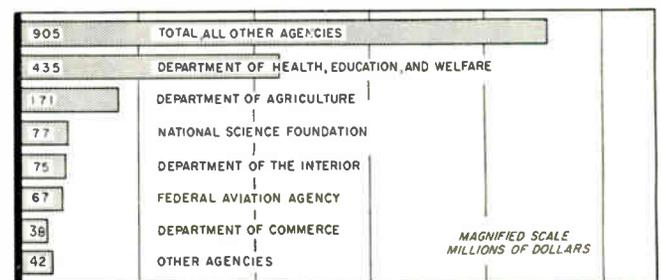
The value of semiconductor shipments increased about 4% to \$565 million despite the sharp decline in prices of many transistor and diode items.

Unfilled orders for components at the end of 1961 were about 8% above those of a year earlier, and amounted to about 11 weeks of production at the 1961 average rate.



Federal Obligations for R&D, By Agency

All Other Agencies—Fiscal Year 1961



Source: National Science Foundation

MOBILE MARINE CORPS TRANSCEIVER AIDED BY JENNINGS VACUUM COMPONENTS

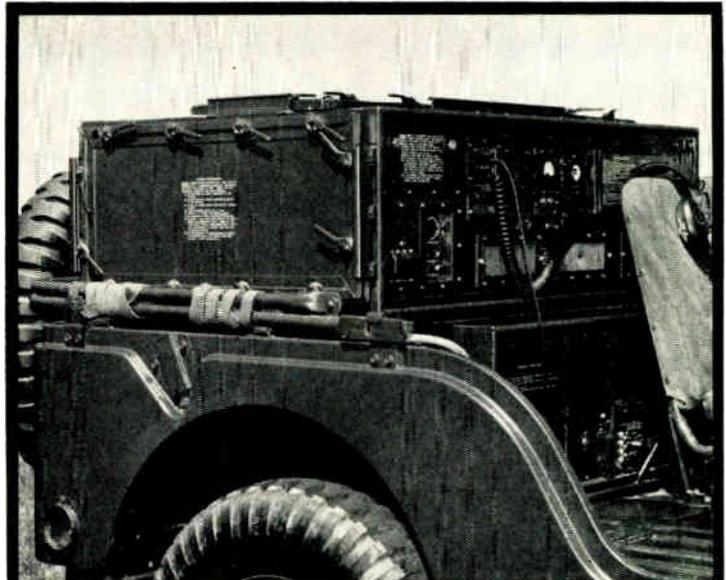
Jennings Vacuum Capacitors and Relays permit compact mobility with high voltage dielectric and high resistance to shock and vibration.

Collins Radio Company designed this very efficient AN/TRC-75 transportable 1KW HF SSB communication system for Jeep, truck, or shipboard installation. The problem of designing a KW automatically-tuned, wide-frequency-range transmitter to occupy such a small space and operate perfectly under the most arduous conditions demanded the smallest, lightest high-voltage components available. No other components so capably met these requirements as Jennings.

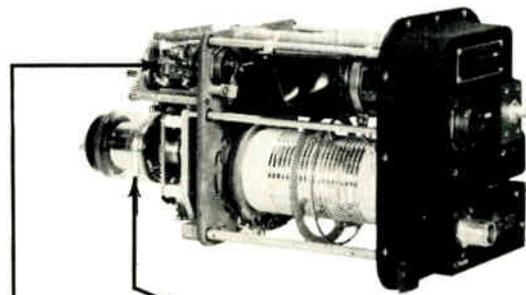
The system includes Jennings Type RB3 vacuum transfer relays and Type USLS 465 vacuum variable capacitor in the automatically-tuned antenna coupler. Jennings Type RE6B vacuum transfer relays are also used to switch high voltage RF coils.

The Type RE6B is designed to meet peak voltages of 30 kv and rf currents of 25 amps, yet it is only 3¼ inches long. The Type RB3 has a peak voltage rating of 15 kv and rf current rating of 15 amps rms. It has an auxiliary set of contacts to turn off the transmitter before the high-voltage contacts switch the antenna. The Type USLS 465 is only 5 inches long and will withstand 10 kv at its minimum capacity of 5 mmfd and 5 kv at its maximum capacity of 465 mmfd.

Jennings vacuum components possess many more exclusive advantages to solve difficult design problems. We will be pleased to send detailed catalog literature.



COLLINS AN/TRC-75 TRANSPORTABLE HF SSB COMMUNICATION SYSTEM



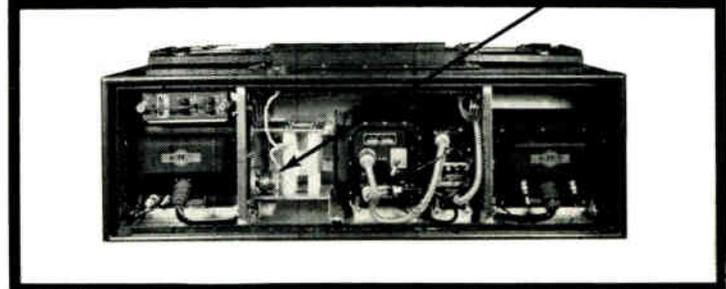
JENNINGS TYPE
RB3



JENNINGS TYPE
USLS 465



JENNINGS TYPE
RE6B



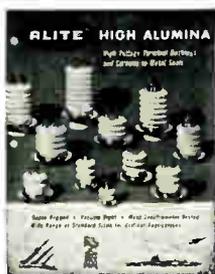
RELIABILITY MEANS VACUUM / VACUUM MEANS *Jennings*®

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on standard and special
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In all phases of planning for high-alumina ceramic-to-metal seals you can rely on Alite for the “know-how” and “do-how” required to produce highest quality for critical applications.

From design to finished part, every manufacturing step — including formulating, firing, metalizing and testing — is handled within our own plant and carefully supervised to assure strict adherence to specifications, utmost uniformity and reliability.

To simplify design problems and speed delivery, Alite terminals, feed-throughs and cable end seals are available in over 100 standard sizes.

ALITE DIVISION



U. S. STONEWARE

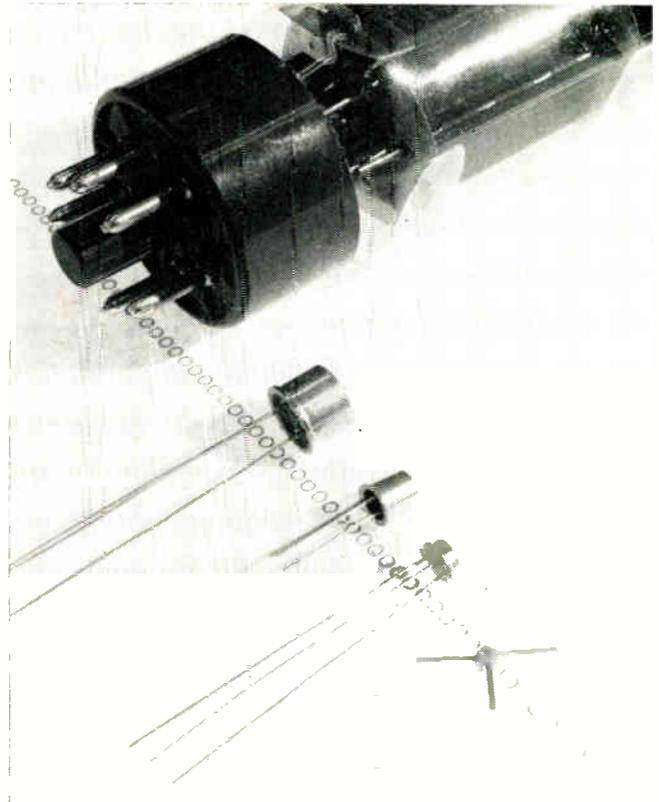
Box 119 • Orrville, Ohio

88H-3

SNAPSHOTS... OF THE ELECTRONIC INDUSTRIES

CONTRAST

Tiny new transistor at lower right contrasts with large tube at top, illustrating the trend toward miniaturization. Between the two are several sizes of conventional transistors. Called a Microseal transistor by its developers at Hughes Aircraft Co.'s semiconductor division, Newport Beach, Calif., the new model fits within small letter 'o' on an average typewriter.



"HONEYCOMB"

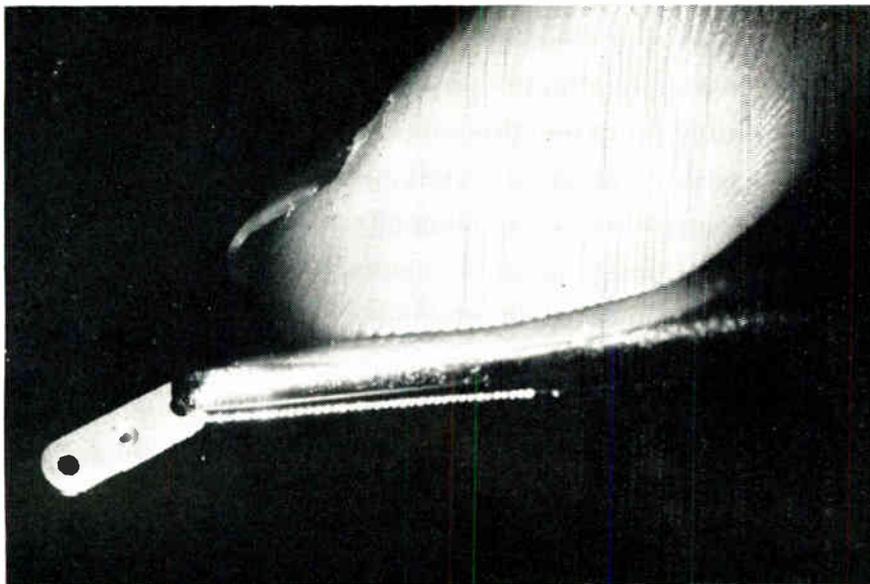
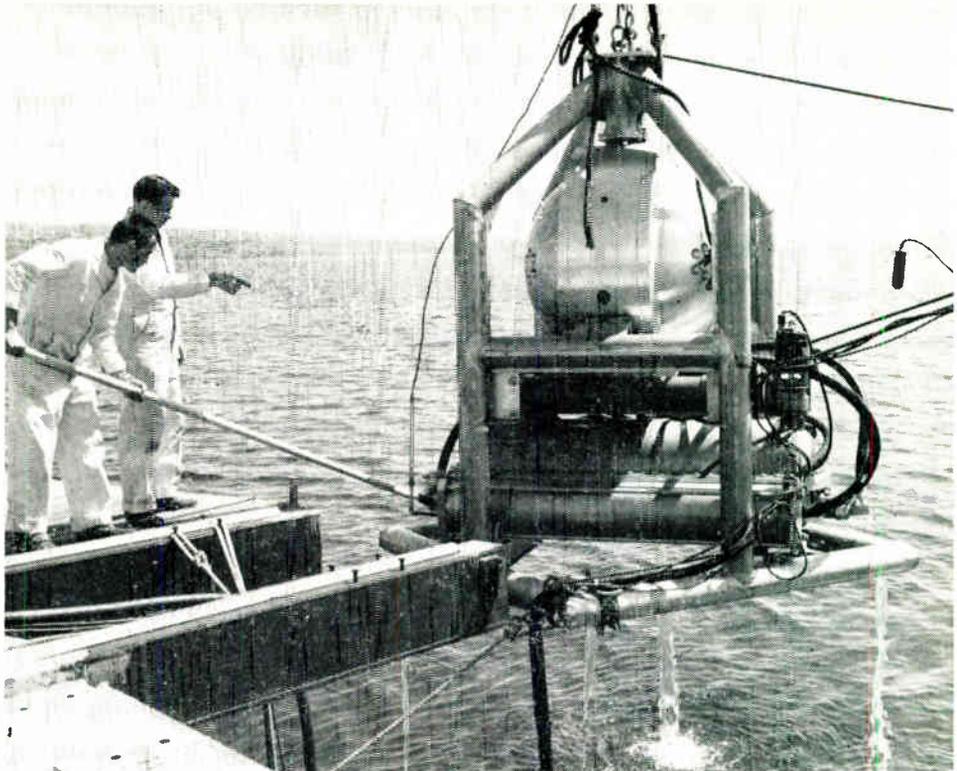
An engineer from Goodyear Aircraft Corp., inspects pressed paper core which will be covered with glass fiber skins to make hexagonal panels for ground-based spherical radomes.

Containing 1,646 panels, the radome can withstand winds up to 130 mph. Goodyear has already installed one radome and the antenna it protects at a BMEWS site near Thule, Greenland.



EXPERIMENTAL TRANSDUCER

Hydroacoustic transducer, developed by General Dynamics/Electronics, Rochester, N. Y., is hauled from the waters of Seneca Lake, N. Y., where it is undergoing trials. The device is to be used as a massive source of sound in anti-submarine warfare research. It converts pressurized hydraulic fluid into vibratory energy which is transmitted through water as acoustic waves.

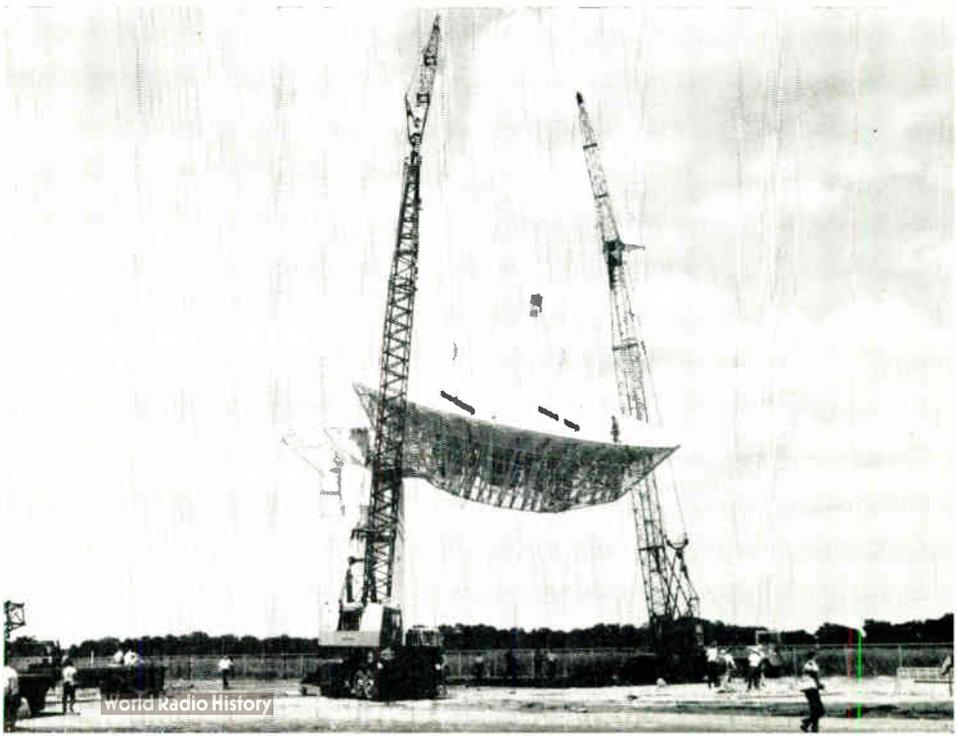


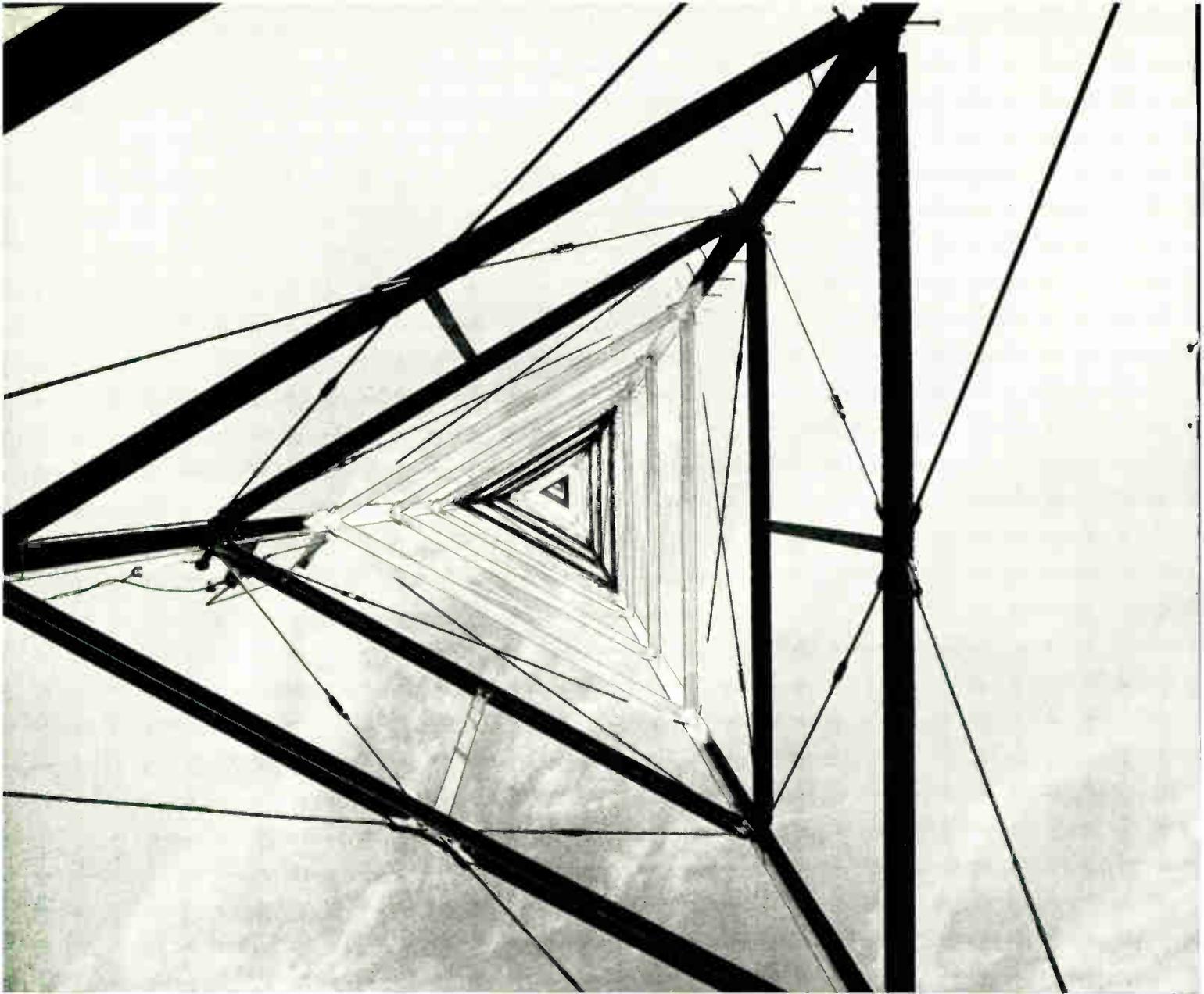
COMMUNICATIONS POTENTIAL

Close-up view of gallium arsenide diode that will transmit twenty TV pictures simultaneously on a single beam of infrared light. The diode (in back of the small hole in the center, through which the infrared light beam is emitted) was developed by the M.I.T. Lincoln Laboratory.

SPACE ANTENNA

Giant 60-ft.-diameter, 8-ton parabolic reflector, which contains 140 aluminum panels aligned to within 0.024 of an inch accuracy, is hoisted into place at Collins Radio Company facilities near Dallas, Tex. The reflector is part of a \$1 million deep space tracking station. Cost of the station is being borne by the company.





Inductrol® regulator assures precise voltage control at station KCSJ's television transmitter



G-E INDUCTROL REGULATOR

- Automatic voltage control accuracy of $\pm 1\%$
- Smooth, stepless voltage control
- Drift-free controls
- 100% overload capacity up to 1 hr.
- 98 to over 99% efficiency
- Load power-factor, frequency, and temperature compensated
- No harmful waveform distortion
- Rugged, compact design

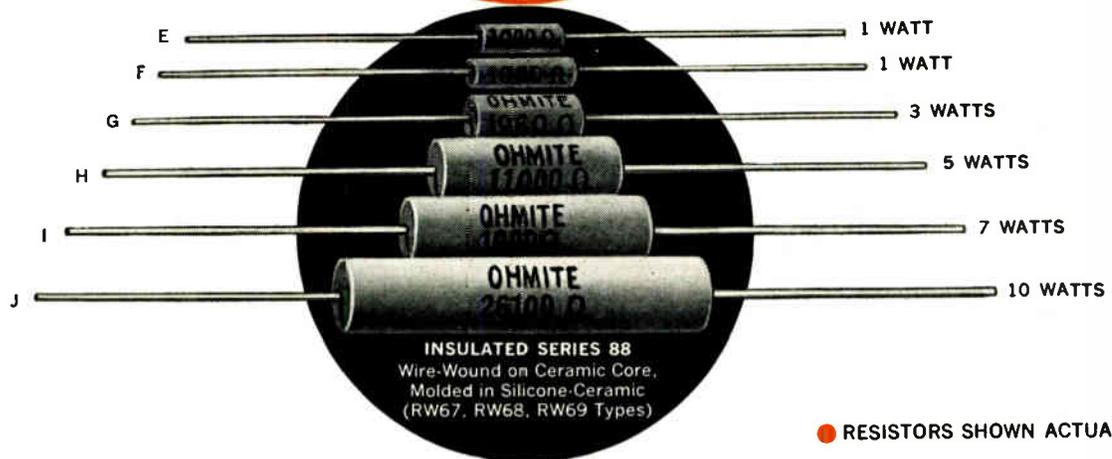
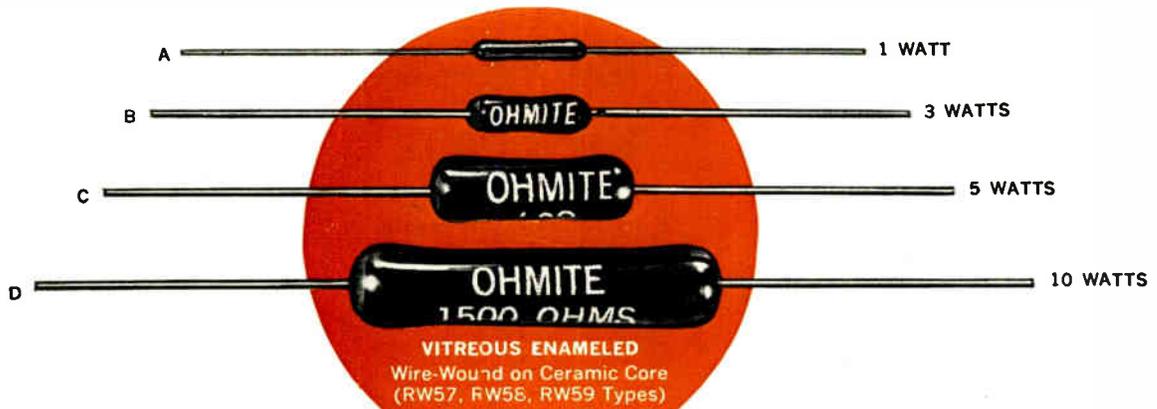
In the transmitter building at the base of television station KCSJ's 977-foot tower near Pueblo, Colorado, a General Electric Inductrol voltage regulator precisely controls input to all electronic equipment. Before the Inductrol regulator was installed, frequent line-voltage drops of as much as 25 volts had to be corrected manually. Now, according to Chief Engineer Kenneth Renfrow, "The Inductrol regulator automatically holds our input range within two volts and has functioned 28 months without control adjustment, or maintenance. It can't be beat for our type of operation."

A General Electric Inductrol regulator will benefit *your* operation, too. Designed on the inherently simple and reliable *induction* principle, Inductrol regulators can be used to hold fluctuating voltage to precise limits or to provide a variable voltage output from a relatively constant supply. Applications include radar, communications equipment, rectifiers, computers, laboratory equipment, and many others.

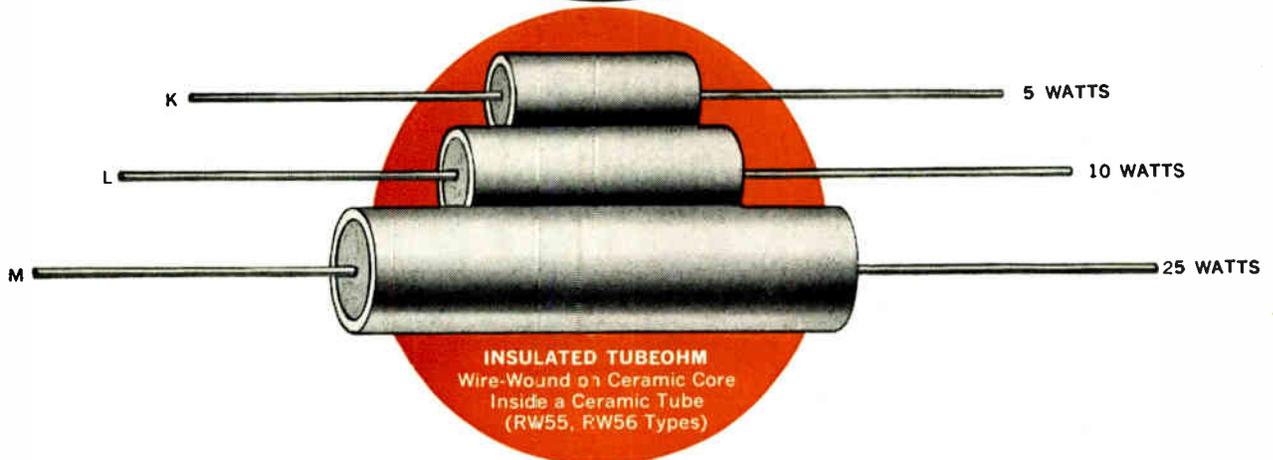
For full information, call your G-E Sales Engineer. Or write for Bulletins GEA-7690 and GEC-1450C to General Electric Company, Section 457-09, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



● RESISTORS SHOWN ACTUAL SIZE



PROBLEM SOLVERS IN AXIAL LEAD RESISTORS

MINIATURE CIRCUITS: Resistors A, B, E, F pack 1 to 3 watts in sizes smaller than many nonpower units.

INSULATED RESISTORS: Choose from two types, E to J and K to M. Meet all MIL requirements for insulation.

PRECISION AND POWER COMBINED: Use E to J for tolerances down to 0.05%; A to D for tolerances to 1%.

MIL REQUIREMENTS: All pertinent MIL-R-26C types.

WELDABLE LEADS: Nickel—specify "weldable" (untinned).

HIGH TEMPERATURE OPERATION: A to D and K to M are rated up to 350°C; E to J, 275°C or 350°C depending on the application.

LOW TEMPERATURE COEFFICIENT: Use resistors E to J for 20 ppm/°C, standard.

IMMEDIATE DELIVERY: A, B, C, D, G, H, J stocked in popular MIL and commercial values. Call your electronic distributor or the factory.

Write for "Axial Lead" Literature

Rheostats • Power Resistors • Precision Resistors • Relays • R.F. Chokes • Germanium Diodes • Variable Transformers • Tantalum Capacitors • Tap Switches



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High voltage
High gain
Low leakage
Silicon Planar

DIFFERENTIAL AMPLIFIERS

Matched h_{FE}
Matched V_{BE}
Thermally matched

Fairchild Planar process alone makes this matching practicable in volume production

Matching Characteristics	2N2060			2N2223			2N223A			Test Conditions
	Min.	Max.	Units	Min.	Max.	Units	Min.	Max.	Units	
Beta Ratio	0.9	1.0		0.8	1.0		0.9	1.0		$I_C = 1.0 \text{ mA}$ $V_{CE} = 5.0 \text{ V}$
Beta Ratio	0.9	1.0								$I_C = 0.1 \text{ mA}$ $V_{CE} = 5.0 \text{ V}$
V_{BE} Differential		0.005	Volts							$I_C = 1.0 \text{ mA}$ $V_{CE} = 5.0 \text{ V}$
V_{BE} Differential		0.005	Volts		0.015	Volts		0.005	Volts	$I_C = 0.1 \text{ mA}$ $V_{CE} = 5.0 \text{ V}$
ΔV_{BE} Tracking		10	$\mu\text{V}/^\circ\text{C}$		25	$\mu\text{V}/^\circ\text{C}$		25	$\mu\text{V}/^\circ\text{C}$	$I_C = 0.1 \text{ mA}$ $V_{CE} = 5.0 \text{ V}$

FAIRCHILD
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 A DIVISION OF FAIRCHILD CAMERA AND INSTRUMENT CORPORATION

Japanese Transistor Radio Export Quota Maintained

The quota on exports of Japanese transistor radios to the U. S. A. and other nations will be maintained at the present level for the rest of 1962, states the Japan Machinery Exporters Association.

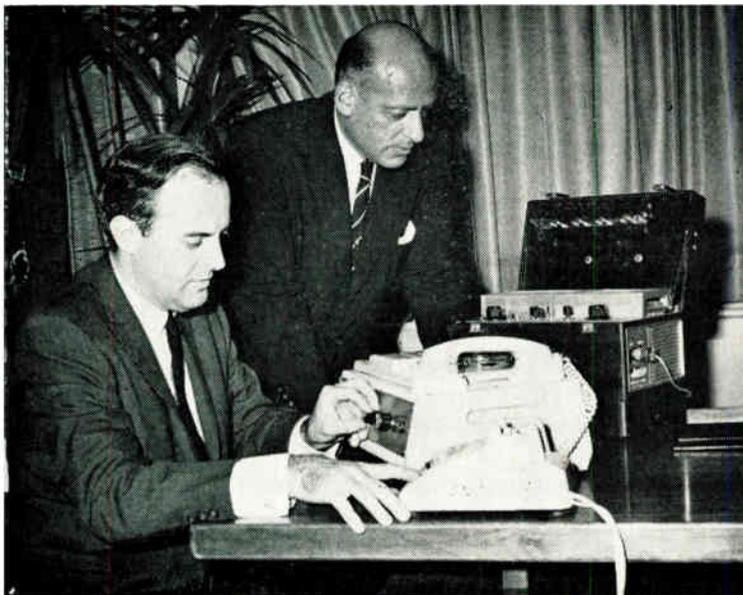
An understanding to this effect has been reached between the Ministry of International Trade and Industry and electronics industry circles, said Misao Matsuda, Director of the association's Business Div. He said the agreement applies to three or more transistor radios.

"Japan has no thought of increasing the volume of transistor radio exports despite the strong trend in the U. S. toward slashing the price of American-made 6-transistor radios," the JMEA official stressed. "Under such circumstances it is feared that increased Japanese exports would be detrimental to both countries and would lead to cut-throat competition."

The JMEA spokesman pointed out exports of Japanese transistor radios to all areas were increasing steadily. He expressed the belief that this trend would continue in the future. He said there were no adverse factors indicating a decrease in exports and that demand was firm the first half of this year.

Hong Kong — Japanese diplomats have requested this crown colony to restrict its imports of transistor radios to the U. S. Radios assembled here are underselling Japanese-made radios in America.

MESSAGE FROM THE HEART



Electrocardiogram of Edward G. Robinson was phoned from Nairobi to his physician in Los Angeles using this Mnemotron Co. "Sonlink." It is checked by Dr. L. A. Scarrone (l.), of Foundation for Diagnostic Research and Education, NYC, and C. Gelman, of Grand Central Hospital, NYC.

Saigon — An analog computer has been delivered to the Vietnamese Atomic Energy Office here by a U. S. firm, Electronic Associates, Inc., of Long Branch, N. J.

Tokyo—Honeywell Electronic Data Processing has concluded an agreement with Nippon Electric Co. under which that firm will manufacture and market the division's full commercial computer line in Japan.

Tokyo—A computer which measures a pearl's gloss and luster is being used by the Japanese Pearl Institute. It was developed by Tokyo Shibaura Electric Co.

Tokyo—Japanese manufacturers are beginning to turn to automation to keep costs competitive as prices continue to rise.

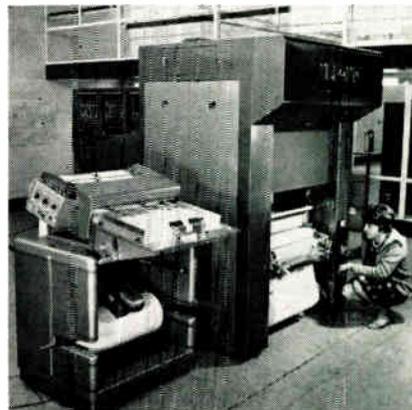
EUROPE

Stockholm — Standard Radio & Telefon Co., an ITT associate company, has been awarded a prime \$10 million contract for automating Sweden's national air defense system.

Berlin — For a newly-constructed main pit shaft in the Ruhr coal-mining area, Germany's AEG Co. has supplied new industrial TV equipment. It will be used to supervise the discharging process in the conveying plant.

Vienna—Telephone service between Austria and Italy has been increased by opening of a 50-mile coaxial cable system between Klagenfurt and Tarvisio. The system will provide an ultimate capacity of 960 telephone circuits, opposed to 159 at present. It was built by Standard Telephones & Cables, Ltd., a British IT&T associate.

HIGH-SPEED PRINTER



The Rank Organization's Xeronic high-speed computer output printer produces forms at linear paper speed of 40 ft./min. The speed represents computer output rate of 4,700 characters/sec. British government will use this to maintain 26 million insurance accounts under new graduated pension plan.

Belfast—A 50,000 sq. ft. plant for producing telephone exchange equipment has been opened near here by Standard Telephones & Cables, Ltd., an IT&T associate. The Northern Ireland Development Council supplied the building. The company is constructing a 150,000 sq. ft. structure nearby.

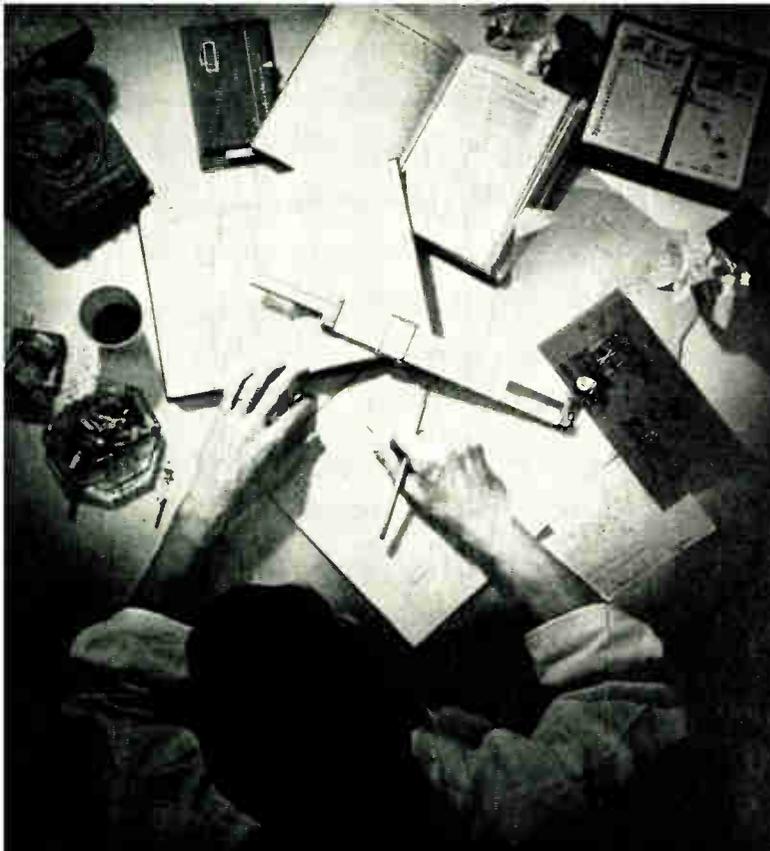
Paris—William T. Stratton has been chosen Manager of the Paris Office of Hughes International. He succeeds George E. Todd Manager of European Offices, who also has been filling the Paris job.

London—A low-cost TV station that can be operated by one man and transmit programs up to five miles has been designed by EMI Electronics, Ltd. Able to be fitted into a classroom, it includes a 50-ft. aerial mast, a live pickup TV camera and film and slide projection equipment.

Rome—An entire ground telemetry station for missile tracking was flown from Burbank, Calif., to Sardinia to fill an order from the Italian government. The system was built by the Raytheon Co.

London—Marconi's new "solid-state" Type HC-121 Autoplex, combines two or four teleprinter channels by time-division multiplexing. It automatically corrects errors occurring in transmission.

London — An automated hot-strip mill will begin operating later this year at Llanwern, Wales. The 68-in. mill is located at the Spencer Works of Richard Thomas & Baldwins, Ltd. All its operations — from the slag reheating
(Continued on page 36)



8 hrs....

Some engineers now design high-frequency switching circuits by:

1. Estimating transistor electrical characteristics at the design operating points rather than at points specified on the manufacturer's data sheet.
2. Allowing for variation in specification limits of devices due to changes in current and voltage.
3. Allowing for parameter variations resulting from changes in temperature.
4. Throwing in a safety factor based upon educated estimates.
5. Breadboarding circuits with limit transistors and checking operation at temperature extremes. Then, when necessary, due to unsatisfactory performance of breadboarded circuits by:
 - Trimming safety margins
 - Refining circuit design
 - Writing specs for special devices
 - Selecting specials at Incoming Inspection

Making these estimates and calculations and doing expensive breadboard testing and analysis wastes valuable time and frequently results in marginal or over-designed circuits...



MOTOROLA



or 15 min

But not YOU if you use Motorola's new 2N964A Designer's Data Sheet

1. It contains limit curves that fully define "on" conditions from 2 to 100 mAdc (h_{FE} , $V_{CE(SAT)}$, $V_{BE(SAT)}$); "off" conditions (leakage, latchup); and "transient" conditions (total charge, rise and fall time constants).
2. Sufficient curves are given on important design parameters to permit easy construction of any other curve desired.
3. Curves define necessary min-max limits.
4. Curves are given for various junction temperatures.
5. Safety factors are included in the curves.
6. Breadboard is used merely to check circuit analysis.
7. The 8-page Motorola "Designer's Data Sheet" contains typical calculations showing step-by-step how you use this complete design information for switching circuits.

In fifteen minutes you'll learn more about this transistor from the Designer's Data Sheet than you could in days of testing. Tightly specified in characteristics, but designed for a broad range of application, the Motorola 2N964A transistor is the ideal high frequency switch for most of your requirements.

For a copy of the Motorola 2N964A Designer's Data Sheet, or for more information, write or call your local Motorola Semiconductor Engineering Representative.

Semiconductor Products Inc.
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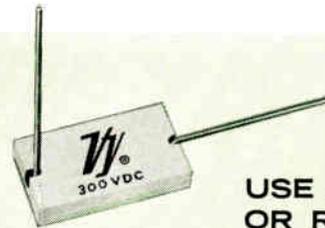
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1986



solid state
PORCELAIN CAPACITOR

Labstock Kits



USE AXIALLY
OR RADIALLY!

**SPECIALLY
PRICED**

FOR EXPERIMENTAL USE

Electronic components are used up fast in experimental work, and budgets often take a beating. The two assortments of Axial-Radial "VY" Capacitors not only provide the units you need for prototype and breadboard use, but are offered at 45% off list price.

Parts are packaged and sorted by value in individual, labeled drawers for fast, easy selection. 32-drawer, enameled metal cabinet is compact, sturdy — takes up less than 1/2 sq. ft. of bench space.



GENERAL PURPOSE KIT

Contains 576 parts consisting of 18 pieces each of VY 12 and VY 16 case sizes in all values between 100 and 1000 mmf., and the following lower values: 10, 22, 33, 39, 47, 68 and 82 mmf. 5% tolerance.

Complete Kit, Specially Priced At **\$380.00**



RF CAPACITOR KIT

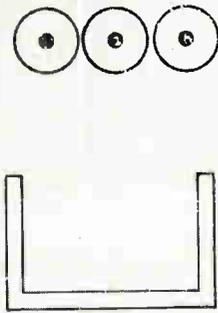
Contains 18 pieces each of the following capacitance values in the VY 12 case size: 1.0, 1.5, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2, 10, 12, 15, 18, 22, 33 and 47 mmf. 5% tolerance.

Complete Kit, Specially Priced At **\$180.00**

Write for FREE CATALOG on the complete line of "Vitramon" Porcelain and Ceramic Capacitors

Vitramon[®]
INCORPORATED

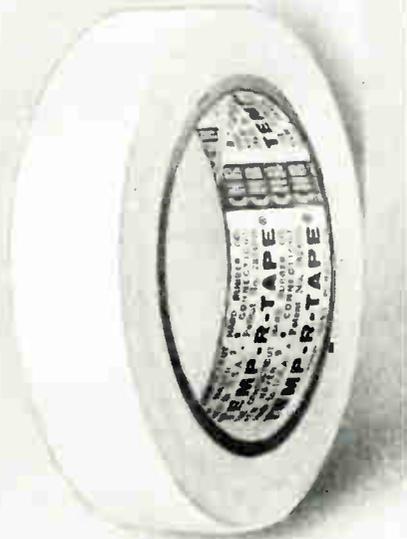
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TEFLON[®] + SILICONE ADHESIVE

**PRODUCES
TEMP-R-TAPE[®]**

**A
HIGHLY
RELIABLE
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INSULATION**



Pressure Sensitive Temp-R-Tape[®] is produced by CHR in a good variety of thicknesses and widths. If you require reliability Temp-R-Tape has it . . . ■ High dielectric. ■ Resistant to environmental aging. ■ Withstands temperatures from -100 to +500°F. ■ Extremely thin and lightweight. ■ High elongation — tight wrap over sharp bends. ■ Non corrosive — non contaminating. ■ Non moisture absorbing. ■ Temp-R-Tape is stocked by distributors across the country. Check Thomas Register for your local CHR Distributor. The Connecticut Hard Rubber Co., New Haven, Connecticut.

CHR

*DuPont TM

Temp-R-Tape is a registered TM of CHR.

CONNECTICUT HARD RUBBER CO., NEW HAVEN, CONN.

INTERNATIONAL NEWS

furnaces to the coil conveyors—will be controlled by a GE-412 computer.

London—A new closed-circuit TV camera which can be operated from a 12-v. dc car battery or ac mains has been announced by EMI Electronics.

AUSTRALIA

Canberra—The second of two large-scale Honeywell 800 computers, valued at more than \$2 million, has been flown from Boston to Australia. The EDP systems are consigned to the Dept. of Defense here.

NORTH AMERICA

New York—American business firms establish foreign subsidiaries to maintain and expand markets, not because of tax advantages, reports the National Association of Manufacturers. Of 82 large firms surveyed, only 15 mentioned tax advantages as an important reason for establishing foreign subsidiaries.

Washington, D. C.—Draper Daniels, Illinois advertising executive, has been appointed U. S. National Export Coordinator. Operating from the Dept. of Commerce and responsible to Secretary Luther H. Hodges, Daniels will coordinate the export expansion programs of all government agencies.

New York—An up-to-date catalog of electrical standards used in 38 foreign countries, including those of member nations of the Common Market, has been published by the American Standards Association.

SOUTH AMERICA

Caracas—One of the largest power stations in South America, the hydroelectric Macagua I station on the lower Rio Caroni, has been put into operation after a six-year construction period. Six hydro-electric alternators were supplied by AEG, of Germany.

AFRICA

Salisbury—A model electronic teaching lab was one of the highlights at the U. S. Exhibit at the Third Central African Trade Fair. It was held in Bulawayo, another Southern Rhodesian city. Blonder-Tongue Laboratories, Newark, N. J., supplied the equipment.

Accra—Based on power available from the Volta River Project, Ghana plans to develop an electronics industry. Radio and TV assembly plants will be built along with facilities for electrical production.

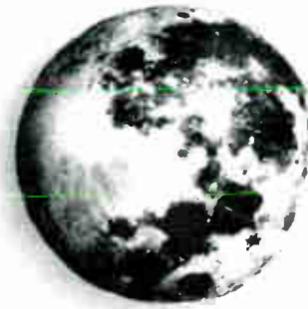
Description	All units shown 3/4 actual size	Name	Model	Resistances (Ohms) ①	Terminals ②	End Settings (%) ③	Tolerance (%) ④	Power Rating (Watts)	Max. Operating Temp. (°C)	Adjustment Turns	Humidity Proof (Mil Specs)	Size (Inches)			Standard Resistances (Ohms)	Prices, U.S.A. ⑤		
												H	W	L		1-9	10-24	25-49
GENERAL-PURPOSE WIREWOUND		TRIMPOT	200	10Ω to 100K	L*,S*,P L*	0-0.7③ 0-5.0	±10	0.25	105	25	No	5/16	1/4	1 1/4	10 to 10K 20K-25K 50K 100K	\$4.86 \$4.50 \$4.05 \$4.05	\$4.50 \$4.05 \$3.60 \$3.60	
GENERAL-PURPOSE RESISTON CARBON		TRIMPOT	215	20K to 1 Meg	L*,S*,P	0-1.0	±20	0.25	125	22	No	5/16	1/4	1 1/4	20K to 1 Meg	4.86 4.50 4.05	4.86 4.50 4.05	
HIGH-TEMPERATURE WIREWOUND		TRIMPOT	260	10Ω to 100K	L*,S*,P L*	0-0.2③ 0-5.0	±10	1.0	175	25	No	5/16	1/4	1 1/4	10 to 10K 20K-25K 50K 100K	5.94 5.50 4.95 6.48 6.00 5.40 7.56 7.00 6.30 9.18 8.50 7.65	5.50 4.95 4.40 6.00 5.40 4.80 7.00 6.30 5.60 8.50 7.65 6.75	
MICRO-MINIATURE HIGH-TEMPERATURE WIREWOUND		TRIMPOT	3000	50Ω to 20K	P	0-0.1③	±10	0.5	175	15	Yes	5/16	5/32	3/4	50-10K 20K	9.72 9.00 8.10 10.80 10.00 9.00	9.00 8.10 7.20	
HIGH-TEMPERATURE RESISTON CARBON		TRIMPOT	3001	20K to 1 Meg	P	0-1.0	±20	0.20	150	15	Yes	5/16	5/32	3/4	20K to 1 Meg	9.18 8.50 7.65	8.50 7.65 6.75	
SUB-MINIATURE HIGH-TEMPERATURE WIREWOUND		TRIMPOT	220	100Ω to 30K	L*,W*	0-0.1③	±10	1.0	175	15	Yes	5/16	3/16	1	100 to 10K 20K to 30K	8.64 8.00 7.20 10.26 9.50 8.55	8.00 7.20 6.30	
HIGH-TEMPERATURE WIREWOUND		TRIMPOT	224	10Ω to 50K	L*,S*,P L*,S*,P	0-0.1③ 0-5.0	±5	1.0	175	22	Yes	5/16	3/16	1 1/4	10 to 10K 20K-25K 50K 100K	7.02 6.50 5.85 8.64 8.00 7.20 9.18 8.50 7.65 11.34 10.50 9.45	6.50 5.85 5.15 7.20 6.30 5.40 8.50 7.65 6.75 10.50 9.45 8.55	
HIGH-TEMPERATURE RESISTON CARBON		TRIMPOT	3051	20K to 1 Meg	L*,S*,P	0-1.0	±20	0.25	150	22	Yes	5/16	3/16	1 1/4	20K to 1 Meg	7.02 6.50 5.85	6.50 5.85 5.15	
HIGH-TEMPERATURE WIREWOUND		TRIMPOT	3010	10Ω to 50K	L*,P* L*,P*	0-0.2③ 0-5.0	±10	1.0	175	25	Yes	5/16	9/32	1 1/4	10 to 10K 20K-25K 50K 100K	7.02 6.50 5.85 8.64 8.00 7.20 9.18 8.50 7.65 11.34 10.50 9.45	6.50 5.85 5.15 7.20 6.30 5.40 8.50 7.65 6.75 10.50 9.45 8.55	
HIGH-TEMPERATURE RESISTON CARBON		TRIMPOT	3011	20K to 1 Meg	L*,P*	0-1.0	±20	0.25	150	22	Yes	5/16	9/32	1 1/4	20K to 1 Meg	7.02 6.50 5.85	6.50 5.85 5.15	
MICRO-MINIATURE WIREWOUND		TRIMPOT	3280	100Ω to 50K	L,P,W	0-0.1③	±5	1.0	175	25	Yes	13/64	3/8	3/8	100-10K 20K-25K 50K	6.71 6.22 5.60 7.56 7.00 6.30 10.01 9.27 8.34	6.22 5.60 4.90 7.00 6.30 5.60 9.27 8.34 7.44	
MICRO-MINIATURE RESISTON CARBON		TRIMPOT	3281	20K to 1 Meg	L,P,W	0-1.0	±20	0.25	150	25	Yes	13/64	3/8	3/8	20K to 1 Meg	7.56 7.00 6.30	7.00 6.30 5.60	
SUB-MINIATURE HIGH-TEMPERATURE WIREWOUND		TRIMPOT	3250	100Ω to 50K	L P,W	0-0.1③	±5	1.0	175	25	Yes	3/16 7/32	1/2 1/2	1/2	100 to 10K 20K-25K 50K 100 to 10K 20K-25K 50K	6.71 6.22 5.60 7.56 7.00 6.30 10.01 9.27 8.34 7.23 6.69 6.02 7.97 7.38 6.64 10.53 9.75 8.78	6.22 5.60 4.90 7.00 6.30 5.60 9.27 8.34 7.44 6.69 6.02 5.30 7.38 6.64 5.90 9.75 8.78 7.85	
SQUARE HIGH-TEMPERATURE RESISTON CARBON		TRIMPOT	3251	20K to 1 Meg	L P,W	1.0	±20	0.50	150	25	Yes	3/16 7/32	1/2 1/2	1/2	20K to 1 Meg	7.83 7.25 6.53	7.25 6.53 5.85	

UNSEALED SINGLE-TURN
COMMERCIAL
HUMIDITY-PROOF
SPECIAL-PURPOSE

Description	All units shown 3/4 actual size	Name	Model	Resistances (Ohms) ①	Terminals ②	End Settings (%) ③	Tolerance (%) ④	Power Rating (Watts)	Max. Operating Temp. (°C)	Adjustment Turns	Humidity Proof (Mil Specs)	Size (Inches)			Standard Resistances (Ohms)	Prices, U.S.A. ⑤		
												H	W	L		1-9	10-24	25-49
MICRO-MINIATURE HIGH-TEMPERATURE HUMIDITY-PROOF WIREWOUND		TRIMPOT	3300	50Ω to 20K	P S	0-1.0	±5	0.5	175	1	Yes	5/16 dia. x 3/16 5/16 dia. x 7/32	50 to 10K 20K	5.84 5.50 4.95 7.86 7.00 6.30	5.50 4.95 4.40 7.00 6.30 5.60			
SUB-MINIATURE SINGLE-TURN WIREWOUND		TRIMPOT	3367	100Ω to 20K	P S	0-1.0	±5	0.5	105	1	Steady State Only	1/2 dia. x 15/64 1/2 dia. x 17/64	100 to 20K 100 to 20K	4.86 4.50 4.05 5.67 5.25 4.73	4.50 4.05 3.50 5.25 4.73 4.20			
SUB-MINIATURE SINGLE-TURN RESISTON CARBON		TRIMPOT	3368	20K to 1 Meg	P S	0-1.0	±20	0.25	105	1	Steady State Only	1/2 dia. x 15/64 1/2 dia. x 17/64	20K to 1 Meg 20K to 1 Meg	5.94 5.50 4.95 6.75 6.25 5.63	5.50 4.95 4.40 6.25 5.63 5.10			
COMMERCIAL WIREWOUND		TRIMIT	271 273 275	100Ω to 10K	L* S* P	0-2.0	±10	0.25	85	25	No	5/16	1/4	1 1/4	100 to 10K	3.18 2.95 2.65	2.95 2.65 2.35	
COMMERCIAL RESISTON CARBON		TRIMIT	272 274 276	20K to 1 Meg	L* S* P	0-7.5	±20	0.2	85	25	No	5/16	1/4	1 1/4	20K to 1 Meg	3.78 3.50 3.15	3.50 3.15 2.80	
COMMERCIAL WIREWOUND		E-Z-TRIM	3067	50Ω to 20K	S,P	0-1.0	±10	0.5	85	15	Steady State Only	23/64	9/32	1	50 to 20K	1.65 1.53 1.37	1.53 1.37 1.20	
COMMERCIAL RESISTON CARBON		E-Z-TRIM	3068	20K to 1 Meg	S,P	0-5.0	±20	0.2	85	15	Steady State Only	23/64	9/32	1	20K to 1 Meg	1.65 1.53 1.37	1.53 1.37 1.20	
HIGH-POWER (2-WATT) HIGH-TEMPERATURE WIREWOUND		TRIMPOT	207	100Ω to 100K	L*	0-0.2③	±10	2.0	175	25	No	13/16	9/32	1 1/4	100 to 50K 100K	10.26 9.50 8.55 11.88 11.00 9.90	9.50 8.55 7.65	
HIGH-POWER (3 1/4-WATT) HUMIDITY-PROOF WIREWOUND		TRIMPOT	3020	100Ω to 50K	L*	0-0.1③	±5	3.75	200	25	Yes	21/64	1/4	1 1/4	100 to 10K 20K-25K 50K	14.04 13.00 11.70 15.66 14.50 13.05 16.20 15.00 13.50	13.00 11.70 10.35	
DUAL-ELEMENT WIREWOUND		TWINPOT	209	10Ω to 50K	L*	0-0.2③	±10	0.25 (each element)	105	25	No	5/16	1/2	1 1/4	10 to 10K 20K-25K 50K	12.96 12.00 10.80 14.58 13.50 12.15 16.20 15.00 13.50	12.00 10.80 9.45	
HIGH-POWER (15-WATT) HIGH-TEMPERATURE WIREWOUND		TRIMPOT	3030	10Ω to 10K	L	0-5.0	±10	15	265	25	No	1-5/64	33/64	1-17/64	10 to 10K	12.96 12.00 10.80	12.00 10.80 9.45	
PANEL MOUNTING																		

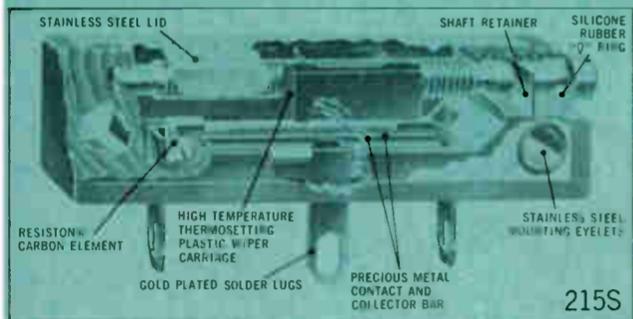
*Models so designated are available with the added convenience of panel mounting. Unique design permits quick factory conversion of "off-the-shelf" units. Clip brackets, mounting brackets and mounting screws are available for other mounting requirements.

	add to price of basic unit
209	2.16 2.00 1.80
All others	.81 .75 .68

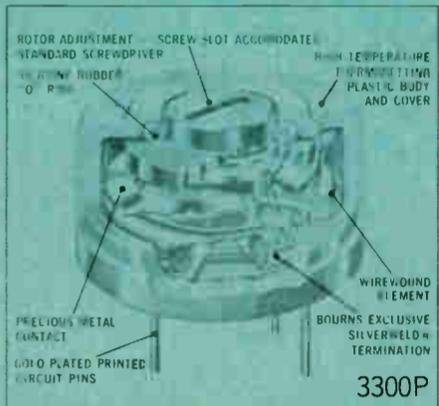


THE TRIMPOT ADJUSTMENT POTENTIOMETER line has grown from a small nucleus to 28 standard models, four terminal types, and three mounting styles . . . the most complete selection in the industry! This single-source capability, combined with the TRIMPOT component record of reliability, make Bourns the logical adjustment potentiometer source. You can almost always find a model with specs and price suited to your specific needs. Write for a detailed specification sheet, including out-line drawings, on the model of your choice.

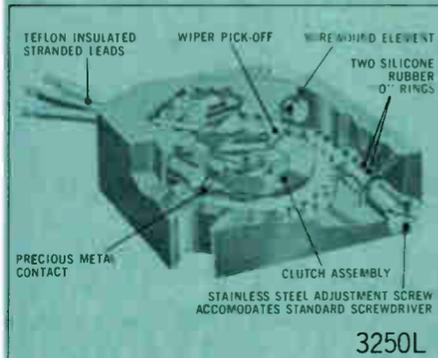
① Key to terminal types: L = Insulated stranded leads, S = Solder lugs (includes 3367S & 3300S, panel mounting bushing only), P = Printed circuit pins, W = Uninsulated wires (side mounting 3250, 3251, 3280).
 ② Franchised local distributors quote factory prices through 500 pieces. Contact factory for prices in higher quantities.
 ③ The following resistances are standard if they fall within the limits listed: 10, 20, 50, 100, 200, 500, 1K, 2K, 5K, 10K, 20K, 25K (wirewound only), 50K, 100K, 200K, 500K, 750K, 1 Meg. Other resistances available on special order.
 ④ Or 0 to 0.5 ohms, whichever is greater. ⑤ Or 0 to 1.0 ohms, whichever is greater. ⑥ Closer tolerances available on request, except commercial models.
 ⑦ All models are sealed against sand and dust. ⑧ Humidity-proof version available on special order. Contact factory for part number, price and delivery.
 ⑧ TRIMPOT, TWINPOT, TRIMIT, and E-Z-TRIM are registered trademarks of Bourns, Inc. Other products made by Bourns, Inc. are identified by trademarks which include BOURNS®, TRIMMISTOR®, TRIMM®, SILVERWELD®, RESISTON®, PARILIUM®, and RESISTALOV®.



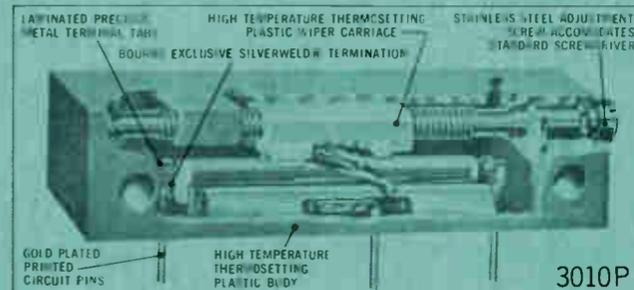
215S



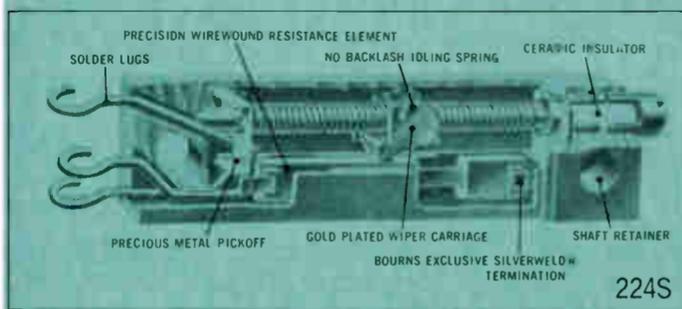
3300P



3250L



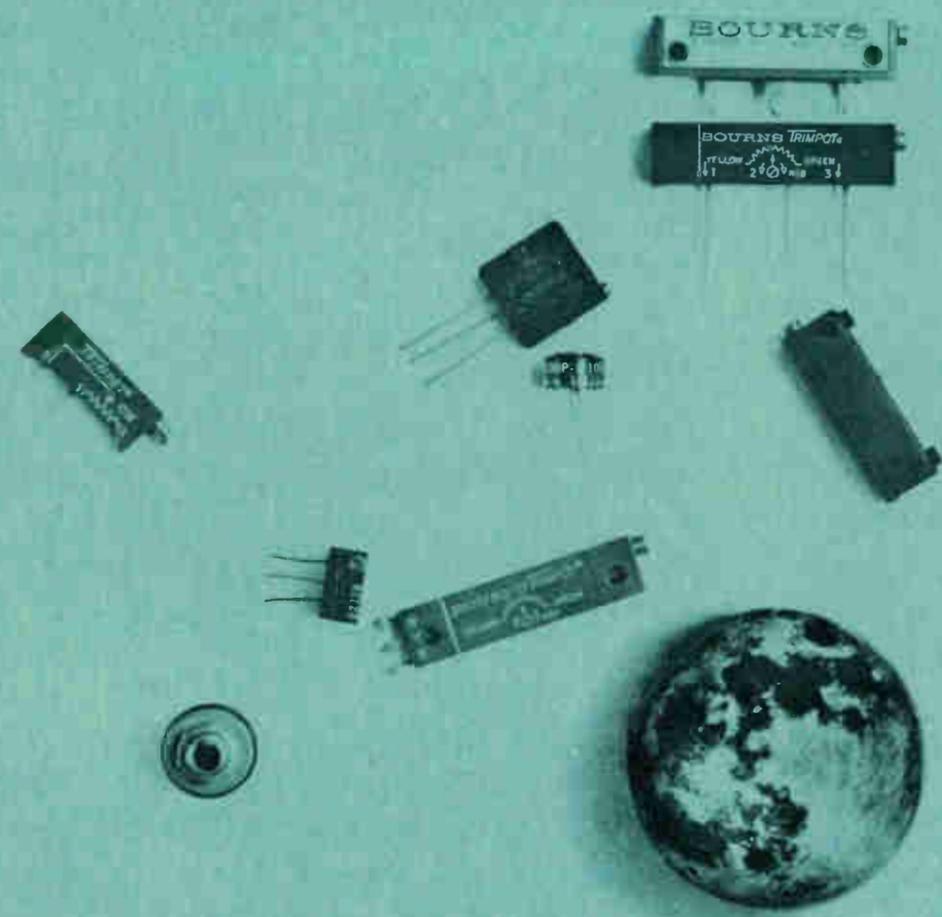
3010P



224S

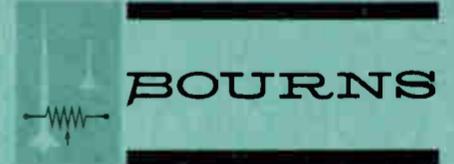
The construction details shown in these cut-a-way drawings are not necessarily descriptive of all models, but typical of the design features found in Bourns adjustment potentiometers. These features include multi-turn screwdriver adjustment; small space-saving configuration; idling wiper assembly to prevent damage from forced adjustment; self-locking shaft; silicone rubber O-rings; low temperature coefficient resistance cards; and Bourns exclusive indestructible SILVERWELD[®] multiwire termination.

In addition to TRIMPOT[®] adjustment potentiometers, Bourns reliability and performance are now available in other outstanding products. A complete series of precision potentiometers fill the industry requirements for military reliability and reduced size; the new KNOBPOT[®] readout-precision potentiometer introduces an entirely new design concept — a precision potentiometer, readout dial, and adjustment knob integrated into a single unit; and a subminiature relay — small enough to fit into a transistor case—meets military reliability standards. For detailed information on these components, contact your nearest Bourns sales representative or write the factory direct.

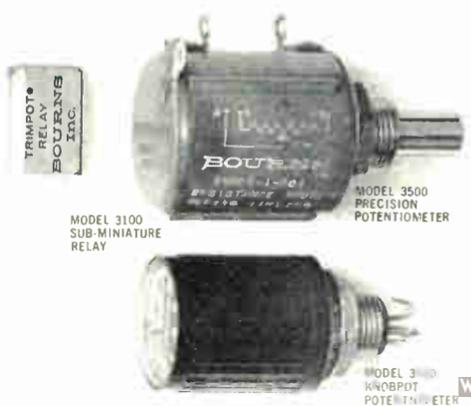


BOURNS TRIMPOT[®] ADJUSTMENT POTENTIOMETERS

The TRIMPOT potentiometer was introduced by Bourns, Inc. in 1952 to meet the need of the aircraft-missile industry for a rugged, high-performance miniature adjustment potentiometer. The first TRIMPOT model pioneered such potentiometer qualities as small size, accurate multi-turn adjustment, stable settings, and reliability. Today the TRIMPOT potentiometer is accepted as a standard component in thousands of applications ranging from aerospace projects to communications equipment, from computers to amplifiers, from satellites to commercial appliances . . . wherever the ultimate in reliability and performance is required.



BOURNS, INC., TRIMPOT[®] DIVISION
1200 COLUMBIA AVENUE, RIVERSIDE, CALIF.
OV 4-1700, TWX RZ9222, CABLE BOURNSINC



MODEL 3100 SUB-MINIATURE RELAY

MODEL 3500 PRECISION POTENTIOMETER

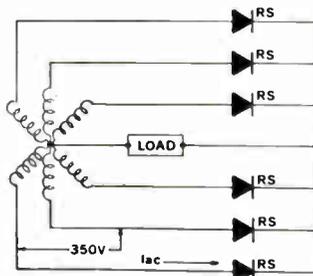
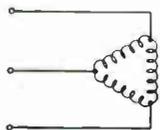
MODEL 3 KNOBPOT POTENTIOMETER



TARZIAN HEAVY DUTY RECTIFIERS

Hard solder joints top list of features in Tarzian hermetically sealed **250 AMP Rectifiers**

Six Phase Star Application



RS = Sarkes Tarzian 9-50 • Output = 230 VDC @ 1250 amps dc
Ripple = 4.5% (unfiltered) • Iac = 500 amps RMS
(Forced air cooling, 2000 lfm, fin size 6" square, Cu)

■ Hard solder at every junction interface, to resist metal fatigue, is only one example of Tarzian's ability to give you the latest top-performance features at low cost. The 250 ampere, 100 to 600 piv Tarzian ST9 series rectifiers also give you:

- Hermetic seals at all points
- Special refractory metals to support silicon junction, match silicon expansion coefficient
- Special Tarzian processed silicon with very low dislocation density, eliminating points of high voltage or current concentration
- Oversize alloyed junctions, holding maximum forward voltage drop to a low 1.2 volts in all units
- Processed in reducing atmosphere for maximum bonding and stability

Take advantage of years of Tarzian experience in rectifier production. Prices are competitive. Delivery is prompt. Application engineering assistance is free. Write today for specifications and application ideas.

Tarzian Type*	Amps DC	Peak inverse volts	Max. inverse volts	Max. forward voltage drop	Max. reverse current (ma)
ST9-10	250	100	70	1.2	50
ST9-20	250	200	140	1.2	50
ST9-30	250	300	210	1.2	50
ST9-40	250	400	280	1.2	50
ST9-50	250	500	350	1.2	50
ST9-60	250	600†	420	1.2	50

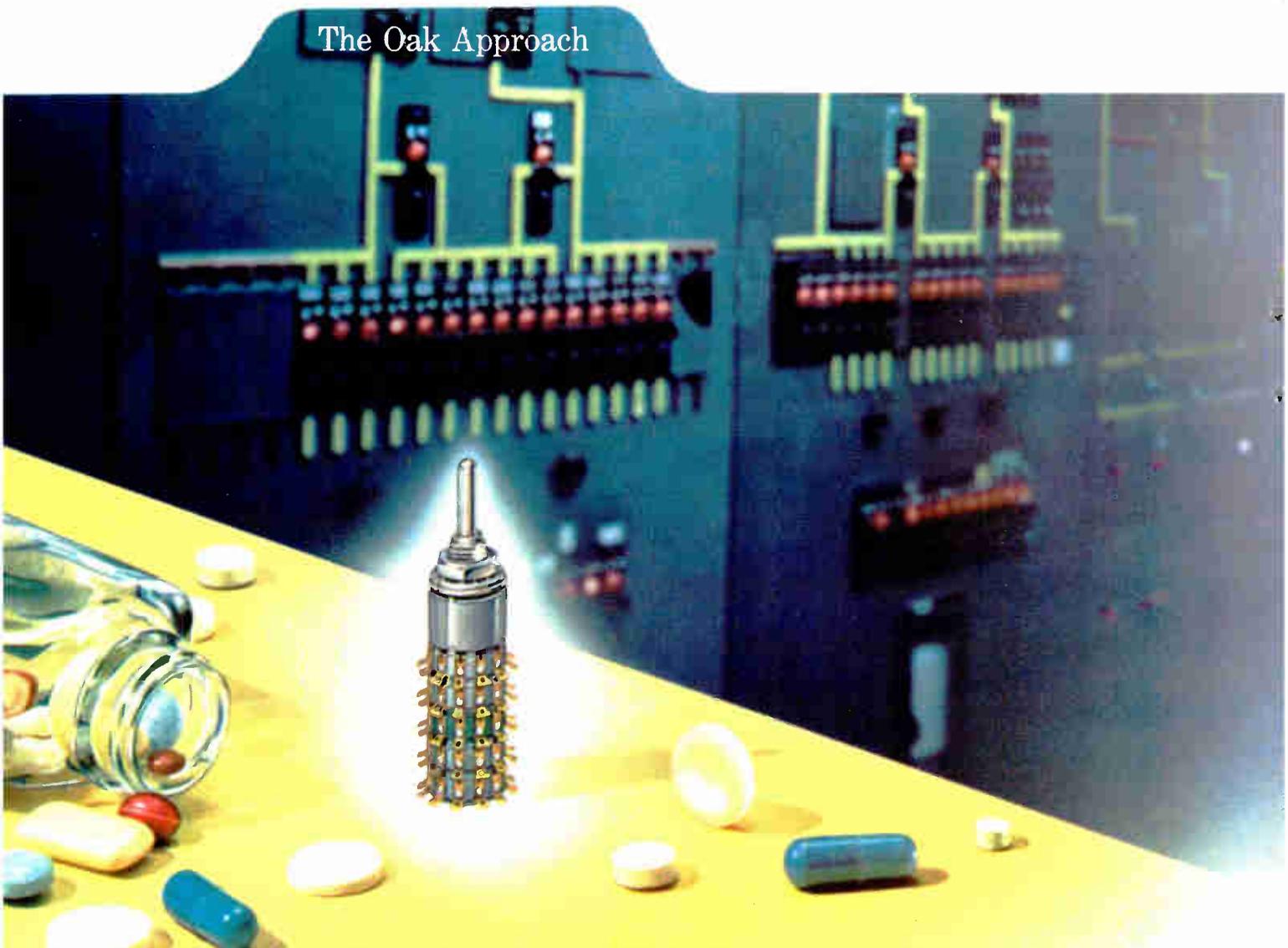
*Add N for negative, P for positive, base polarity

†Other 600 PIV units available for 0.5, 0.75, 1.5, 2, 6, 10, 12, 20, 35, 50, 100, 150, and 200 ampere requirements



SARKES TARZIAN, Inc.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices
SEMICONDUCTOR DIVISION • BLOOMINGTON, INDIANA
Canadian Licensee: Marsland Engineering Limited • 350 Weber Street North, Waterloo, Ontario



Cure... for space headaches

new ultracompact half-inch switch cuts space problems down to size!

It's become almost axiomatic in electronics that "thinking big" requires thinking *small*. And, of course, when circuit proportions shrink, the demand for smaller switches mounts correspondingly. Imagine how many tight places are presently crying for the advantages of this new *half-inch diameter, multisection rotary switch*: the *very first of its kind*, functionally equivalent to a regular-size rotary — physically smaller than your index finger!

Obviously rotary switches have "gone small" before; but this is far-and-away the first *multisection*, 12-position design able to match the versatility of its more sizable counterparts. Up to 5 sections per switch; 3 poles per section! And small

size doesn't imply delicateness. Half-inch Oak rotary switches shrug-off environmental extremes . . . withstand 50-hour salt spray; feature reliable double-wiping, self-cleaning contacts.

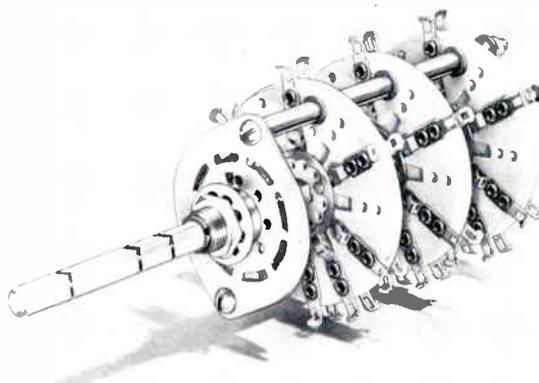
Even if your present requirements are apart from this sort of diminutive design, Oak application engineers still offer you a vital service. Their experience ranges through all sorts of switching problems involving function, environment, space and costs. And Oak capabilities also encompass production of precision subassemblies, made to your exact specifications.

For further information, contact your Oak representative. Or, feel free to phone us direct any time that we can be of help.

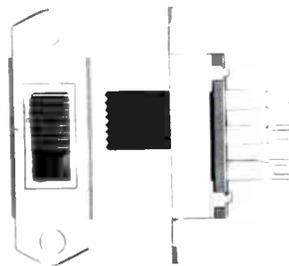
SWITCH SHOWN ACTUAL SIZE

Where creativity pays practical dividends

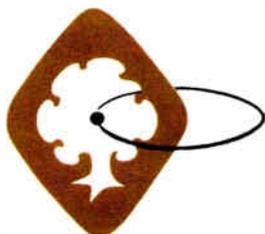
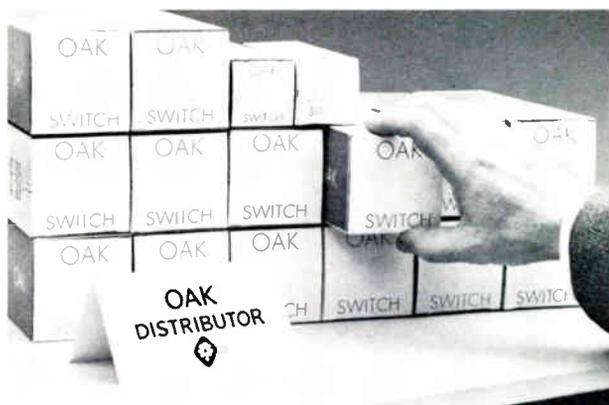
OAK rotary Power-Rated Switch — New compact design, with trim profile. Lowest-cost of all rotary power switches! Actually brings savings of one-third to one-half, compared to other alternatives. And the new Oak rotary Power-Rated Switch is just one current offspring of *New Product Engineering* — the department at Oak now given the full-time assignment of creating and improving product design. Rotary power switches can be had with one, two or three sections; provide up to 12 positions. UL listed for 125 vac, 6 amps; inductive rated at .75 PF; tested to 60,000 makes-and-breaks — or *ten times UL* requirements!



OAK space-saver slideswitch — 30% slimmer than prior designs, with seven fewer parts. Width savings so significant as to suggest literally hundreds of uses in equipment where space is at a premium! Economical too — you'll find this trim, new slideswitch *priced lower* than bulkier, ordinary models. Series-200 Oak slideswitches are obtainable in 11 different switching configurations. Rated 3 amps; available with or without UL listing. Double-wiping, self-cleaning contacts. Operation thoroughly tested, proven more reliable and longer-lasting than even its popular forebears.



OAK also helps you save time! A new program now means distributors nation-wide will carry more than 130 types and sizes of Oak rotary switches, right on their shelves! You'll find superior replacements for many common makes; plus special configurations not available from stock *anywhere else*. Also component parts for assembling your own style of switch, from one to four sections, two to 23 positions. Quality is fully equivalent to our custom switch runs. Call collect for the name of your nearest Oak stock-switch distributor: Area code 815; 459-5000—request *Oak operator 10*.



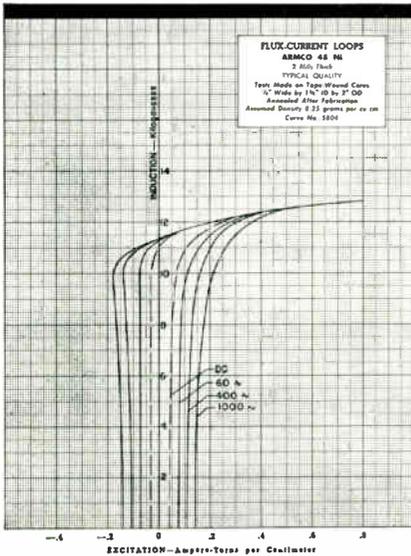
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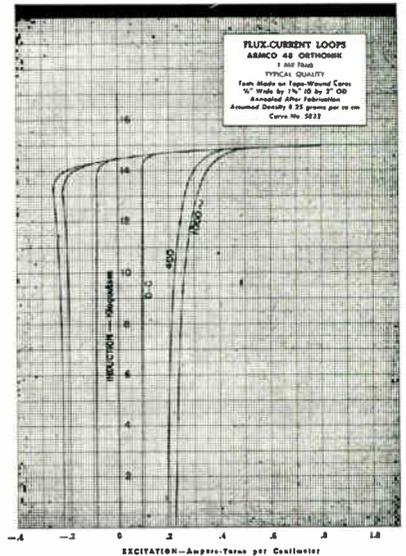
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ROTARY AND PUSHBUTTON SWITCHES • TELEVISION TUNERS • VIBRATORS • APPLIANCE
AND VENDING CONTROLS • ROTARY SOLENOIDS • CHOPPERS • CONTROL ASSEMBLIES

HOW ARMCO NI-FE MAGNETIC ALLOYS HELP YOU



*Design
Efficient,
Low-Cost
Electronic
Components*



Armco 48 Ni and 48 ORTHONIK® provide all the basic advantages of nickel-iron magnetic alloys, plus a full range of magnetic properties and thicknesses that enable you to achieve design objectives more precisely and at least cost. In addition, our free 64-page manual gives you necessary design curves and other pertinent data on each alloy and thickness. For communication, computer, control and high efficiency equipment, as well as the rapidly expanding list of other electronic apparatus, these materials offer useful advantages.



For Better
Electrical
Apparatus

Armco 48 Ni—Combines high permeability at low and moderate inductions with low coercive force and low hysteresis loss. It is available in thicknesses of 2 to 14 mils and is specially processed for wound cores or laminations. Armco 48 Ni is especially suitable for communications equipment, high quality transformers and other units requiring high permeability.

Armco 48 ORTHONIK — This highly oriented Armco alloy combines a rectangular hysteresis loop with low coercive force and high permeability at low and moderate inductions. Available in thicknesses from 1/4 to 14 mils for use over a wide range of frequencies. An ideal core material for reactors, computer components, magnetic amplifiers and bi-stable elements for logic circuits.

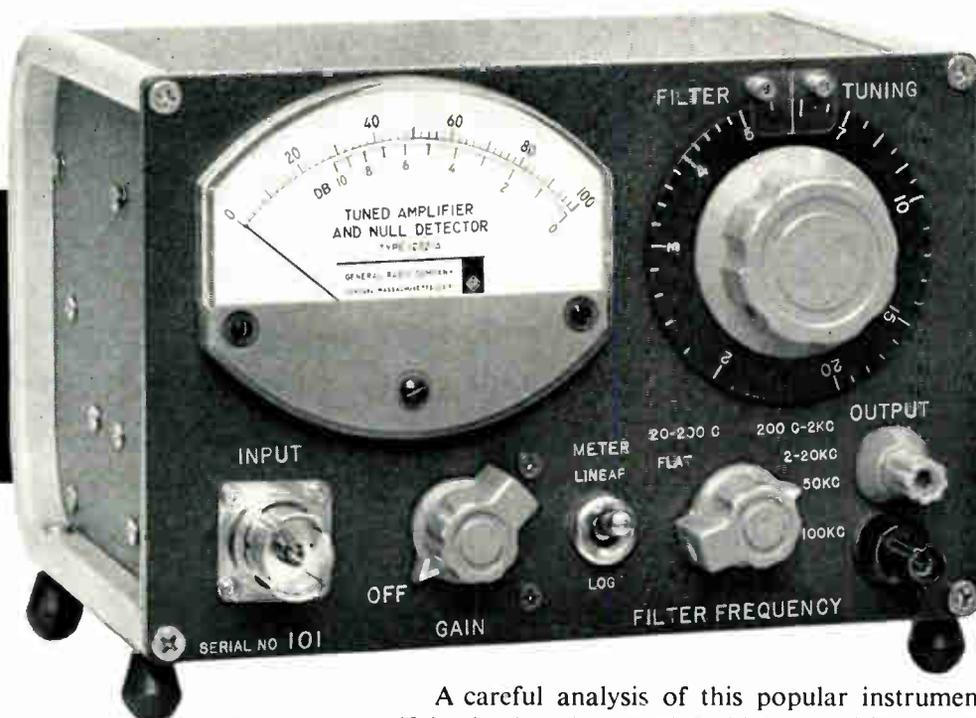
Use Armco Nickel-Iron Magnetic Alloys to give your products maximum efficiency most economically. Write us for complete information. **Armco Division, Armco Steel Corporation, 2382 Curtis St., Middletown, Ohio.**



Armco Division

Looking for a Null?

This Detector's 1 μ v Sensitivity Will Find It



Fully Transistorized

Type 1232-A
Tuned Amplifier
and Null Detector
\$360

A careful analysis of this popular instrument will reveal why engineers are specifying it when they require a highly sensitive, low noise, continuously tunable null detector. Extremely high sensitivity is attained by new circuits that stem from the application of a simplified noise theory* developed by GR engineers. Continuous tuning is provided by an RC null network that contains a potentiometer as its single variable element. This unique feature eliminates the alignment and tracking problems associated with conventional null networks using three variable elements. Other major features are listed below.

Although designed primarily as a bridge detector, the 1232-A can be used, as well, as a detector of high-frequency modulated signals (with a crystal demodulator), audio-frequency wave analyzer, and general-purpose tunable amplifier.

- **EXTREMELY HIGH SENSITIVITY** — one microvolt or better, full scale, over most of the frequency range.
- **EXCELLENT SELECTIVITY** — bandwidth at any frequency is about 5%. Second harmonic rejection is at least 35 db. Above 200 cps, 60-cycle rejection is at least 60 db.
- **LOW NOISE LEVEL** — less than 0.2 μ v for most of the tuned range.
- **CONTINUOUSLY TUNABLE** — from 20c to 20 kc in three 10:1 ranges.
- **TWO FIXED-TUNED FREQUENCIES** — at 50 kc and 100 kc.
- **HIGH GAIN** — 120 db for tunable settings; 100 db for flat 20c to 100-kc position; 106 db at 50 kc; and 100 db at 100 kc.
- **CONSTANT OUTPUT** — ± 3 db from 20c to 100 kc (FLAT position).
- **LINEAR OR LOGARITHMIC RESPONSE** — provided by meter switch. Compression adds 40 db to upper portion of meter scale for null measurements; does not affect sensitivity at bottom end of meter scale.
- **SMALL, COMPACT, AND LIGHTWEIGHT** — fully transistorized, unit measures 8 inches wide x 6 inches high x 7 $\frac{1}{2}$ deep, and weighs 5 $\frac{3}{4}$ pounds.
- **FRONT LEGS EXTEND** — permits tilting for easier viewing of panel.
- **LOW POWER REQUIREMENTS** — 12 volts dc, from 9 mercury cells. Estimated battery life is 1500 hours at a cost of about 0.4-cent per hour.
- **RACK MOUNTING PROVISIONS** — panel extensions available for rack mounting.

*Available on request, reprint of "A Simplified Noise Theory, and its Application to the Design of Low-Noise Amplifiers", by A. E. Sanderson and R. G. Fulks, IRE Transactions on Audio, July — August, 1961, and NEREM 1960 Record

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KAY
Mega-Switch
KMC 255-A

New DC to 500 mc Coaxial Electronic Switch

Primarily designed for use with a sweeping oscillator, the Kay Mega-Switch KMC 255-A is an extremely fast, accurate electronically controlled coaxial switch that displays two related wave-shapes on an oscilloscope. *Superimpose calibrating reference line (3 db, 6 db.) on frequency response display or switch in reference standard to establish tolerance limits.*

Offering superior switch action and frequency response, the Mega-Switch KMC 255-A provides leakage across input and output down to 70 db and more. The switching rate is continuously variable from 0.2 to 100 cps and can be synchronized externally or by internal circuitry.

Write for Complete Catalog Information

KAY ELECTRIC COMPANY

DEPT. EI-9 MAPLE AVENUE, PINE BROOK, MORRIS COUNTY, N. J.
Capital 6-4000

SPECIFICATIONS

Frequency range: DC to 500 mc
VSWR: Less than 1.15:1
Off: More than 70 db down at 200 mc
Switching rate: Variable 0.2 to 100 cps
Impedance: 50 ohms
Price: \$345.00 F.O.B. Factory
(\$380.00 F.A.S. N.Y.)



KAY Mega-Switches D.P.D.T.

- Molded Teflon Body
 - Solid Silver Contacts
 - DC to 500 mc and Up
 - Low Inductance
 - Low Resistance
 - Low Capacitance
- Box of 12 \$49.50 ppd. in U.S.A.

Design for Reliability and Superior Performance

with these Allen-Bradley quality electronic components

■ Mr. Design Engineer! When deciding upon components for your circuits, please remember that you can always be sure of obtaining *maximum reliability* with Allen-Bradley electronic components—and quality of production is consistent from one order to the next—and from one year to the next.

For example, Allen-Bradley fixed resistors—made by A-B's exclusive hot molding process—are famous for their conservative ratings, stable characteristics, and *complete freedom from catastrophic failures*.

Then there are the miniature Type G potentiometers. They feature a solid, hot molded resistance element that gives exceptionally long life and quiet operation which even improves with use. Control is always smooth

—there are never any abrupt resistance changes during adjustment.

This same hot molding process is also used in making A-B's Type R adjustable fixed resistors, which provides "stepless" adjustment of resistance. In addition, the moving element is self-locking, resulting in absolutely stable settings.

Another "exclusive" is A-B's ceramic feed-thru and stand-off capacitors for use at VHF and UHF frequencies. With their *unique* discoidal design, all parallel resonance effects are eliminated at frequencies of 1000 mcps and less.

For details on the complete line of A-B *quality* electronic components, please send for Publication 6024.



HOT MOLDED RESISTORS
Type TR 1/10 Watt
MIL Type RC 06

HOT MOLDED RESISTORS
Type EB 1/2 Watt
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VARIABLE RESISTORS
Type G 1/2 Watt
MIL Type RV-6

FEED-THRU AND STAND-OFF CAPACITORS
Also made with solder mounting

HOT MOLDED RESISTORS
Type CB 1/4 Watt
MIL Type RC 07

HOT MOLDED RESISTORS
Type GB 1 Watt
MIL Type RC 32

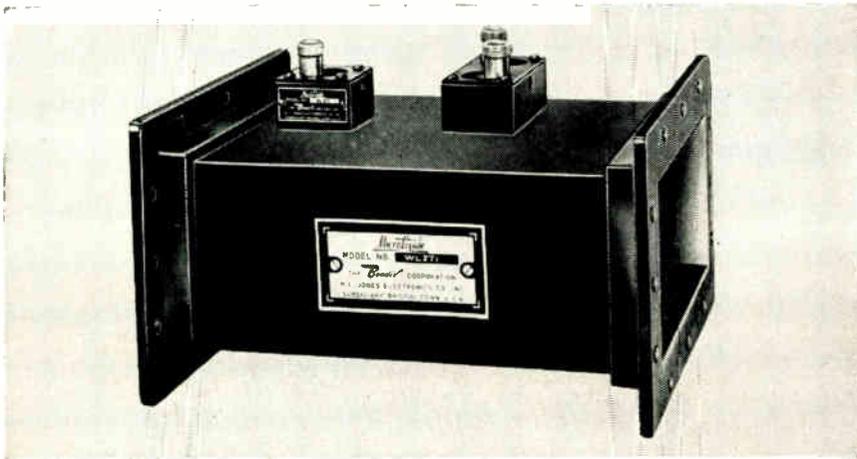
ADJUSTABLE FIXED RESISTORS
Type R 1/4 Watt

HOT MOLDED RESISTORS
Type HB 2 Watts
MIL Type RC 42

ALLEN-BRADLEY

Allen-Bradley Co., 1342 S. Second Street, Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ontario

**QUALITY
ELECTRONIC
COMPONENTS**



NEW, EXOTIC WAVEGUIDE DIRECTIONAL COUPLERS

As MicroMatch® has identified a complete line of high-quality coaxial directional couplers for the past 14 years, so MicroGuide now identifies a new line of waveguide directional couplers. And you can now specify MicroGuide with equal confidence whenever you have a requirement for S, C, X or L band directional couplers.

The model WL271, illustrated, is an example of a standard model modified to meet a specific customer requirement: L Band; 1100-1700 MCs.; 2RF sampling probes 30 and 72 db below main line Incident Power, and 1 probe 53 db below main line Reflected Power; directivity 35 db minimum; 150 KW average; 30 megawatts peak power. *All this in a package 1/10th the size of a conventional waveguide coupler.*

Find out how readily and inexpensively your most exacting S, C, X, and L Band coupler requirements can be satisfied. Write us at 185 N. Main St., Bristol, Connecticut, outlining your specifications in terms of frequency range, power level, coupling attenuation and type of waveguide.

M. C. Jones Electronics Co., Inc.



TELE-TIPS

COMPETING COMPUTERS is one of the problems facing American and Eastern Airlines officials as their merger progresses. Question is, which of their reservation systems to adopt? American is experimentally operating a \$30 million modified IBM 7090 dubbed "Sabre", in service since last May. It will eventually handle all reservations on the airline's 450 daily flights. Eastern's Rem Rand Univac 490 was placed in service last March performing a like function for its system.

NOISE ANNOYS reveals a 5 yr. Air Force study on the effects of jet noise near cities and housing developments. The decibel level is found a continuing problem despite a succession of efforts to solve it. From a psychological standpoint, the study reveals that fear of an aircraft crash is usually associated with the noise reaction. The study also showed that length of residence (accustoming) is no cure for annoyance. And older residents seem to voice greater annoyance over the jet sound levels.

FRINGE BENEFITS at Aerojet-General Corp.'s Astrionics "Clean Room" include a free shoe shine. The room's employees enter via a walk-through automatic machine which buffs their shoes top, bottom, and sides, and vacuums the dust away. Reason given for such a seeming clean feet fetish is that delicate satellite assembly work is carried on inside the clean room and dust tracked in by foot could seriously contaminate the satellite's components. Even the air in the room is filtered to maintain the purity of the product.

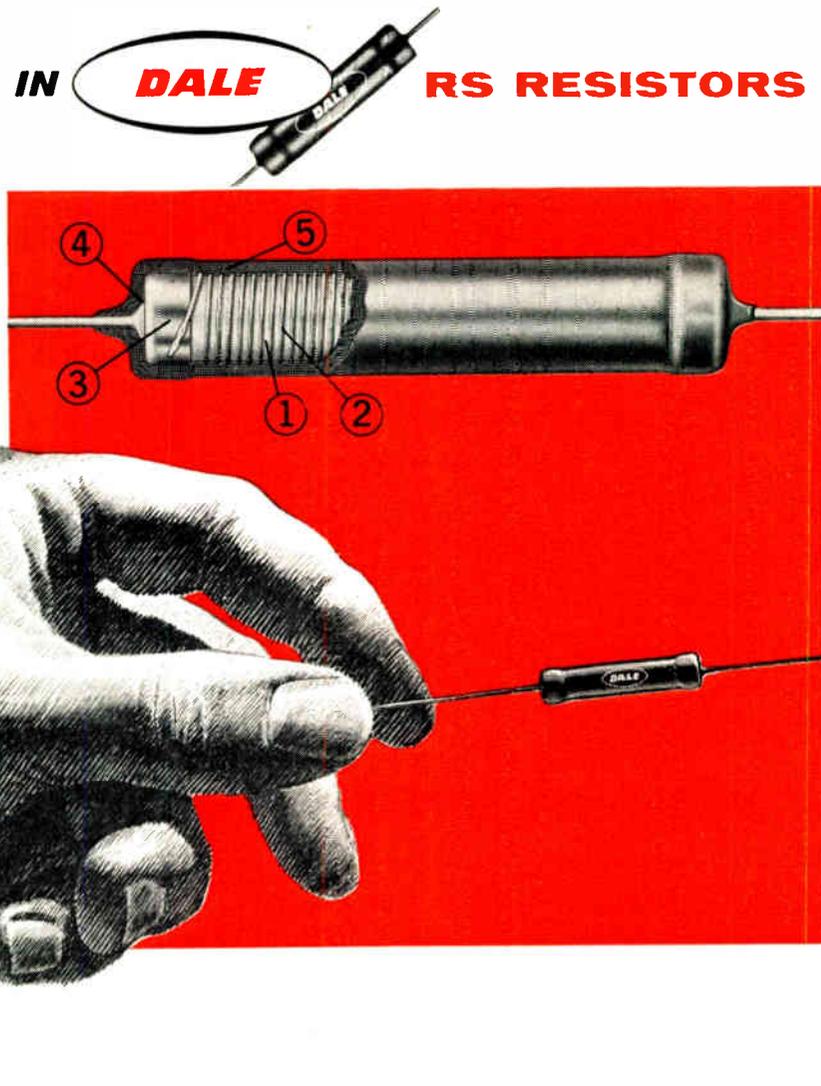
RUSSIAN TRANSLATIONS are being made available to American scientists and engineers in increasing numbers through the U. S. Department of Commerce, Office of Technical Services and the Special Libraries Ass'n. OTS and SLA began publishing a semi-monthly journal, TECHNICAL TRANSLATIONS, in January of 1959, listing all available translations. The journal is aimed at providing a central source of catalogued translations, particularly in the fields of science, engineering, technology, and medicine. The joint effort holds over 92,000 translations in its collection to date.

(Continued on page 50)

STABILITY IS INHERENT IN

DALE

RS RESISTORS



Designed to meet precision power requirements in advanced electronic circuits where space is at a premium. Outstanding silicone coating maintains stable performance under adverse environmental conditions.

SPECIFICATIONS

- Eleven physical sizes rated at $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 2.5, 3, 5, 7, 10 watts.
- Meet functional requirements of MIL-R-26C.
- Resistance range from 0.05 ohm to 175K ohms, depending on type and tolerance.
- Tolerances 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%.
- Temperature coefficient 20 PPM/degree C.
- Operating temperature range -55° C to 275° C.

Write for Dale Resistor Catalog A

HERE'S HOW DALE "BUILDS IN" RELIABILITY

- **CORES** are centerless ground, high purity ceramic, untouched by hand or foreign materials. Wire lays firmly and uniformly, eliminating local hot spots.
- **RESISTANCE WIRE** is procured to rigid specifications (analysis of each melt required). Untouched by hand or foreign materials. Tension accurately controlled; pitch limited to 200% minimum.
- **END CAPS** are made from non-corrosive stainless steel for good weldability and ideal mechanical properties.
- **COMPLETE WELDED CONSTRUCTION** from terminal to terminal. Welds tested on sample basis to destruction.
- **SILICONE COATING** built up as a lamination of many thin coats, each cured separately at a temperature higher than the maximum operating temperature of the resistor, thus providing an automatic normalizing process. This exceedingly tough, uniform coating is free of pin holes, cracks or blisters; provides outstanding protection against thermal shock, moisture and mechanical damage.

COMPLETE TESTING PROGRAM: Resistance check: 100% final and 100% during processing; 100% Hipot test; complete military specification environmental test on sampling basis.

DALE ELECTRONICS, INC.

1304 28th Avenue, Columbus, Nebraska

A subsidiary of THE LIONEL CORPORATION

Also Made and Sold by Dale Electronics Canada, Ltd., Toronto, Ontario, Canada

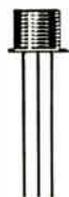




ELECTRONICS
PROGRESS IN SEMICONDUCTORS

The hard way

(up to 9 unnecessary components)



The unijunction

(one little transistor)

REDUCE OVERALL CIRCUIT COST...SIMPLIFY CIRCUITRY... IMPROVE STABILITY OVER A WIDE TEMPERATURE RANGE

Consider the cost savings. Example: In a typical time delay circuit, one unijunction transistor can save you up to \$13.11 by replacing three silicon transistors, one diode, one capacitor and four resistors. Another example: In a typical voltage threshold detector, one unijunction can save you up to \$7.40 by replacing two silicon transistors, one capacitor and three resistors. Our Application Engineers can give you many more examples, all reflecting similar cost savings with improved stability in your timing circuits.

2N489 series. TO-5 case. Military and industrial applications (a military version is used on MINUTEMAN)

2N2417 series. TO-18 case. Essentially the same electrical characteristics as 2N489 in a smaller package

2N1617 series. TO-5 case. For general purpose industrial applications with economy and stability

5C28 series. TO-18 case. Radical new structure. High switching speed (typical $t_{on}=50$ nsec), low valley current (3 milliamps max.), low saturation voltage (2.2 volts max.)

For detailed Application Notes on the unijunction, on the new 5C28 series, and on unijunction temperature compensation, see your G-E District Sales Manager. Or write Section 131136, Semiconductor Products Department, General Electric Company, Electronics Park, Syracuse, New York. In Canada: Canadian General Electric, 189 Dufferin St., Toronto, Ont. Export: International General Electric, 159 Madison Avenue, New York 16, N. Y.

AVAILABLE THROUGH YOUR G-E SEMICONDUCTOR DISTRIBUTOR

GENERAL  ELECTRIC

HERE'S WHY FLUKE DC DIFFERENTIAL VOLTMETERS CHALLENGE COMPARISON

★ ACCURACY

±0.01%

0-500V DC

★ DURABILITY

★ LOW COST

\$895⁰⁰ FOB SEATTLE



FLUKE MODEL 821A Now—for the first time—it is possible to obtain ±0.01% accuracy with a differential voltmeter over a 0-500V DC range *regardless of source impedance!* Built-in rugged construction, plus the use of highest quality components and latest manufacturing techniques guarantee long, trouble-free operation. Through simplified circuitry and conservative design, factory selection of components is virtually eliminated insuring ease-of-maintenance ... minimum down-time. Fluke instruments cover many applications such as: calibrating, testing, and stability measurements of regulated power supplies, DC voltmeter calibration, AC voltmeter calibration and precise AC voltage or current measurements when used with an AC/DC transfer standard. The John Fluke Mfg. Co. is the most experienced manufacturer of differential voltmeters—with over 18,000 in use today! Buy with confidence from the company that developed the *differential voltmeter!*

PARTIAL SPECIFICATIONS:

ABSOLUTE ACCURACY: ±0.01% of input voltage from 0.5 to 500V. ±0.01% of input voltage plus 10 microvolts below 0.5V.

INPUT RESISTANCE: Infinite at null from 0 to 500V

METER RESOLUTION: 5uv maximum; 1 MV full scale.

CALIBRATION: 500V working reference supply calibrated against built-in standard cell.

STANDARD CELL STABILITY: 0.003% per year.

INPUT POWER: 115/230V AC ±10%, 50-400 cps, 60 watts.

FEATURES:

- Infinite resistance at null over entire 0-500V range
- Polarity switch
- Taut-band suspension meter
- Standard cell reference
- Recorder output
- In line readout with automatic lighted decimal
- No zero controls

The complete FLUKE line of differential voltmeters offers a variety of test/measuring instruments to meet every application at minimum cost. Ask for a demonstration or write for detailed information.

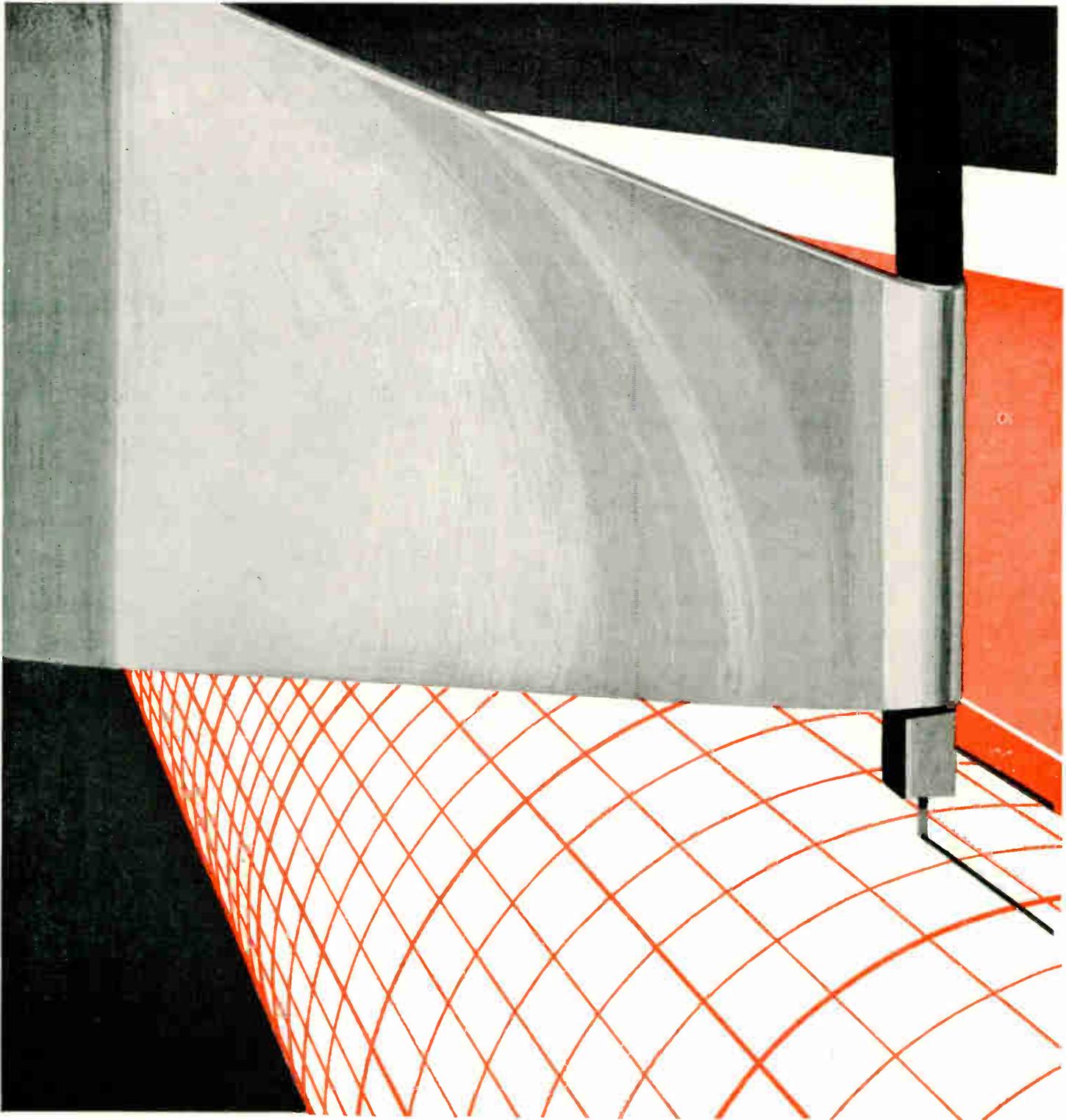
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All prices FOB Seattle. Prices and data subject to change without notice.



STYLUS TIP AND INPUT SIGNAL LOCKED-IN BY POSITIONAL FEEDBACK SERVO, NO PEN LINKAGE ERROR POSSIBLE • ALL STYLI TIPS CONSTRAINED TO A STRAIGHT LINE, NO PHASE DISPLACEMENT • REPEATABILITY BETTER THAN 0.1% • LINEARITY 0.15% • FREQUENCY RESPONSE, DC TO BEYOND 150 cps • SENSITIVITY, 1 mv/mm WITHOUT PREAMPLIFIER, 1 μ v/mm WITH • PAPER QUALITY AND PRICE SAME AS INK CURVILINEAR. ALSO HIGH CONTRAST PAPER AVAILABLE • PUSH BUTTON PAPER SPEED CONTROL • TO 24 CHANNELS • ALL TRANSISTORIZED CIRCUITRY FIELD PROVEN SINCE 1956 • FOR DATA SEE YOUR OFFNER REPRESENTATIVE, OR WRITE US.

963-037

NEW! Ink Rectilinear
 Offner Dynograph® Recorder
 pen point servo controlled
 for unapproachable accuracy.



Spec. Table

Sensitivity:	without preamplifier 1 mv/mm with preamplifier 1 μ v/mm
Freq. Response:	DC to beyond 150 cps
Repeatability:	0.1% or better
Linearity:	0.15% or better



Beckman®

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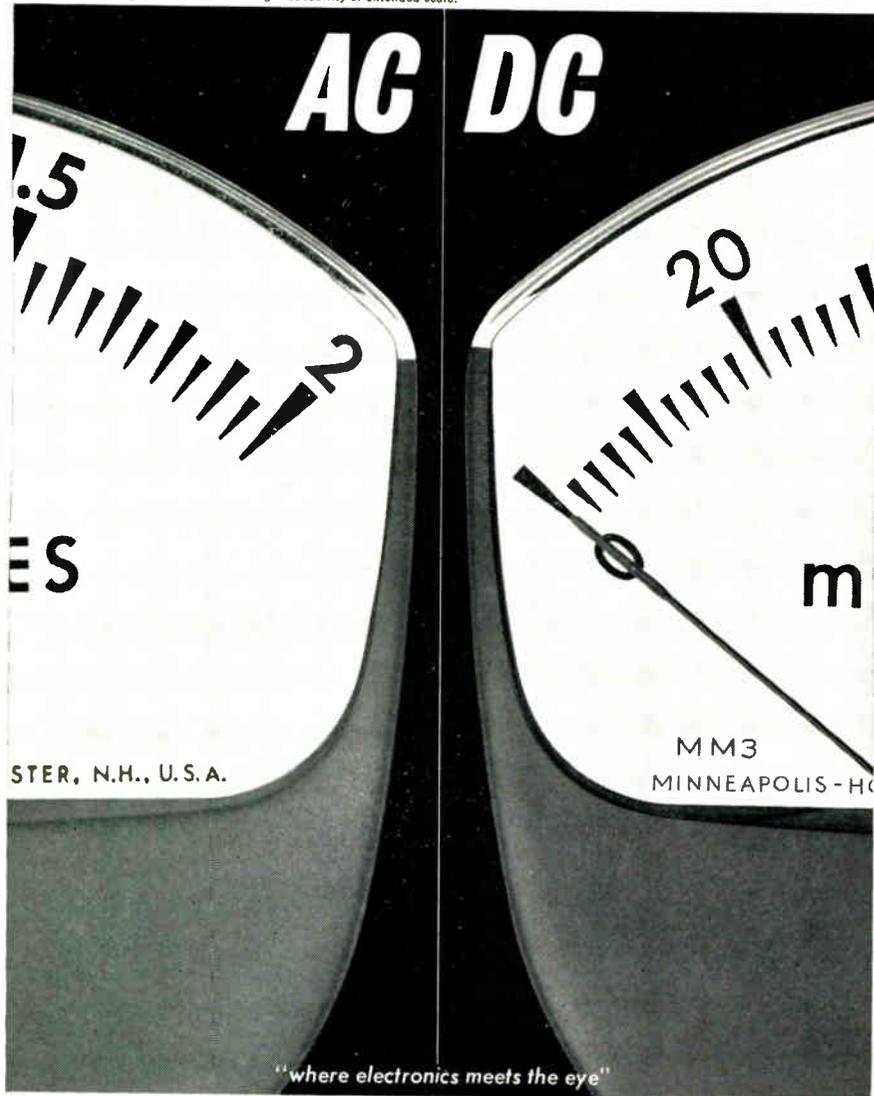
International Subsidiaries: Geneva, Switzerland; Munich, Germany; Glenrothes, Scotland

TWINNS

Honeywell AC Iron Vane meters, available in a wide selection of case styles, are counterparts to the popular Honeywell DC line. Whether you prefer conventional round or square meter cases or the distinctive Honeywell Medalist series, you can enhance the appearance of your equipment and instrument panels by using matching case styles for both AC and DC meter requirements.

■ Honeywell's AC Iron Vane meters deliver top performance at moderate cost. Scale linearity equals or exceeds that of any comparable meters and for applications where space is at a premium, the shallow depth of Honeywell AC Iron Vane meter cases is a distinct advantage. For a catalog write to: Honeywell Precision Meter Division, Manchester, New Hampshire.

MM3 (3 1/4") Case style illustrated. Note high readability of extended scale.



Honeywell



Precision Meters

TELE-TIPS

GLOBAL WEATHER reporting involving a world-wide communications network was approved at a recent meeting of the World Meteorological Organization Commission in Washington, D. C. Plans include an unbroken chain of point-to-point teletypewriter circuits encircling and connecting the Northern and Southern hemispheres. The WMO, a specialized UN agency, projects 8 communication centers receiving weather information, either direct or by relay, from each other.

NASA SCIENTISTS theorize the existence of a source of upper atmosphere heat in addition to that provided by direct sunlight. Discrepancies between theoretical and actual observations of this "thermosphere's" temperature variations have led to the postulation of corpuscular radiation from the sun providing a source of heat energy at these levels in space.

CARRIER CURRENT SYSTEM of Pacific Tel. & Tel. was bothered with radio telegraph interference on a VLF band. FCC quickly traced it to a U. S. government station. But since carrier current communication does not enjoy protection from a radio transmission on an authorized frequency, the telephone company will have to modify its equipment or the mode of its operation to eliminate the interference.

RE-ENTRY BLACKOUT SOLUTION may be near. NASA has created and tested (on an aircraft only) an X-band telemetry system that uses a communications frequency higher than the critical frequency of the ionized layer that normally envelopes a spacecraft reentering the atmosphere. Besides breaking through the blackout, the system has another major feature. It was built from a surplus X-band radar system.

SENSE OF HUMOR turns up as one of the desirable attributes of future U. S. space crews according to the results of psychological research. It is pointed out that confinement to close quarters for long periods plus tension generated by the mission alone could make irritability an increasing problem. Desirable solution is the presence of a crew member capable of maintaining a sense of spontaneous wit to puncture this bubble of tension in a space cabin.

(Continued on page 54)



OHMITE

12½-Watt Rheostat Meets MIL-R-22B

New Revision "B" Brings Small Rheostat into the Specification



RP06 - Unenclosed,
12.5 Watts

Actual Size



RP07 - Enclosed,
6.25 Watts

ONLY FROM OHMITE! ALL ELEVEN MIL-R-22B SIZES . . . FROM 12½ TO 1000 WATTS



NOTE: New Revision "B" to MIL-R-22 also includes the addition of shaft locking devices for 12½ to 150-watt rheostats—RP06, RP10, RP11, RP15, RP16, RP20, RP25, and RP30.



OHMITE

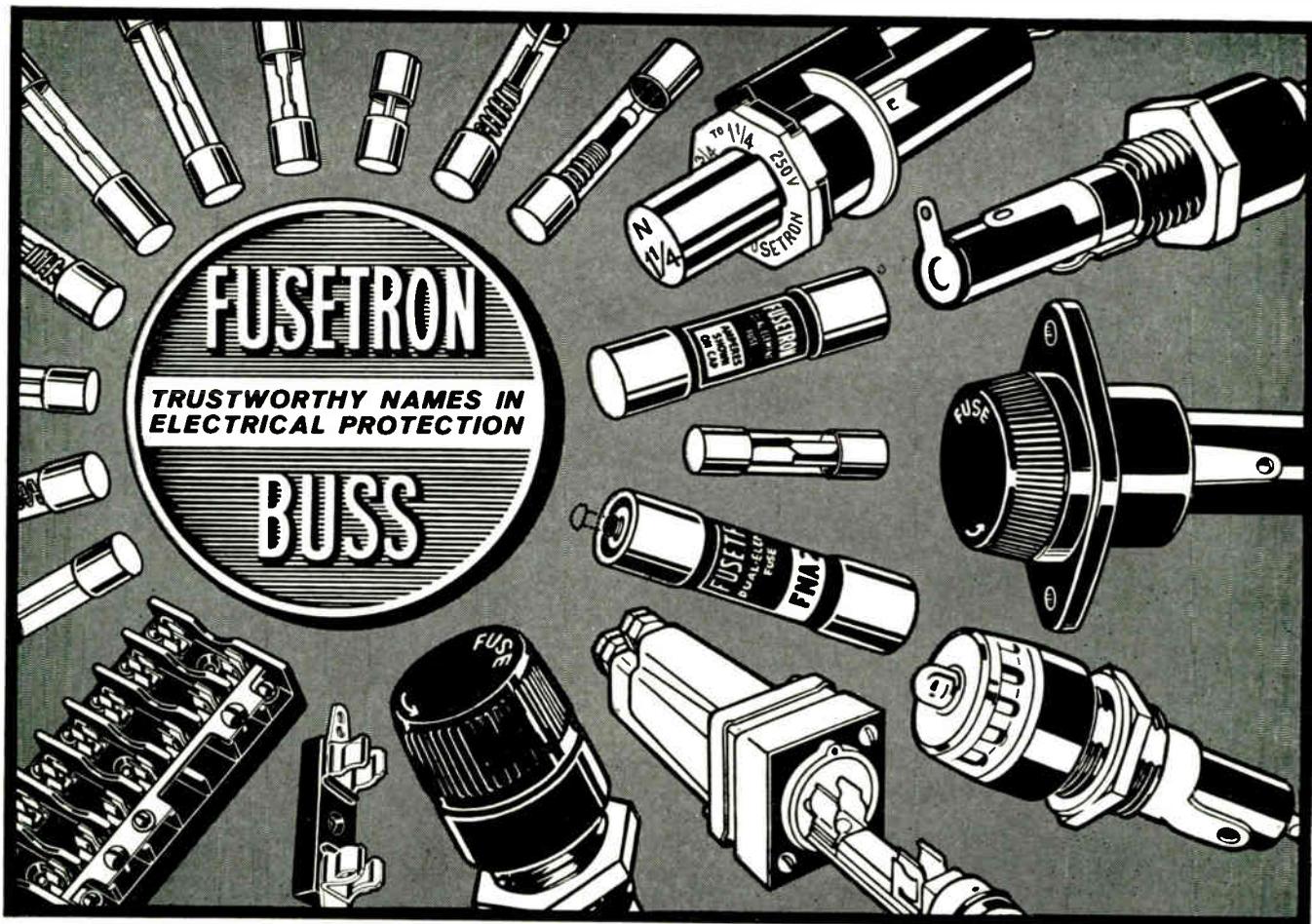
MANUFACTURING COMPANY
3662 Howard Street, Skokie, Illinois

■ It's no larger than a man-sized cuff link . . . takes less space than many 1 and 2-watt potentiometers . . . yet Ohmite's Model "E" Rheostat dissipates 12½ watts (unenclosed) under all requirements of MIL-R-22, Revision B.

The unusual power handling ability of the Model "E" is characteristic of Ohmite's proven rheostat construction which uses only ceramics and metals.

The Model "E" is stocked in popular MIL and commercial values, which are available from your distributor or the factory. Made-to-order rheostats can be supplied in tandem assemblies and taper wound as commercial units. *Ask Your Ohmite Representative or Write for Technical Bulletin.*

RHEOSTATS • POWER RESISTORS • PRECISION RESISTORS • VARIABLE TRANSFORMERS • TANTALUM CAPACITORS • TAP SWITCHES • RELAYS • R.F. CHOKES • GERMANIUM DIODES



Save Time and Trouble by standardizing on BUSS Fuses—You'll find the right fuse every time...in the Complete BUSS Line!

By using BUSS as your source for fuses, you can quickly find the type and size fuse you need. The complete BUSS line of fuses includes: dual-element "slow-blowing", single-element "quick-acting", and signal or visual indicating types . . . in sizes from 1/500 amp. up—plus a companion line of fuse clips, blocks and holders.

BUSS Trademark Is Your Assurance Of Fuses Of Unquestioned High Quality

For almost half a century, millions upon millions of BUSS fuses have operated properly under all service conditions.

To make sure this high standard of dependability is maintained . . . BUSS fuses are tested in a sensitive

electronic device. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

Should You Have A Special Problem In Electrical Protection . . . BUSS fuse engineers are at your service—and in many cases can save you engineering time by helping you choose the right fuse for the job. Whenever possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be serviced easily.

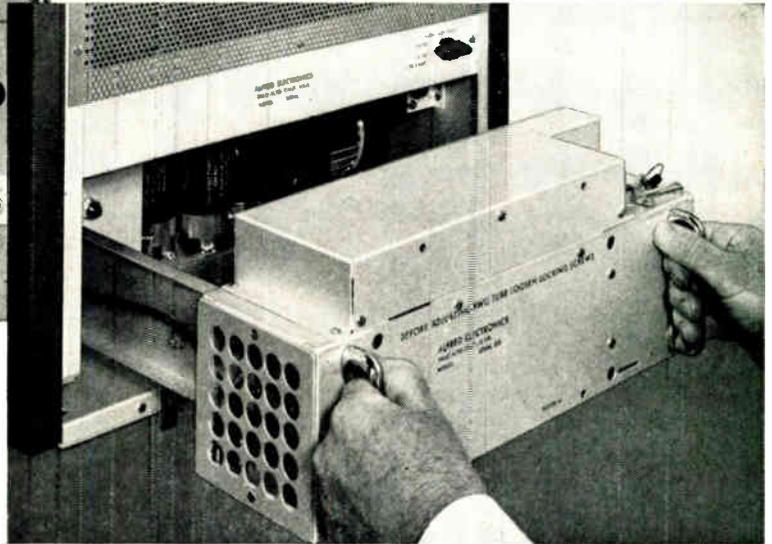
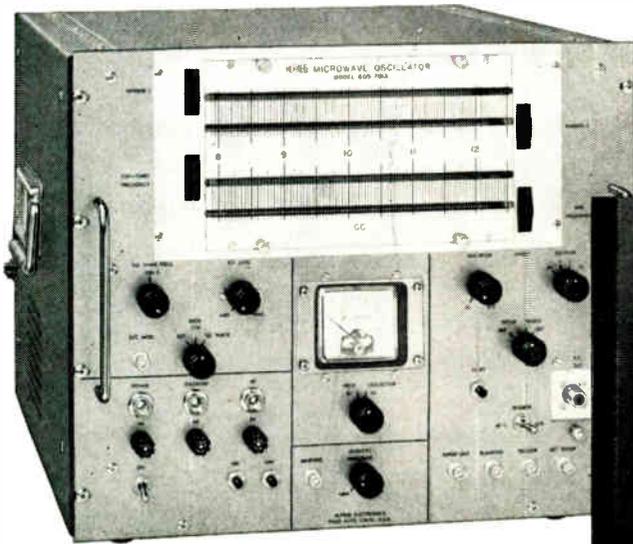
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BUSS: The complete line of fuses and fuse mountings of unquestioned high quality.



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

WHY BUY SIX SWEEPERS to cover 1 to 26.5 Gc?



Plug-in Generator Head slides simply and quickly into Alfred's Model 605 General Frequency Oscillator.

ALFRED 605 saves time, plug-in heads save money. Buy one Model 605 and only the plug-in Generator Heads you need now. Extend frequency range with additional Heads when your requirements change. The 605 with six plug-ins provides electronically swept or single frequency coverage from 1 to 26.5 Gc. Sweep rate adjustable from 100 cps to 0.01 cps permits either oscilloscope or recorder display of broadband microwave component characteristics.

Your Model 605 is never obsolete; greater coverage is possible with new Heads as they become available. Special frequency requirements are covered with intermediate range Heads (some are listed below).

Heads Easily Installed—Heads are pre-calibrated—no adjustment needed—and can be changed in 3 minutes. Any Head can be used with any Model 605.

Replaces Signal Generators—As single frequency signal sources ALFRED Microwave Oscillators are as stable as mechanically tuned signal generators.

Field Proven Performance—Over 2 years in production and over 200 units in service.

SPECIFICATIONS

SWEEP WIDTH Continuously adjustable from 0 to any part of the entire frequency range with direct calibrated dial.

SELECTOR Recurrent Sweep, Single Sweep, CW, and External.

CONTROL Single Sweep triggered by panel button, external positive going 20 v signal or internal line frequency signal.

TIME 100 to 0.01 second.

EXTERNAL SWEEP 200 v gives full sweep. DC to approx. 10 Kc response.

FREQUENCY MARKERS Two markers continuously adjustable over entire frequency range.

INTERNAL AM Square wave, 800 to 1200 cps.

EXTERNAL AM 25 v for 100% control. DC to 1 Mc response.

PRICE Model 605: \$1,750 fob factory.

ALFRED ELECTRONICS

3176 Porter Drive • Palo Alto, California • Phone: DAvenport 6-6496

GENERATOR HEADS FOR MODEL 605	A Generator Head consists of voltage tuned backward wave oscillator and focusing magnet arranged for convenient insertion into Model 605. When installed the Heads will perform to following specifications:										
Generator Head Model Number	GA102	GA103	GA204	GA408	GB8012	GB7013	GB7013A	GB10015	GB12018	GC15022	GC18026
Frequency Range Gc	1 to 2	1.4 to 2.5	2 to 4	4 to 8	6.5 to 11.5	8 to 12.4	8.2 to 12.4	10 to 15.5	12.4 to 18	15 to 22	18 to 26.5
Power Output—minimum mw	10	10	10	10	10	10	10	10	10	5	3
Residual FM percent peak	0.003	0.003	0.0025	0.002	0.002	0.0015	0.0015	0.001	0.001	0.001	0.001
Drift % of max. freq./hr.	±0.025	±0.02	±0.02	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01	±0.01
Price of Generator Heads	\$1690	\$1790	\$1690	\$1590	\$1590	\$1590	\$1650	\$1940	\$1990	\$2650	\$2950

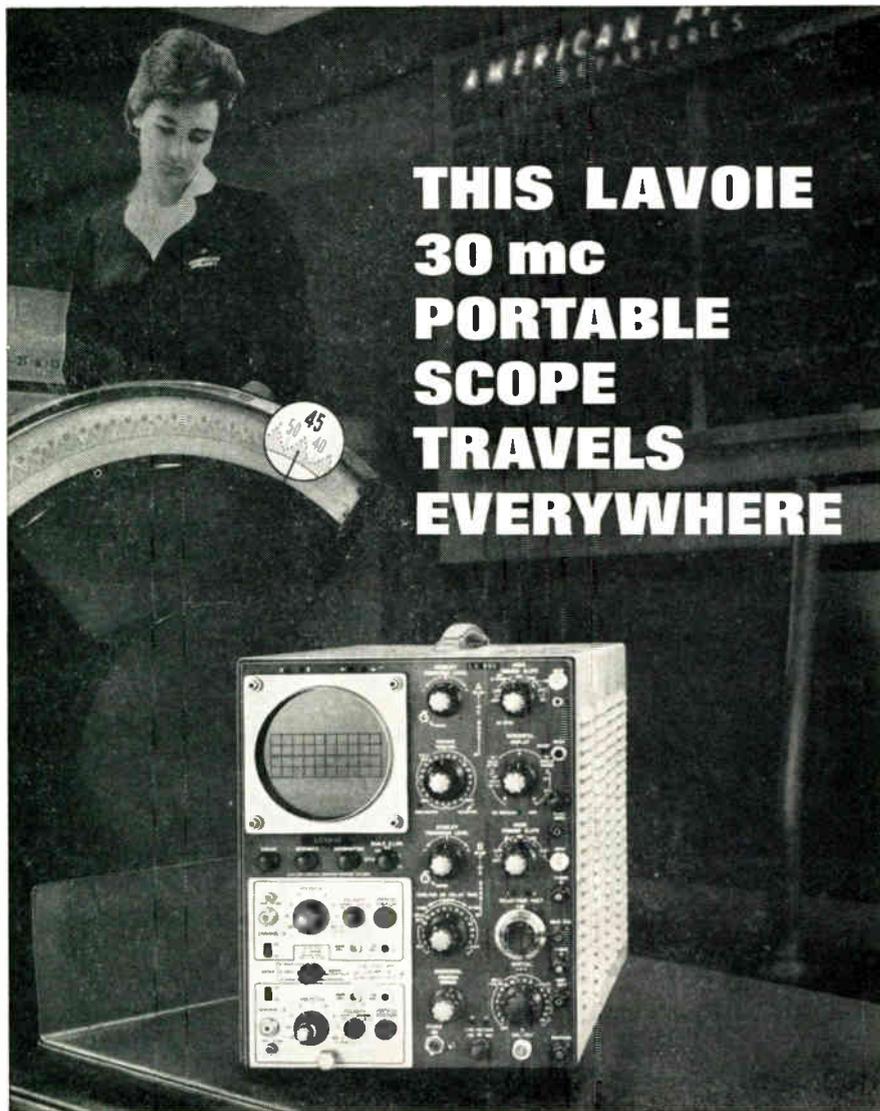
TELE-TIPS

BOOKIES, operating with unlicensed radio transmitters or securing licensed services on false grounds, have been a continuing target of FCC investigation. In a recent case, the investigator discovered that a low-power transmitter was employed to speed race results from inside the track to a confederate operating a mobile station licensed in the Domestic Public Land Service. The licensee was unaware of this use of his facilities, since the messages were in code form for a contracting company which turned out to be fictitious.

SALES geared to the requirements of the Space Age customer is the subject of a pamphlet available upon request from the Small Business Administration. The pamphlet, "Are You Selling to Today's Customers?," was prepared by R. H. Myers, Professor of Marketing, Miami University, Ohio. Contents includes advice to small marketers to price intelligently, equate merchandise with good taste, emphasize quality and value, and to make the most of leisure time merchandise. Do-it-yourself products are particularly attractive to today's consumer.

MINIATURIZATION, a technique perfected in the space and defense programs, is providing an increasing number of remarkable new tools to medical science. Already available are painless dental drills and restored hearing through the surgical implant of a tiny electronic device. In prospect is a battery-powered TV set which can be swallowed by a patient, thereby transmitting a pictorial report from an ailing stomach. Capsule transmitters that broadcast intestinal data already are in use.

MICROWAVE COOKING RANGE, which cooks in seconds by microwave energy, is being used by American and Canadian government study groups to thaw deep-frozen fish catches as they come off trawlers for commercial processing. To prevent spoilage on long commercial cruises, the fish are frozen on board immediately after being caught. Necessity of defrosting the catch for processing and the time consumed in this operation prompted authorities to investigate the Radarange and its possibilities. A 60-sec. exposure to UHF deep heat leaves the catch thawed for processing, packing, and delivery to market.



THIS LAVOIE 30 mc PORTABLE SCOPE TRAVELS EVERYWHERE

Model LA-285 \$1485.
Weight 45 lbs. as shown.

Wherever it goes, the new Lavoie LA-285 portable oscilloscope provides a full range of test capabilities. A frequency response of DC to 30 mc and a rise time of only 12 nanoseconds, it has two versatile time bases for a choice of sweeps from 0.02 microseconds per centimeter to 12 seconds per centimeter with a wide range of sweep delay periods. For calibration, portions of the sweep may be magnified and intensified.

This remarkable instrument will operate over a range of line voltages from 95 to 135 volts and is available for 60 to 400 cps use.*

It will accept plug-in heads from other Lavoie oscilloscopes, as well as heads from scopes of other manufacturers.

Ideally suited for rapid transport in plant, on flight line or shipboard, it can be easily handled by one man. The only portable oscilloscope (12" x 15" x 20") with all of these features plus 10 KV CRT accelerating voltage, it is a truly universal laboratory or field tool.

*Special

Write today for complete technical details and specifications.

Lavoie Laboratories, Inc.

MORGANVILLE, NEW JERSEY • LOWELL 6-2600 • TWX MWN-1250

Since 1939, one of America's leading manufacturers and designers of: Oscilloscopes, Spectrum Analyzers, Frequency Standards, Frequency Comparators, Pulse Generators, Digital Counters, Automatic Test Equipment.

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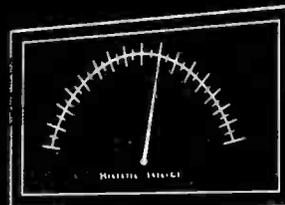
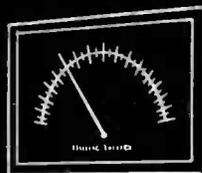
225 WATTS

1 to 999,999

ohms

1 ohm increments

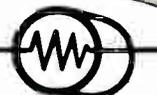
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POWER
RESISTOR
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Unique with Clarostat—a Power Resistor Decade utilizing famous Clarostat Greenohm Power Resistors. Handles real loads—switch it in and out of circuits—stands overloads. Direct reading dials indicate exact ohmage at all times. Self-cleaning switches hold load till next decade is switched in. Available in rack-mounted or bench models. A “must” in every lab, every shop, and many production line tests. Write for complete details, or ask your Clarostat distributor . . .



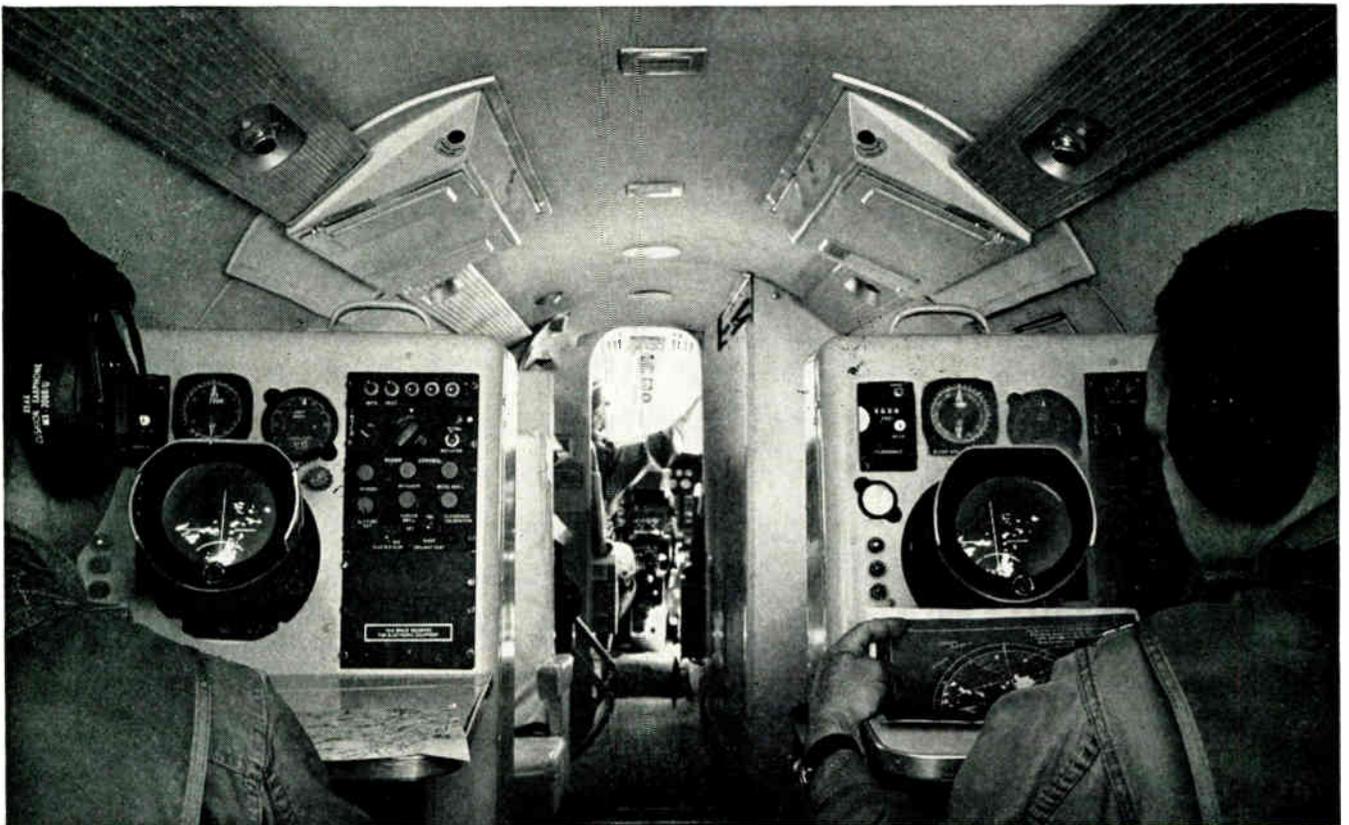
POWER RESISTOR DIVISION



CLAROSTAT

CLAROSTAT MFG. CO., INC. DOVER, NEW HAMPSHIRE

TODAY'S PILOTS SEE FROM TAKEOFF TO TOUCHDOWN WITH HUGHES TONOTRON TUBES



Fighter-bomber pilots rely on Hughes Tonotron* direct-view storage tubes to get them to the target and back. Instant information is provided continuously for pilot use by AUTONETICS' R-14 NASARR monopulse radar system.

Cockpit presentation of radar data is made on the Hughes family of H-1010 Tonotron tubes in an easy-to-read, visual display.

Hughes Tonotron tubes prove ideal for optimum, high-resolution display of radar information. These rugged and reliable storage tubes have a built-in brightness which makes reading easy even under difficult light conditions. And their controllable per-

sistence permits storage of half-tone displays for extended periods, or instantaneous erasure, if desired.

Product of over 10 years' experience in storage tube design and development, today's Hughes Tonotron tubes are a result of the complete integration of capabilities from research through manufacturing —our guarantee of your satisfaction.

Need help on your display problems? Call, wire or write today: HUGHES STORAGE TUBES, 2020 Short St., Oceanside, Calif., Area 714, SARatoga 2-2101.

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

Century-series pilots train aboard T-39B in using R-14 NASARR. Radar modes include: ground-mapping, contour-mapping, terrain avoidance, air-to-ground, air-to-air search, attack.

Creating a new world with Electronics

HUGHES

HUGHES AIRCRAFT COMPANY
VACUUM TUBE PRODUCTS DIVISION

*Trademark Hughes Aircraft Company

REPRINTS ARE AVAILABLE . . .

A limited number of copies of the following articles from back issues of ELECTRONIC INDUSTRIES are available, free of charge. For copies write, Reader Service Dept., Electronic Industries, 56th & Chestnut Sts., Phila. 39, Pa.

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Be fussy

Two things determine whether or not a particular printed circuit connector is "right" for your application:

1. How the printed circuit board mates with the connector, and
2. How the connector connects to the rest of the system.

Take mating, for example. Besides having the correct number of contacts, a printed circuit connector must hold the board securely whether the board happens to fall at the high or low end of thickness tolerances.

IT TAKES THREE

These considerations convinced Amphenol engineers that no single contact design could satisfy the requirements of a wide range of applications. So they designed three contacts that will.

One, used in Prin-Cir* connectors, looks a lot like a tuning fork with lips. The circle lip design makes contact overstressing or "setting" impossible—even after repeated insertions. The contact's long spring base also enables it to accommodate boards that range in thickness from .055" to .073", while doing an excellent "wiping" job.

EASY DOES IT

But not every application requires the Prin-Cir "bite." For this reason, Amphenol engineers designed connectors with ribbon contacts that mate with a gradual wedge-like force. In

blind mating applications, gradual mating makes the feeling of *correct* mating unmistakable. (Just the thing when your equipment may eventually be maintained by less-skilled and less-concerned personnel.) Ribbon contact wedge action also makes it possible for connectors using these contacts to accept the same wide range (.055" to .073") of board thicknesses as do Prin-Cir connectors.

Finally, advances in micro-miniaturization (like Amphenol-Borg's Intercon® pre-fabricated circuitry) meant that tinier-than-ever-before connectors were needed. Amphenol's answer was the Micro-Min® receptacle and printed circuit board adapter. Micro-Min contacts are actually tiny springs of beryllium copper wire, formed in a precisely designed arc to assure firm circuit board retention. This unique design makes it possible to space contacts on .050" centers and crowd 19 connections into a little more than an inch of space.

TERMINATIONS COUNT, TOO

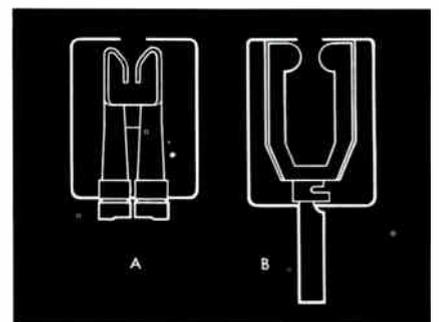
"How to connect connectors to the rest of the system" also merits a good deal of consideration. In some cases, hand soldered terminations will do just fine. In others, higher volume requirements call for high production rate methods like dip soldering and wire-wrapping. Some engineers prefer taper pin terminations.

Our printed circuit connectors are available with contact tails designed for each of these termination methods. In addition, adapters are available for use in connecting printed circuit boards at right angles to each other or in modular arrangements. We make printed circuit connectors with hermetically sealed contacts — still others with coaxial contacts.

Take your choice.

Any Amphenol Sales Engineer or authorized Amphenol Industrial Distributor will be happy to discuss printed circuit connectors (ours) with you. Or, if you prefer, write directly to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.

*T.M. Amphenol-Borg Electronics Corp.



Wedging action of Amphenol ribbon-type (A) and long spring base of Amphenol Prin-Cir connectors (B) assure firm printed circuit board retention, whether board happens to fall at low (.055") or high (.073") end of thickness tolerance.



Connector Division / Amphenol-Borg Electronics Corporation

Aerovox Miniaturized Capacitors Offer Widest Selection of Case Style, Dielectric, and Application Capability



Reliability proven in demanding military, industrial and commercial installations



Type SRE* (Bulletin 201B1)
Aluminum Electrolytic Metal Case Tubular
-0°C to 65°C
3 to 150 DCWV
1 to 500 mfd
3/8" x 1" to 1/2" x 1-5/8"



Types P123ZN-323ZN* (Bulletin 131B8)
Metallized Paper Metal Cased Tubular
-55°C to 125°C
50, 150, 200, 400, 600 DCWV
.001 to 12.0 mfd
.175" x 7/16" to 1" x 2-9/16"



Aerotan® Types ST12*-ST13* (Bulletin 215B2)
Solid Tantalum Electrolytic Metal Cased Tubular
-80°C to 125°C
6 to 35 DCWV 1.0 to 330 mfd
.125" x .250" to .341" x .750"



Type 83Z* (Bulletin 131B2)
Metallized Paper Thermoplastic Cased Tubular
-15°C to 85°C
200, 400, 600 DCWV
.0005 to .04 mfd
3/16" x 7/16" to 1/4" x 9/16"



Types CRE-QRE* (Bulletins 201B6 & 201B7)
Aluminum Electrolytic Metal Cased Tubulars
-40°C to 85°C
3 to 150 DCWV
1 to 500 mfd
3/16" x 1/2" to 3/8" x 1-1/2"



Type V84B* (Bulletin 142B5)
Mylar; Tubular with Paper-Mylar Case
-40°C to 85°C
150, 200, 400, 600 DCWV
.001 to 2.0 mfd
.156" x 1/2" to 1.421" x 3"



Type 8292ZN* (Bulletin 131B6)
Metallized Paper Plastic Cased Tubular
-30°C to 100°C
200, 400, 600 DCWV
.01 to 2.0 mfd
1/4" x 19/32" to 1" x 2-3/8"



Type PTT* (Bulletin 201B5)
Aluminum Electrolytic Plastic Cased Tubular
-30°C to 65°C
3 to 50 DCWV
1 to 500 mfd
1/4" to 3/4" to 3/8" x 2"



Type V146X*-V146XR* (Bulletin 142B2)
Mylar "Wrap and Fill" Flat and Round Styles
-65°C to 85°C
150, 200, 400, 600 DCWV
.001 to 2.0 mfd
.156" x 1/2" to 1.421" x 3"

*Specifications listed are for standard units. If your requirements are unusual, special units can often be designed to meet your needs.

†Registered Du Pont trademark.

the state of the art and to satisfy the demands of all markets.

Yes, you can specify Aerovox with confidence. Confidence that you are buying and using the highest quality capacitors available anywhere. And, you have access to the widest selection of miniaturized capacitors in paper, metallized paper, mica, ceramic, electrolytic, solid tantalum and film types.

Environmental test requirements for capacitors are becoming more stringent, especially those established by the military services. In order to keep ahead of these demands, advanced research and development projects are being initiated continually at Aerovox. Entirely new design concepts have resulted from this concentrated effort. Some of the most reliable, long-life miniaturized capacitors available in the industry today are shown here. These include top-quality types ranging from low-voltage capacitors for transistorized circuits to ultra-miniature units designed to meet highly critical space requirements in such applications as computers, missiles and airborne electronic equipment.

Only through the use of revolutionary design and manufacturing techniques and equipment have the greatly reduced sizes been achieved, thus permitting circuit applications previously considered impracticable or impossible. For example, a radically new etching and formation process was developed by Aerovox engineers in order to produce the unique advantages of the new QRE capacitors. As part of the automation program in the factory, a new automatic testing and sorting machine was recently installed to run more efficient tests for short circuits, opens, and grounds, while automatically sorting "ok" capacitors into specific tolerance groups. The utilization of such modern equipment by highly skilled personnel is part of the long-range program at Aerovox to advance



Engineering Service — If you have a special design concept, qualified engineering service is available from Aerovox at no cost or obligation. As a pioneer and leader in capacitor design and manufacture, Aerovox offers years of experience and know-how for the discussion and analysis of your specific capacitor requirements.

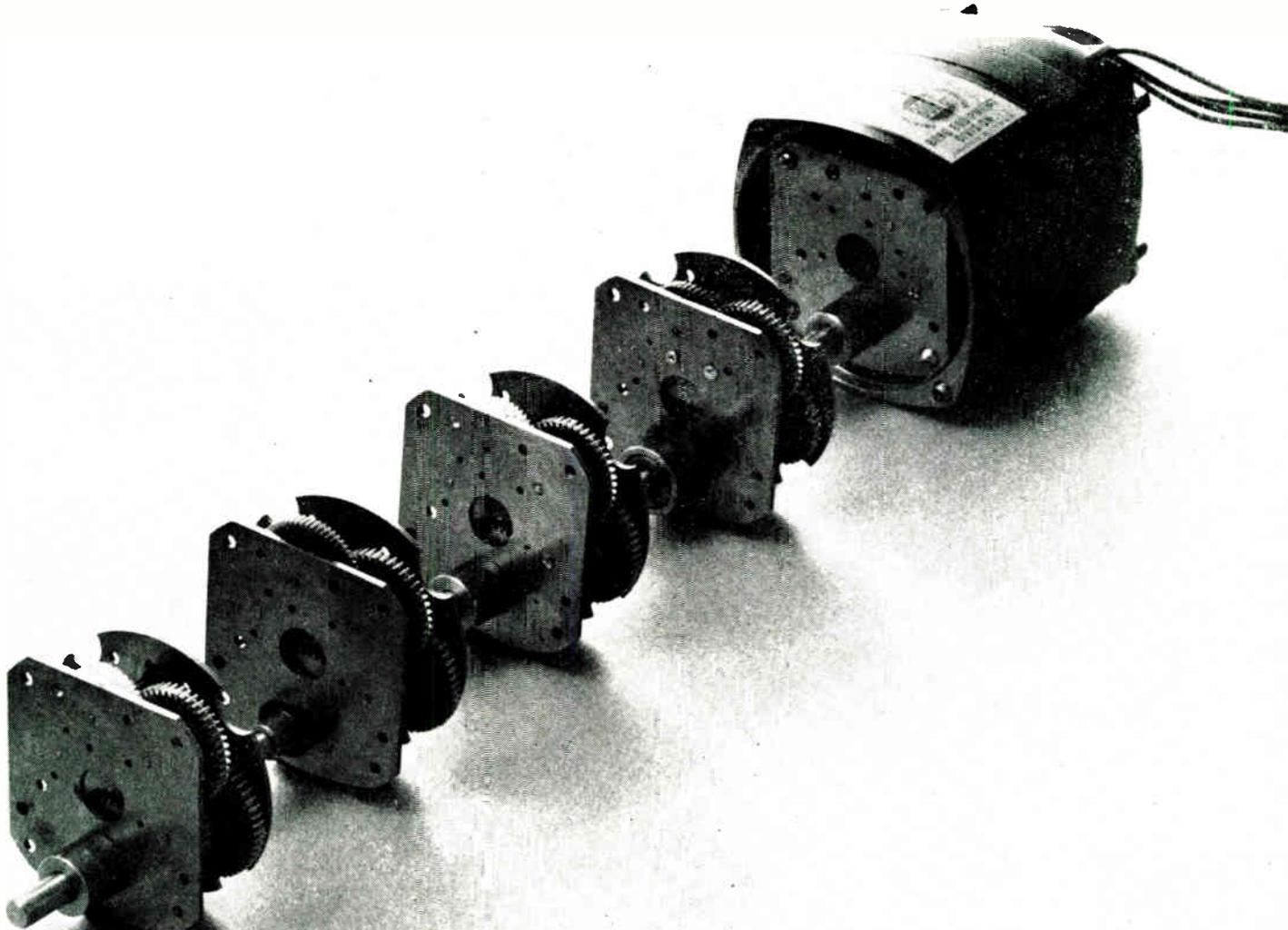
Technical Data — Call your Aerovox Field Representative or send today for free data sheets . . . specify the capacitor types you are interested in.





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NEW BEDFORD DIVISION NEW BEDFORD, MASS.

Technical Leadership — Manufacturing Excellence



Why Borg motors let you shift gears

Because you can save money by stocking fewer motors.

Take the new sub-fhp 1060 series*, for example. You stock one model and several interchangeable gear trains. As the torque requirements of your equipment change, you simply select the appropriate gear train to vary the output speed, gaining the needed torque rating. By stocking spare gear trains—instead of extra motors—you use less shelf space, you save on inventory.

**The new Borg 1060 series are sub-fhp, four-pole, induction type control motors featuring low-inertia, high-resistance, squirrel-cage rotors.*

There's more to Borg motors than gear-train versatility and economy. Synchronous, induction, and low-inertia types are available. Their torque speed relationships meet the exacting requirements of instrument and control applications. And you can depend on a Borg motor to outlast any other—it's designed and built for maximum severity service.

Anticipating the problematical, Borg motors offer minimum temperature

rise to counter heat dissipation problems, optional high-speed shaft extensions, special outboard bushings, special length and diameter shafts for gear boxes—and even special paint colors to match your equipment.

If you are snagged by a sub-fhp motor problem, the man to see is your nearby Borg technical representative or Amphenol-Borg Industrial Distributor. Or, if you prefer, write R. K. Johnson, Sales Manager:



BORG EQUIPMENT DIVISION

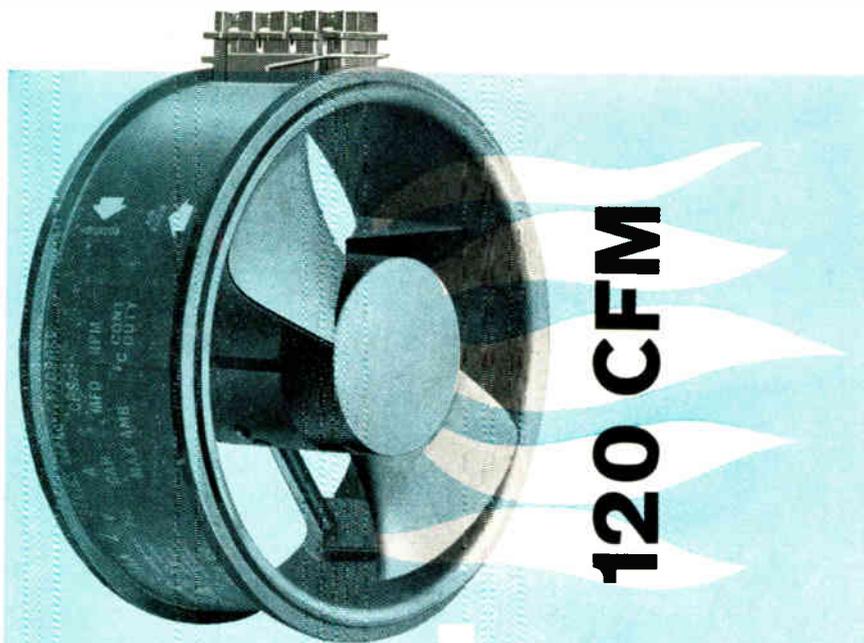
Amphenol-Borg Electronics Corporation,
Janesville, Wisconsin.

Circle 39 on Inquiry Card

World Radio History

tiny but mighty!

PROPIMAX[®] 2

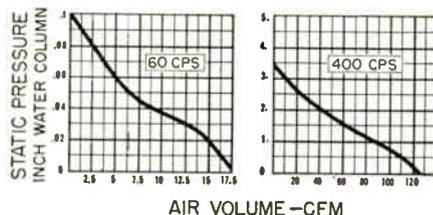
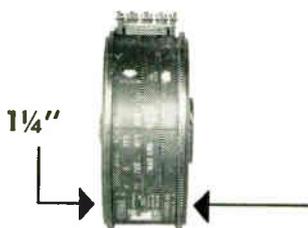


(ACTUAL SIZE)

6½ OZ.

A featherweight with heavyweight power! The Rotron PROPIMAX 2 produces more air flow for its size than any other unit commercially available. At 400 cps., under free delivery, this mighty mite moves 120 CFM. Ideally suited for ground or airborne applications. For airborne or missile applications, the PROPIMAX 2 is equipped with the exclusive ALTIVAR motor which automatically compensates for varying air densities at increased altitudes. Also available in 60 cps model for a compact and lightweight cooling device. Physically and aerodynamically symmetrical, permitting reversible air flow by merely turning end for end. Mounting is by servo rings.

Write for complete details



Visit Booths 2427-2429 IRE Show

ROTRON mfg. co., inc.
 WOODSTOCK, NEW YORK • ORiole 9-2401
 In Canada: The Hoover Co., Ltd., Hamilton, Ont.

LETTERS

to the Editor

Optical-Electronic Spectrum

Editor, ELECTRONIC INDUSTRIES:

A word to let you know that *EI's* summary of the optical-electronic spectrum was perused with considerable interest. All in all it was a very good job, and should prove helpful for orientation and applications purposes.

Generally, for visual fluorescence work the application center resides at 3650 Å° while mineral detection benefits most from 2536 Å°. These are the principal wavelengths from properly filtered high and low pressure mercury arcs, respectively.

Jack DeMent

DeMent Laboratories
 1717 Northeast 19th Avenue
 Portland 12, Oregon

"Effects of Nuclear Radiation"

Editor, ELECTRONIC INDUSTRIES:

Your survey article, "Basic Effects of Nuclear Radiation," by J. R. Crittenden serves a most useful purpose. It happens that we manufacture a high dose rate x-ray machine with output of 10⁸ rads/sec. We note that no mention was made of high dose rate type of testing or measurements in the article by Crittenden. Although this is a specialized field it is growing exceedingly rapidly.

There are a large number of experts in the field including Dr. J. W. Easley, Sandia Corporation, New Mexico, Dr. Paul Caldwell, Diamond Ordnance Fuse Laboratory, Washington, D. C., and M. M. Weiss, Bell Telephone Laboratories, Whippany, New Jersey.

Ten reprints of your article, "Basic Effects of Nuclear Radiation," would be most useful to us for distribution to key personnel in our organization.

S. D. Bennett, General Mgr.
 Field Emission Corp.
 McMinville, Ore.

"Shielding—"

Editor, ELECTRONIC INDUSTRIES:

Reference is made to the article entitled *Shielding An Enclosure* by Cyril P. Durnovo in your January 1962 issue. On page 114 a table was
(Continued on page 66)

Proved through 9,000,000 cycles



SUSPENSION TYPE METERS

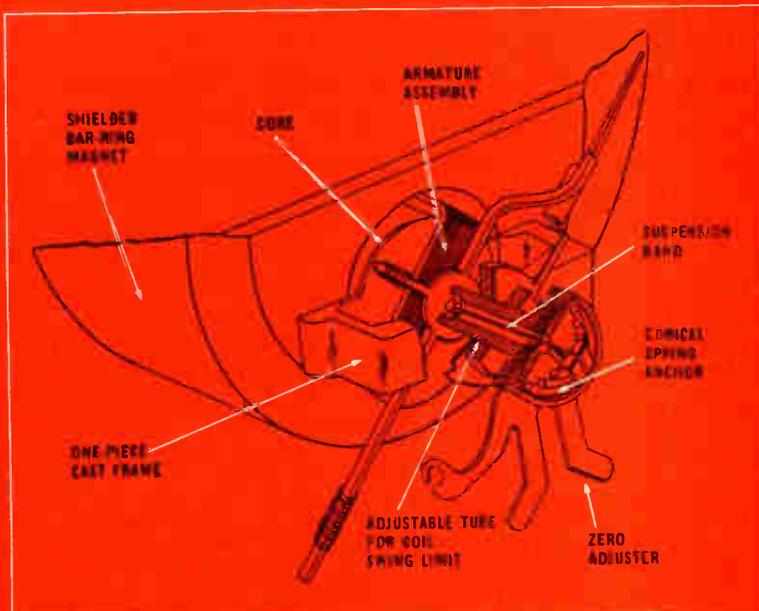
- NO PIVOTS ▪ NO JEWELS
 - NO HAIR SPRINGS
- thus NO FRICTION

FACTS MAKE FEATURES

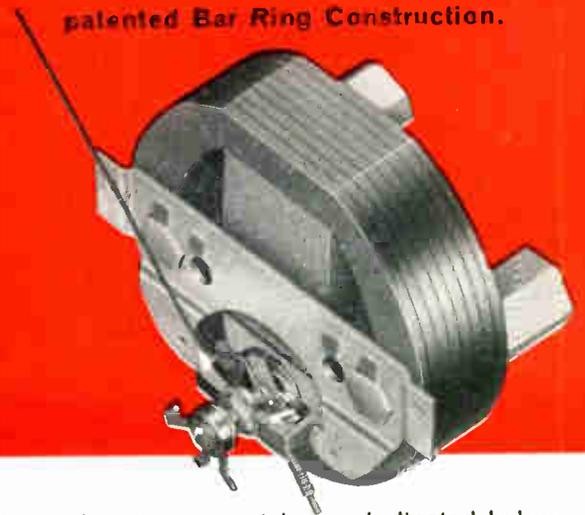
1 No pivots . . . no jewels . . . no hair springs . . . thus **NO FRICTION**.

2 Greater **SENSITIVITY** and **REPEATABILITY** (2 microamperes available).

3 **RUGGED** and **ACCURATE**. Highly resistant to extreme shock. Accurate to 2% of full scale deflection (coming from line production at 1% maximum tolerance. Greater accuracy available on special order!) Famous Triplet patented Bar Ring Construction.



1/4 TIMES ACTUAL SIZE



This improved new suspension type movement comes in standard panel meter case styles as indicated below. Meters can be used with almost negligible current drain. Especially applicable to transistor and similar circuits. Their high overload capacity prevents harm from surges many times normal full scale current. These instruments feature a short, very thin, narrow band kept tightly suspended on special spring terminals, which support the coil with its moving counter parts. The Triplet spring is conical in shape, the suspension wire being looped over and fastened to the top cone section. This allows freedom of action for the twisting suspension and added protection against severe shocks. As in all Triplet products, attention to detail makes for longer instrument life.

THE TRIPLET ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

8 CASE STYLES—11 MODELS—SIZES 2 1/2" THROUGH 8"



MANUFACTURERS OF PANEL AND PORTABLE INSTRUMENTS; ELECTRICAL AND ELECTRONIC TEST EQUIPMENT



UNDERRATED...

Deliberately. And because Clevite rates it *low*
... users rate it *high!*

Perhaps it's our New England conservatism ... or just good Value Engineering ... but when you specify Clevite PNP germanium power transistors, you get a unit that's literally *loafing* along when it's working at full rated power in a normal circuit environment.

But circuits and environments may vary considerably from any design center and it's well to have plenty of reserve.

So we've built reserve safety margins right into the heart of these transistors: Thermal resistance, junction to heat sink, runs about 0.6° C/W although the ratings are based on 0.8° C/W and 100°C junction temperature. Further, we stabilize every unit for a full 100 hours at 125°C.

Add these facts: Clevite power transistors, with the closest emitter to base spacing in the industry, give very low base resistance and input impedance with no sacrifice in breakdown voltage. Both the junction geometry and manufacturing processes are designed to give the superior high current performance and power rating characteristics of large area transistors — but with the low leakage current of small area transistors.

Order a dozen, a hundred or a hundred thousand ... you'll get consistent performance and uniform reliability that will really show you the *value* behind Clevite's conservative rating policy. Write for a full technical description.

TYPE NRS.	V _{ce(Sat)} Volts		I _c	R _θ °C/W		ICBO μA (25°) @ -2V	
	TYP.	MAX.		TYP.	MAX.	TYP.	MAX.
2N257 *	0.8	1.5	2A	0.6	1.5	50	
2N301 *	0.5	1.0	2A	0.6	1.5	50	100
2N268 *	1.0	2.0	2A	0.6	1.5	60	
2N1146,A,B,C 2N1147,A,B,C	0.5	1.0	15A	0.6	0.8	75	
2N1529-33	0.6	1.5	3A	0.6	0.8	75	200
2N1534-38	0.4	1.2	3A	0.6	0.8	75	200
2N1539-43	0.2	0.6	3A	0.6	0.8	75	200
2N1544-48	0.1	0.3	3A	0.6	0.8	75	200
2N1549-52	0.5	1.0	10A	0.6	0.8	100	200
2N1553-56	0.4	0.7	10A	0.6	0.8	100	200
2N1557-60	0.25	0.5	10A	0.6	0.8	100	200

*Power Gain (db) @ P_{out} = 2 Watts (2N257) (2N268); 4 Watts (2N301)

Reliability in volume



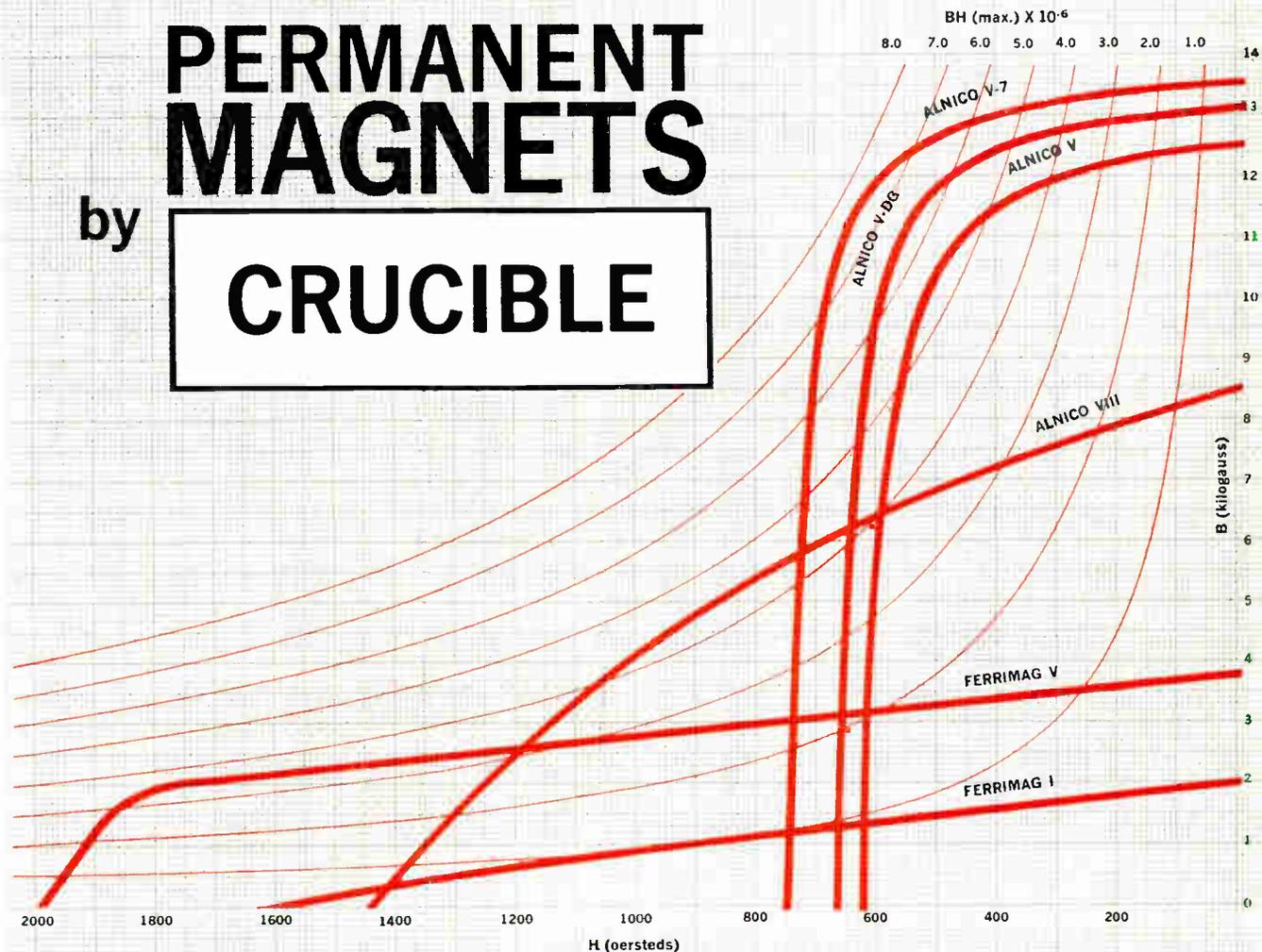
CLEVITE TRANSISTOR

WALTHAM 54, MASSACHUSETTS • 894-7780

PERMANENT MAGNETS

by

CRUCIBLE



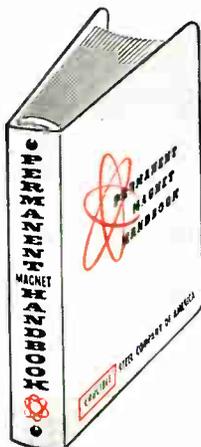
DESIGNED FOR EVERY INDUSTRY

For consistently higher energy product in any size of magnet from a fraction of an ounce to hundreds of pounds—

For coercive forces ranging from 400 to over 1,400 oersteds—and for energy values up to 7½ million gauss-oersteds or greater—

For an equally wide variance in physical and mechanical properties—

Crucible's magnet engineering staff can develop exactly the right magnet for your application.



Whether you need performance characteristics that must be specially designed for your product or any of the wide range of Alnico Magnets available from stock, let Crucible help with your design.

Crucible's "Permanent Magnet Handbook," one of the most comprehensive texts available on this subject, contains completely detailed data on magnet measurements, ferromagnetism, magnetization, demagnetization and electromagnetic theory. Performance and property data of over 60 magnet materials are also included. For your copy, send check or purchase order for \$10.00 (plus 40¢ tax if you are located in Pennsylvania) to Crucible Steel Company of America, Dept. EI2, Box 88, Pittsburgh 30, Pa.

CRUCIBLE

STEEL COMPANY OF AMERICA
MAGNET DIVISION P.O. Box 32, Harrison, New Jersey

BALLANTINE Wide-Band VTVM

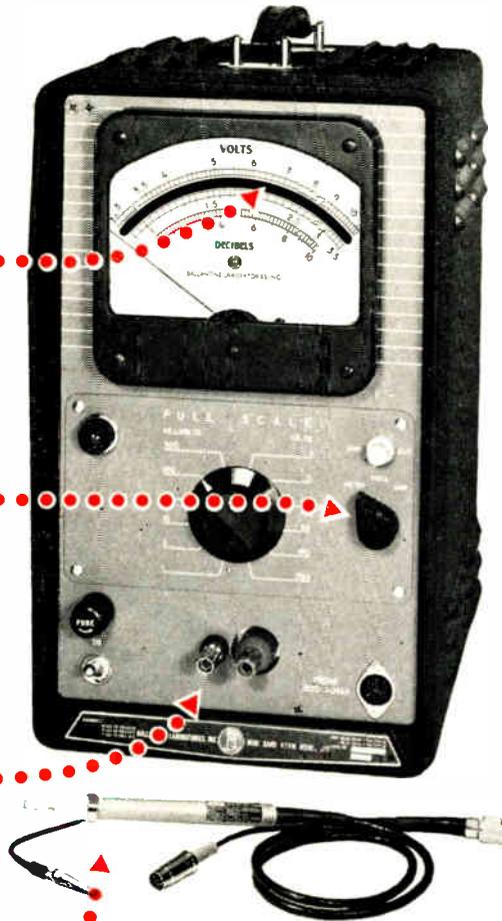
Measures 300 μV to 300 V at frequencies 10 cps to 11 Mc

Logarithmic scales with high precision and constant accuracy at any point

Usable as 100 μV null detector, or as wide-band amplifier to 20 Mc

Binding post, or coaxial input to reduce ground current error

Cathode follower probe has high input impedance of 10 $\text{M}\Omega$ —7 pF



model 317
Price: \$495. with probe

A stable, multi-loop feedback amplifier with as much as 50 db feedback, and 10,000 hour frame grid instrument tubes operated conservatively, aid in keeping the Model 317 within the specified accuracy limits over a long life. Its uses extend from simple audio frequency measurements to accurate RF measurements made directly in the circuit using the low-loading cathode-follower probe. Individually calibrated logarithmic scales provide uniformly high accuracy over their entire length. Accuracy is 2%, 20 cps to 2 Mc; 4%, 2 Mc to 4 Mc; 6%, 4 Mc to 11 Mc.

Write for brochure giving many more details



B BALLANTINE LABORATORIES INC.
Boonton, New Jersey

CHECK WITH BALLANTINE FIRST FOR LABORATORY AC VACUUM TUBE VOLTMETERS, REGARDLESS OF YOUR REQUIREMENTS FOR AMPLITUDE, FREQUENCY, OR WAVEFORM. WE HAVE A LARGE LINE, WITH ADDITIONS EACH YEAR. ALSO AC/DC AND DC/AC INVERTERS, CALIBRATORS, CALIBRATED WIDE BAND AF AMPLIFIER, DIRECT-READING CAPACITANCE METER, OTHER ACCESSORIES.

LETTERS

to the Editor

presented regarding potential or suggested suppliers of shielded enclosures.

In reviewing this table, I was at a loss to understand how the suppliers were selected by the author or by your editor. Ray Proof Corporation manufactures Radio Frequency Enclosures and has been in business since 1930. We are listed in all material purchasing and product directories and we just cannot see why Ray Proof Corporation was omitted from your list as a potential supplier for shielded enclosures.

For your ready reference we are enclosing with this letter a copy of our abbreviated Catalog SW-62 describing the complete line of Ray Proof products and services available.

R. Aronson
Vice President, Eng.

Ray Proof Corp.
843 Canal St.
Stanford, Conn.

"Engineering Status—"

Editor, ELECTRONIC INDUSTRIES:

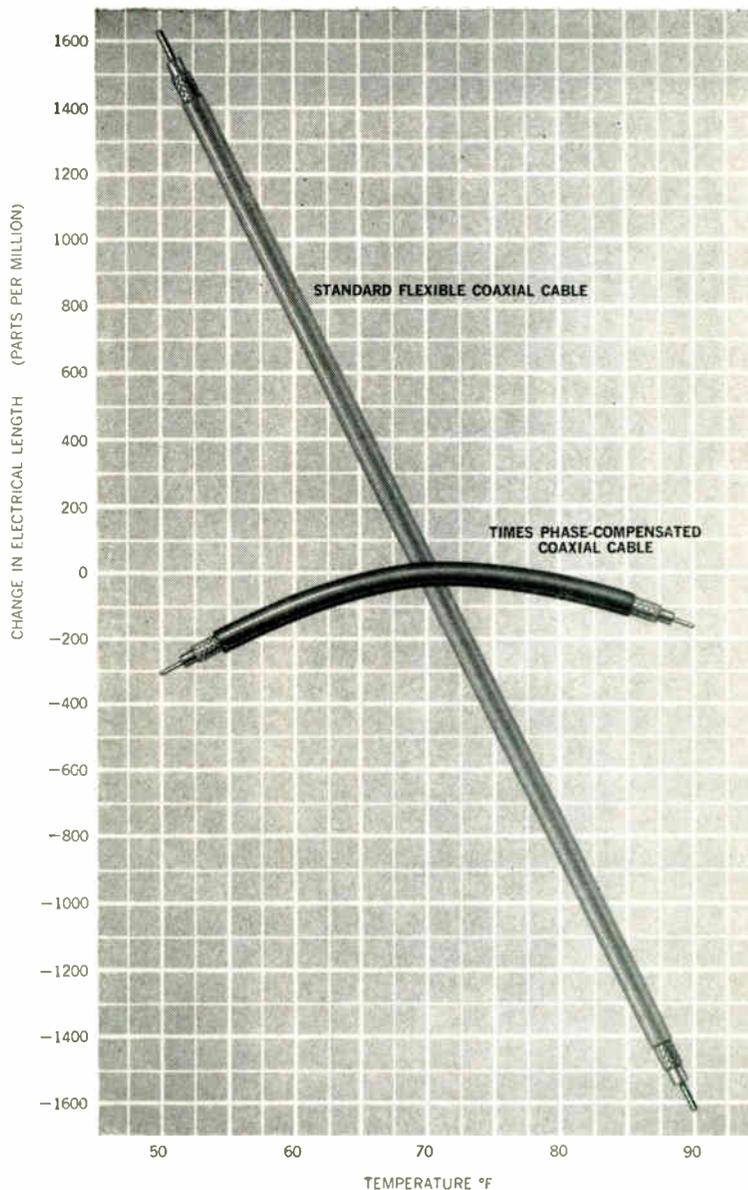
It was certainly wonderful to see your March editorial "Engineering Needs Status."

I am wondering if you have followed the Purdue Engineering Student Poll? For several years this high school graduate opinion poll in U. S. high schools showed the very low opinion these students held toward engineers.

I corresponded with Dr. Remers some, suggesting that their questions invited some unrealistic answers. I understand, however, that some polls at IIT, and other places, some years ago, showed the same unfavorable reaction. You might find some connection here to bear on your question. I will include a little summary of mid-states R & D, done for some of my fellow school board members to make a better case for ETV and the junior college. It bears in a little way upon your editorial. Your "Profile . . ." on page 218 is certainly a fine job; a very fine job.

Off the record, I have a sneaking
(Continued on page 68)

now! a PHASE- COMPENSATED flexible coaxial cable



new TIMES cable exhibits virtually no change in electrical length with temperature variations

To solve the problem in standard flexible coaxial cables of electrical length changes due to temperature variations, Times has developed a new self-compensating, phase-stable cable.

Designed specifically for use with advanced radar systems, this new phase-compensated cable produces less than 20 parts per million change per degree centigrade temperature variation. It virtually eliminates phase shift and permits signals to be relayed with minimal distortion.

Times' new phase-stable cable is a major achievement in the art of perfecting coaxial cables. It provides an ideal solution for applications in which phase change cannot be

tolerated, and where precise signal accuracy is a must. The basic technique used in developing this cable is now being applied to even more sophisticated problems.

The phase-compensated cable is another example of Times' ability to design, engineer and produce cable and cable assemblies for critical transmission system applications. Times will also manufacture cable and assemblies cut to precise electrical length, as well as special cables and assemblies for industrial and commercial applications. When you need assistance with your transmission system problems, wire or write Times' Sales Manager, Dept. 91. *A DuPont Trademark



TIMES WIRE AND CABLE

Division of The International Silver Company
Wallingford, Connecticut

TRANSMISSION SYSTEM DESIGN AND ENGINEERING • STANDARD & SPECIAL PURPOSE COAXIAL CABLE • MULTICONDUCTOR CABLE • COMPLETE CABLE ASSEMBLIES • TEFLON* HOOK-UP WIRE

SG-5000

Transitron offers computer circuit designers a highly reliable, better performing, subminiature glass silicon planar epitaxial diode. Careful development, supported by stringent environmental and life tests, has solved all mechanical and electrical problems. The result is the SG-5000 — a premium unit that fully meets military specifications.

At the same time, Transitron has improved upon the selected performance of silicon planar epitaxial diodes now available. In addition to the recognized features of higher forward conductance, faster switching and lower capacitance, the uniformity of planar epitaxial construction lets Transitron offer tightly controlled forward voltages at specified current levels. The SG-5000 is available in quantity with digital marking for quick diode type identification.

Another step in Transitron's continuing efforts to offer the industry's widest variety of silicon diode types is the introduction of the 1N3604-6 and 1N3062-9 series of silicon planar epitaxial diodes. All Transitron silicon diodes, in-

TENTATIVE DATA — SPECIFICATIONS AT 25°C					
Type	Maximum Forward Voltage @ 200mA	Maximum Inverse Current @ -75V	Minimum Inverse Voltage @ 100μA	Maximum Capacitance @ 0V @ 1Mc	Maximum Reverse Recovery Time*
SG-5000	1.0V	0.1μA	100V	2 pf	2 nsec

* $I_F = 10\text{mA}$, $V_R = -6\text{V}$, recovery to 1 mA, $R_L = 100\text{ ohms}$

cluding the newest types, can be packaged as multiple-chip assemblies to your specification. All are now available through your Transitron distributor.

Transitron invites your inquiry regarding further details of its silicon planar epitaxial diodes. Write today.

Transitron

electronic corporation
wakefield, melrose, boston, mass.

SALES OFFICES IN PRINCIPAL CITIES THROUGHOUT THE U.S.A. AND EUROPE
CABLE ADDRESS TRELCO



Circle 53 on Inquiry Card

TRANSITRON'S NEW FULLY EVALUATED SILICON PLANAR EPITAXIAL DIODE

These 6 steps from Sylvania

Designing for predictable reliability? Sylvania can help. Scrupulous investigation of reported military and commercial tube removal rates has made possible formulation of basic tube failure rates. Sylvania has compiled these figures in terms of %/1000 hours for fourteen popular subminiature tube types (Table I)—with more types to come.

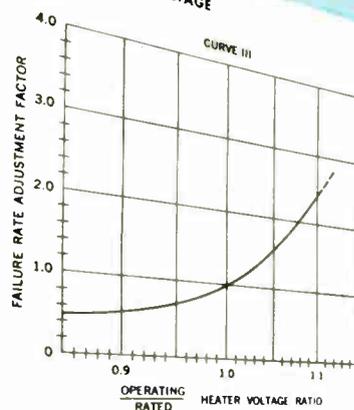
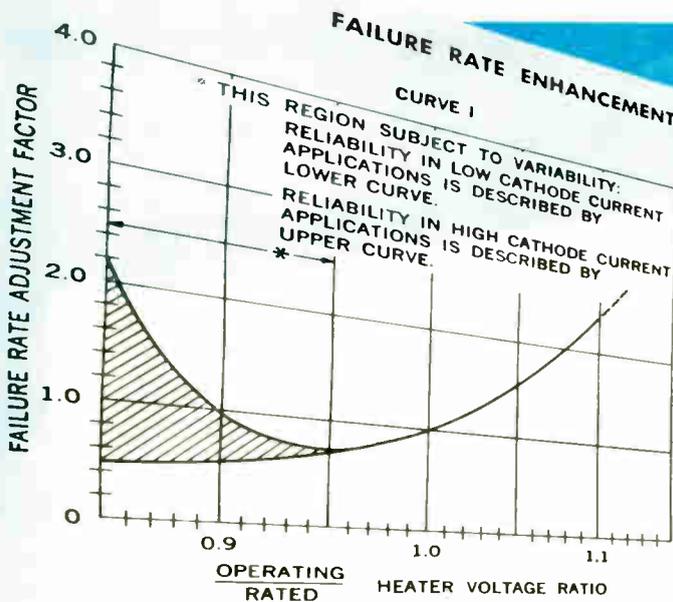
And, since tube failures are affected by heater voltage, bulb temperature and total power dissipated, Sylvania has computed curves indicating their influence on base failure rates. With these tools at hand, it is now possible to make valid predictions of tube reliability in your specific application. Here's how:

1 Find the base failure rate for any of 14 subminiature types listed in Table I.

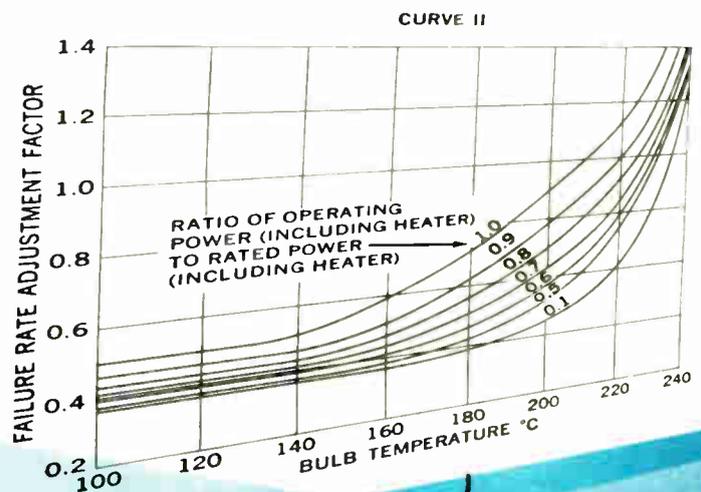
2 Determine the heater voltage required by your application and calculate its ratio to the rated heater voltage of the tube type. From Curves I or III, as indicated by Table I, find the failure rate adjustment factor for this ratio. Note that if the tube is to be operated at rated heater voltage the adjustment factor is 1.0. In any event, the adjusted failure rate is equal to the product of the base failure rate and the adjustment factor.

3 Determine the tube's maximum rated power dissipation by adding the nominal heater power and max. rated plate and screen dissipations. Next, calculate the total power to be dissipated in your application. Determine the ratio of total actual power to total rated power.

4 Decide on the maximum bulb temperature at which the tube will be operated in your application. If the



POWER DISSIPATION AND TEMPERATURE

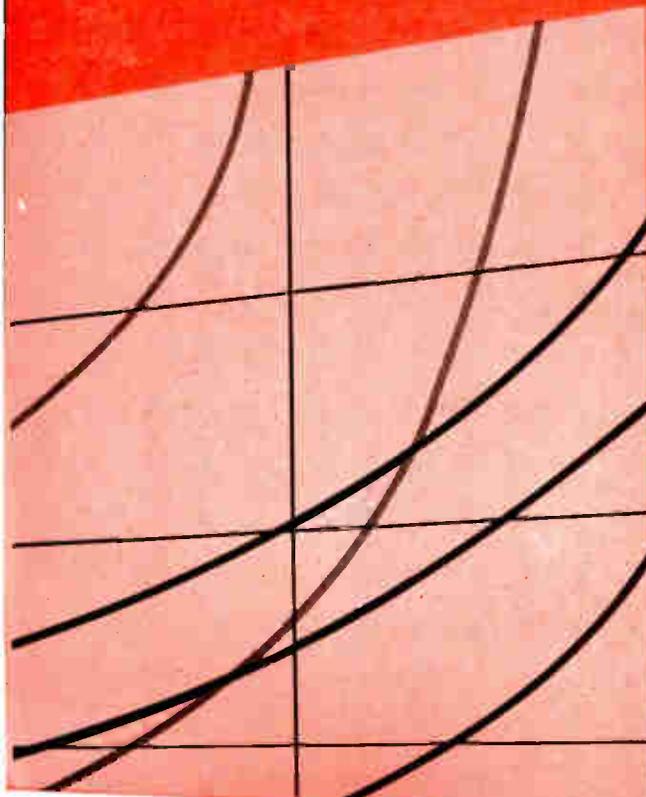


help predict tube reliability!

application is in the design stage, a conservative bulb temperature should be chosen and adequate cooling techniques provided so that bulb temperature will not be exceeded. If a finished design is being evaluated, the standard thermocouple or temperature sensitive paint specified in MIL-E-1, paragraph 4.9.15, should be utilized for determination of actual bulb temperature.

5 Now, having the ratio of operating to rated power and the effective bulb temperature, refer to the reliability enhancement Curves II or IV, as specified by the tube type in Table I, to find the factor to be used in computing the adjusted failure rate.

6 Multiply the base failure rate from step 1, the adjustment factor from step 2 and the step 5 adjustment factor to determine the net expected failure rate for the tube in your application.



ENHANCEMENT CURVES

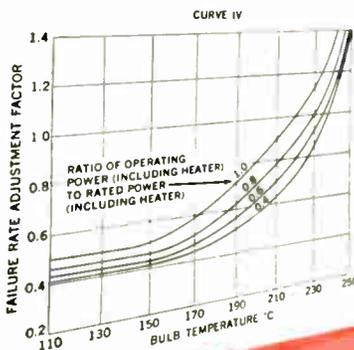


TABLE I

Tube Type	Life Test Conditions	Base Failure Rate in (Percent)	Heater Voltage Enhancement Curve No.	Power Diss. and Temp. Reliability Enhancement Curve No.
5636	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = E_{c3} = 0; R_k = 150 \text{ Ohms}; R_{g1} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
5639	$E_f = 6.3 \text{ V}; E_b = 150 \text{ Vdc}; E_{c1} = 0; E_{c2} = 100 \text{ Vdc}; R_k = 100 \text{ Ohms}; R_{g1} = 0.5 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.6	I	II
5718	$E_f = 6.3 \text{ V}; E_b = 100 \text{ Vdc}; E_c = 0; R_k = 150 \text{ Ohms}; R_g = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	I	II
5719	$E_f = 6.3 \text{ V}; E_b = 150 \text{ Vdc}; E_c = 0; R_k = 680 \text{ Ohms}; R_g = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
5840	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = 0; R_k = 150 \text{ Ohms}; R_{g1} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
5899	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = 0; R_k = 120 \text{ Ohms}; R_{g1} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
5902	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = 0; R_k = 220 \text{ Ohms}; R_{g1} = 0.47 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.6	I	II
5977	$E_f = 6.3 \text{ V}; E_b = 100 \text{ Vdc}; E_c = 0; R_k = 270 \text{ Ohms}; R_g = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	I	II
5987	$E_f = 6.3 \text{ V}; E_b = 150 \text{ Vdc}; E_c = 0; R_k = 1100 \text{ Ohms}; R_{g1} = 0.47 \text{ Meg}; E_{hk} = 140 \text{ Vac}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.6	I	II
6021	$E_f = 6.3 \text{ V}; E_b = 100 \text{ Vdc}; E_c = 0; R_k/k = 150 \text{ Ohms}; R_{g/g} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	I	II
6111	$E_f = 6.3 \text{ V}; E_b = 100 \text{ Vdc}; E_c = 0; R_k = 220 \text{ Ohms}; R_g = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	I	II
6112	$E_f = 6.3 \text{ V}; E_b = 150 \text{ Vdc}; E_c = 0; R_k/k = 820 \text{ Ohms}; R_{g/g} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
6205	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = 0; R_k = 150 \text{ Ohms}; R_{g1} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV
6206	$E_f = 6.3 \text{ V}; E_b = E_{c2} = 100 \text{ Vdc}; E_{c1} = E_{c3} = 0; R_k = 120 \text{ Ohms}; R_{g1} = 1.0 \text{ Meg}; E_{hk} = +200 \text{ Vdc}; T_{\text{Envelope}} = 220^\circ \text{ C Min.}$	0.2	III	IV

If you would like to know more about this forward-looking reliability program, contact your Sylvania Sales Engineer. Or write for your free copy of Engineering Information Service, Vol. 8, No. 4, to Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

CIRCLE 12 ON READER SERVICE CARD

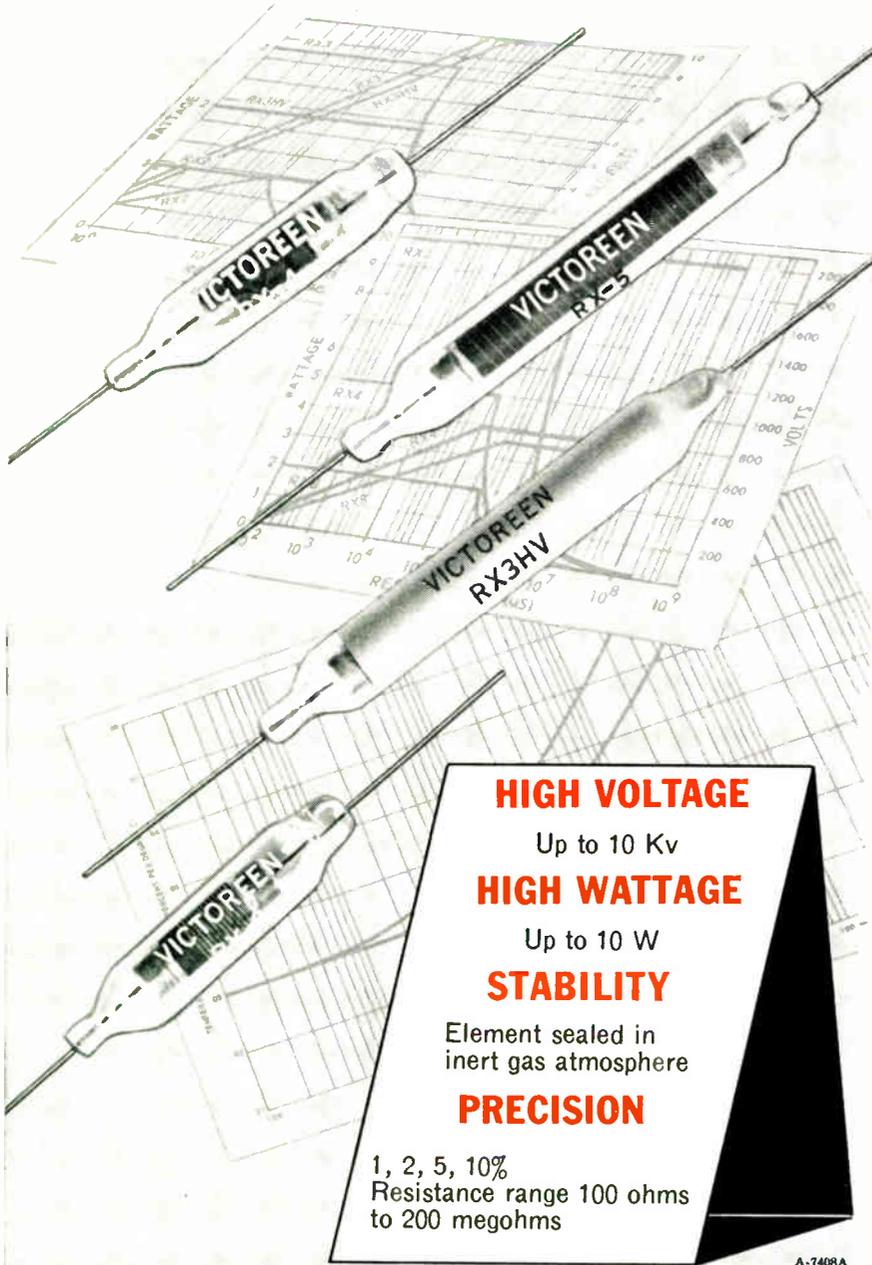
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VICTOREEN Deposited Carbon Precision HIGH-VOLTAGE Resistors



HIGH VOLTAGE
Up to 10 Kv
HIGH WATTAGE
Up to 10 W
STABILITY
Element sealed in
inert gas atmosphere
PRECISION
1, 2, 5, 10%
Resistance range 100 ohms
to 200 megohms

A-7408A

Full technical data available on temperature coefficient, voltage coefficient, power derating, load life, etc.



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THE VICTOREEN INSTRUMENT COMPANY
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LETTERS

to the Editor

"The Competitive Market"

Editor, ELECTRONIC INDUSTRIES:

We enjoyed reading the article entitled "How Late is 'Too Late' In A Competitive Market?" as written by Edwin B. Berlin, appearing in your July 1962 issue of ELECTRONIC INDUSTRIES. It is our feeling that Mr. Berlin has certainly made a thorough study and can benefit all of the industry with his thinking.

H. R. Wood
Sales Manager

Empire Spring Company
140 Olive Street
Elyria, Ohio

"Our Address Should Be—"

Editor, ELECTRONIC INDUSTRIES:

You are to be congratulated on this special edition. It is extremely well done and should be of wide interest in the field.

In checking our listing we note that our address is shown as 111 Main Street, Stepney, Conn. I don't recall having filled out a questionnaire, but, in any case, would appreciate your correcting your records to indicate Box 544, Bridgeport 1, Conn.

Also on page L 53 we would like "capacitors, glass" added to product listings.

Robert E. Cochrane
Manager, Marketing Services
Vitramon® Incorporated
Box 544, Bridgeport 1, Connecticut

Wire & Cable Chart

Editor, ELECTRONIC INDUSTRIES:

Your June, 1959 edition of ELECTRONIC INDUSTRIES carried an excellent series of articles and tabular data on wire and cable.

We at Cannon Electric Company have found the information invaluable and would like to request that you consider publishing up-dated information; however, if your present plans do not call for a recent edition to do this, I would like for you to let us know how to obtain five reprints of the June, 1959 data which you published.

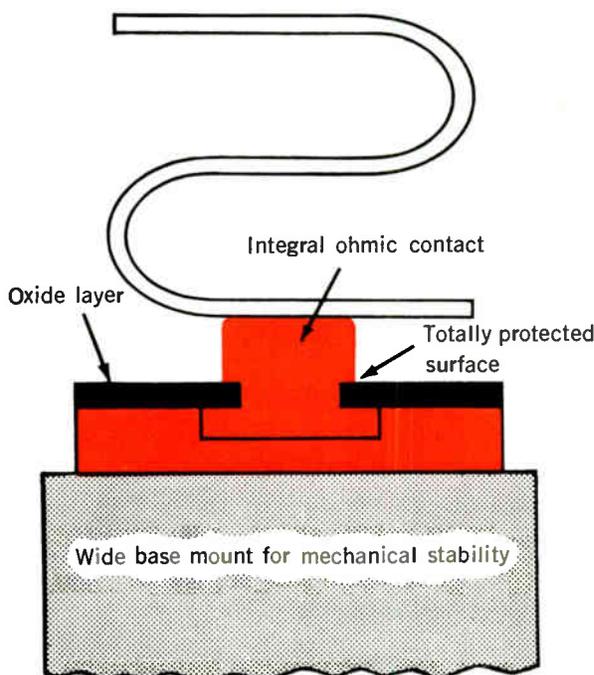
Carlos Beeck
Chief Engineer

Cannon Electric Company
666 East Dyer Road
Santa Ana, California

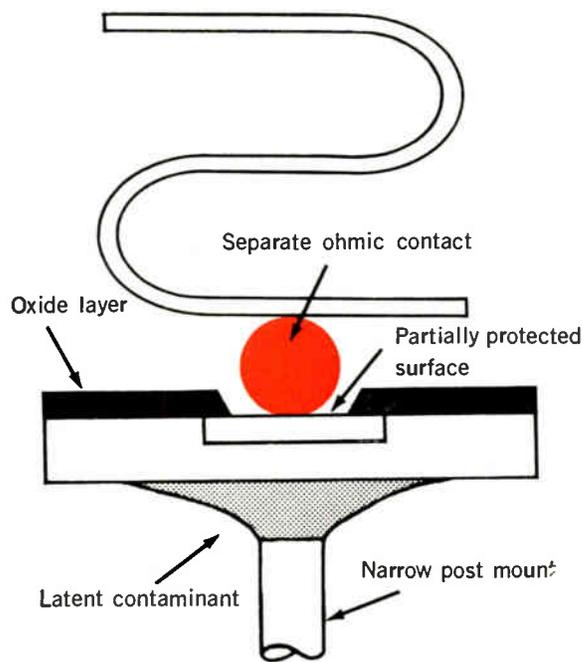


300°C NANOSECOND DIODE

THE INSIDE STORY OF UNIPLANAR* VS. MULTI-PART CONSTRUCTION



RAYTHEON/RHEEM UNIPLANAR* DIODE



CONVENTIONAL PLANAR MULTI-PART DIODE

UNIPLANAR* construction boosts silicon diode reliability

Uniplanar* one-piece construction, produced at Raytheon/Mountain View (formerly Rheem Semiconductor), brings a major improvement to silicon planar diode reliability. This is demonstrated by a 300°C storage capability, unequalled shock and vibration resistance, and more uniform electrical characteristics.

The result of Raytheon/Rheem Uniplanar* construction is a one-piece unit that can't shake loose or become misaligned. The entire chip assembly, including ohmic contact, is formed by a single process. This technique permits positive

surface passivation of the entire junction area. A high level of uniformity is achieved, since ohmic contacts are chemically formed thousands at a time.

300°C storage is obtained because, for the first time, it is possible to exclude the latent contaminants introduced by multi-part assembly techniques.

Uniplanar* construction is available at no extra cost in such types as 1N914, 1N916, 1N3064, and 1N251. For further information, please contact the nearest Raytheon Field Office.

* Exclusive one-piece planar construction from Raytheon/Mountain View (formerly Rheem Semiconductor).



NEW!



- 1/2% FM DISTORTION
- SOLID-STATE POWER SUPPLY
- ELECTRONIC VERNIER TUNING
- AUTOMATIC RF LEVEL SET
- SHOCK-MOUNTED RF UNIT

FM-AM SIGNAL GENERATOR

TYPE 202-H

RADIO FREQUENCY CHARACTERISTICS

RF RANGE: 54-216 MC
 RF ACCURACY: $\pm 0.5\%$
 RF OUTPUT RANGE:
 0.1 μv to 0.2 volts*
 *Across external 50 ohm load at panel jack
 ACCURACY:
 $\pm 10\%$, 0.1 μv to 50 K μv
 $\pm 20\%$, 50 K μv to 0.2 volts
 AUTO LEVEL SET:
 Holds RF monitor meter to "red line" over band
 IMPEDANCE: 50 ohms
 VSWR: < 1.2

AMPLITUDE MODULATION CHARACTERISTICS

AM RANGE:
 Internal: 0-50%
 External: 0-100%
 AM ACCURACY:
 $\pm 10\%$ at 30% and 50% AM
 AM DISTORTION:
 $< 5\%$ at 30% $< 20\%$ at 100%
 $< 8\%$ at 50%
 AM FIDELITY:
 ± 1 db, 30 cps to 200 KC

FREQUENCY MODULATION CHARACTERISTICS

FM RANGE:
 Internal: 0-250 KC in 4 ranges
 External: 0-250 KC in 4 ranges
 FM ACCURACY: $\pm 5\%$ of full-scale*
 *For sine-wave
 FM DISTORTION:
 $< 0.5\%$ at 75 KC (100 MC and 400 cps modulation only)
 $< 1\%$ at 75 KC (54-216 MC)
 $< 10\%$ at 240 KC (54-216 MC)
 FM FIDELITY:
 ± 1 db, 5 cps to 200 KC
 SIGNAL TO-NOISE RATIO:
 > 60 db below 10 KC

PULSE MODULATION CHARACTERISTICS

PM SOURCE: External
 PM RISE TIME: $< 0.25 \mu\text{sec}$
 PM DECAY TIME: $< 0.8 \mu\text{sec}$

MODULATING OSCILLATOR CHARACTERISTICS

OSC FREQUENCY:
 50 cps 7.5 KC 1000 cps 15 KC
 400 cps 10 KC 3000 cps 25 KC
 OSC ACCURACY: $\pm 5\%$
 OSC DISTORTION: $< 0.5\%$

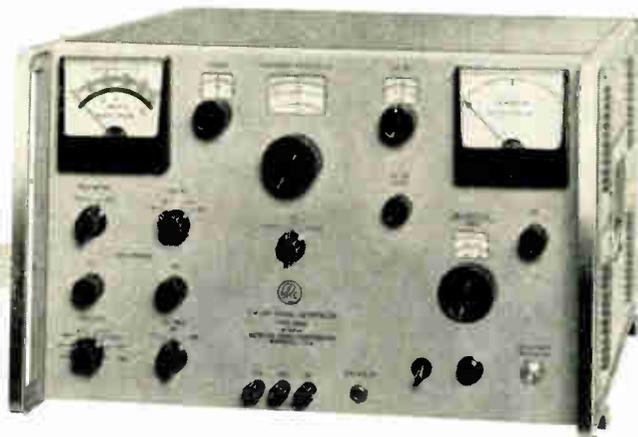
PHYSICAL CHARACTERISTICS

MOUNTING: Cabinet for bench use; readily adaptable for 19" rack
 FINISH: Gray engraved panel; green cabinet (other finishes available on special order)
 DIMENSIONS:
 Height: 10 3/8" Width: 16 3/4" Depth: 18 3/8"

POWER REQUIREMENTS

202-H: 105-125/210-250 volts, 50-60 cps, 100 watts

PRICE — 202-H: \$1365.00
 F.O.B. Rockaway, N. J.



The Type 202-H FM-AM Signal Generator covers the frequency range from 54 to 216 MC and is designed for the testing and calibration of FM receiving systems in the areas of broadcast FM, VHF-TV, mobile, and general communications. The generator consists of a three-stage RF unit, together with a modulating oscillator and power supply, all housed in a single cabinet which may be adapted for rack mounting.

The RF unit consists of a variable oscillator, a reactance tube modulator, a doubler, and an output stage. The modulator is specially designed for minimum distortion and operated in conjunction with the electronic vernier to provide incremental changes in RF output frequency as small as 1 KC. The RF output is fed through a precision, waveguide-below-cutoff variable attenuator; automatic RF level set is incorporated which maintains "red line" on the RF monitor meter over the entire band. The entire RF unit is shock-mounted for minimum microphonism.

An internal audio oscillator provides a choice of eight frequencies which may be used for either FM or AM modulation. A modulation meter indicates either FM deviation or % AM and is calibrated for sine-wave modulation.

A completely solid-state power supply furnishes all necessary operating voltages and may be switched for inputs of either 105-125 or 210-250 volts, 50-60 cps.

Model 202-J is also available for the 215-260 MC telemetering band.

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$\left. \begin{matrix} BV_{CEO} \\ BV_{EBO} \\ BV_{CBO} \end{matrix} \right\} = -150 \text{ VOLTS!}$
 MINIMUM

NEW AND ONLY FROM HUGHES: the 2N2551 featuring symmetrical breakdown voltages greater than 150 volts! This PNP Silicon Alloy Transistor, in a TO-5 package, operates at 400mW. Production quantities are available for immediate delivery. Other outstanding features are:

$h_{FE} = 15 \text{ min./}45 \text{ max.}$ at $I_C = -100 \text{ mA}$ $V_{CE} = -5 \text{ volts}$	$I_{CBO} = -0.1 \mu\text{A max.}$ at $V_{CB} = -100 \text{ volts}$	$V_{CE}(\text{sat}) = -1.2 \text{ volts}$ at $I_C = -100 \text{ mA}$ $I_B = -33 \text{ mA}$	Noise Figure = 6 db max. at $I_C = -500 \mu\text{A}$
---------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------	---------------------------------------------------------------------------------------------------	---------------------------------------------------------

The voltage uniformity of this PNP Silicon Alloy Transistor is due largely to the unique Hughes evaporative-fusion process. This proven process makes possible an unusually high degree of uniform doping and precise junction location, and results in exceptionally low saturation resistance. ■ The highly uniform batch-to-batch characteristics of the Hughes 2N2551 allow much closer tolerances in new-circuit design; and the symmetrical breakdown voltages end all concern with differing voltage limitations across the transistor terminals. ■ It is particularly adaptable to relays and magnetic core drives where an "inductive spike" might destroy other transistors, to ac and dc amplifiers, audio oscillators, low-level circuits, switching, dc choppers and modulators, and especially to those applications with inherent elevated or varying ambient temperatures.

For complete details, call your nearest Hughes representative; or write Hughes Semiconductor Division, Marketing Department, Newport Beach, California. For export, write Hughes International, Culver City, Calif.



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75

AMP set the GOLD standard!

In this AMPin-cert* Blade Connector, gold over nickel plating is standard, never an option . . . never an extra. Gold over nickel plating coupled with engineered contact pressures assure longer life, maximum performance and reliability, setting the highest standard in crimp, snap-in type printed circuit connectors. AMP research and testing have proved conclusively that gold over nickel plating is superior in every way. Crimp, snap-in type contacts are plated with .000030" gold (min.) over .000030" nickel (min.). Uniformity in plating thickness is controlled by X-ray measurement. There is no metal "creep" and no debili-

tating oxide insulation buildup. Three areas of contact are pressure engineered to avoid excessive or quick plating wear.

Another bonus feature is that AMPin-cert Printed Circuit Connectors are not pre-loaded. They can be loaded to accommodate only those circuits actually required. You buy and use only the receptacle contacts you need.

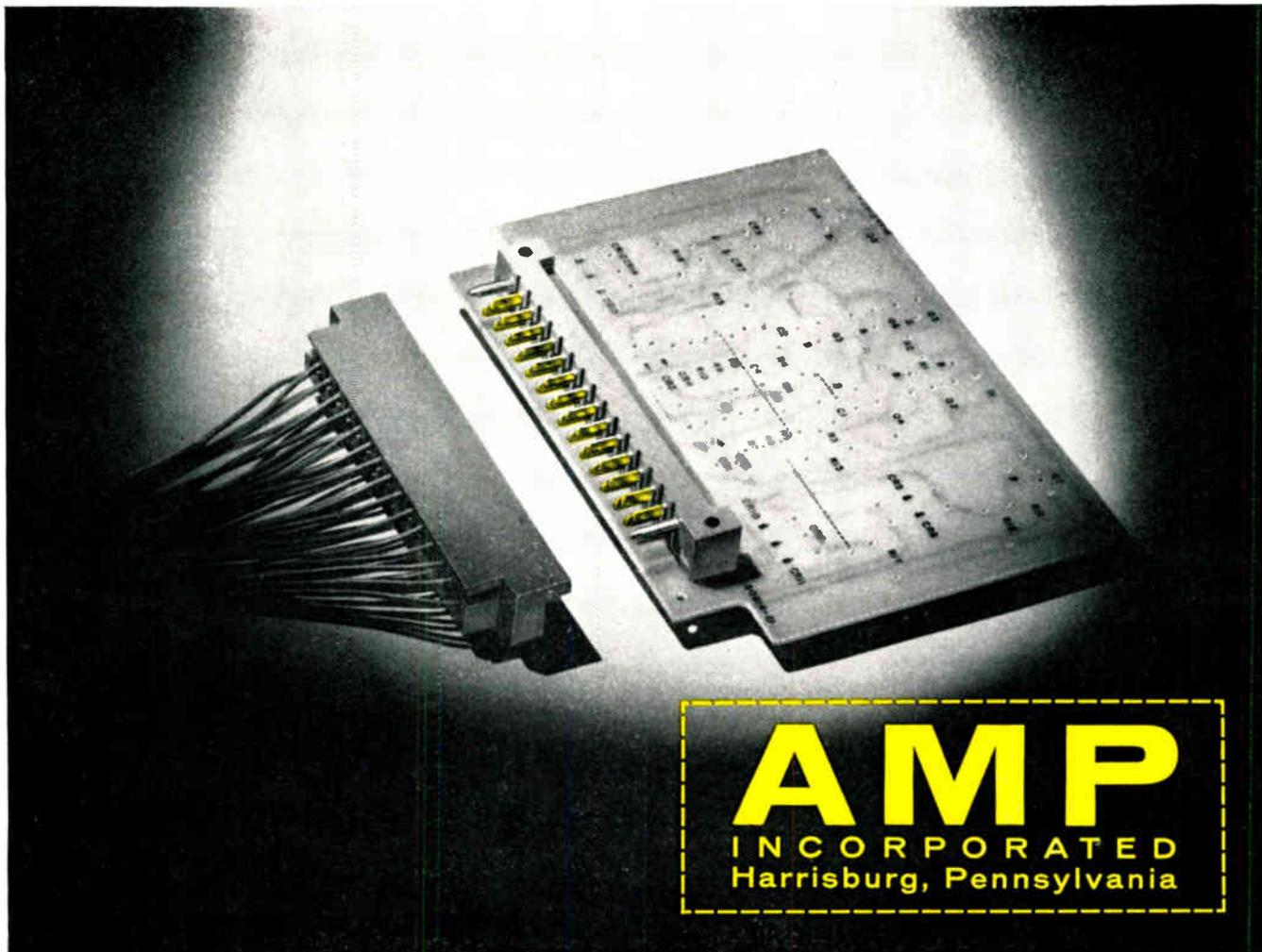
ADDITIONAL FEATURES:

- Encapsulated male tabs prevent misalignment of contacts
- Staked down male tab housing eliminates board warpage
- Guide pins assure positive mating of connector halves
- Raised barrier section and large contact cavities avoid moisture entrapment
- Built-in egg crate construction, and crimp snap-in receptacle contacts eliminate sleeving and soldering.

Why not insure your own standard of quality and reliability by using AMPin-cert Printed Circuit Connectors. You'll find they exceed the most stringent applicable requirements both military and commercial.

Send for more information and a free copy of "A Compilation of Papers published on AMP Research Activities in the Field of Plating."

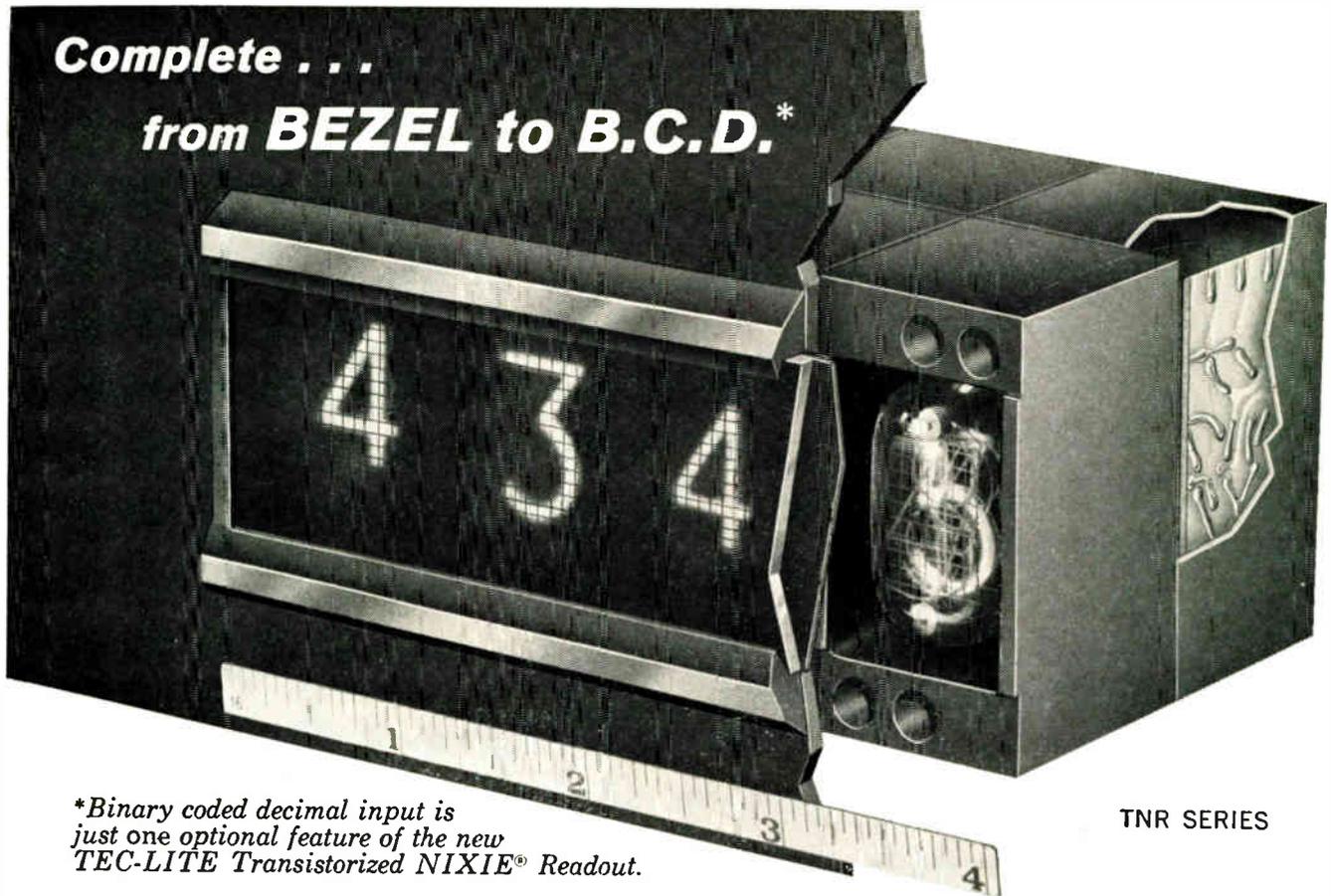
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The expense of relays or external drivers, costs of designing, assembling and testing, is avoided. Self-contained transistorized drivers, which control numeral display, operate from low level signals—as low as 2 volts—typically present in solid state systems. High voltage, 180 VDC required to fire the tube's numerals, is confined to the display panel eliminating the problems created when high voltage is carried into sensitive logic sections.

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MTL SERIES



**"Transistorized" MINI-LITE
INDICATOR**

U.S. Patent No. 2,985,874

TBL SERIES



**BUTTON LITE
(Transistorized)**

U.S. Patent No. 2,985,874

LVN SERIES



**"Transistorized" LOW VOLTAGE
NEON INDICATOR LITE**

U.S. Patent No. 3,041,499

TIL SERIES



**TRANSISTOR CONTROLLED
INCANDESCENT LITE**

U.S. Patent No. 2,986,874

Higher Performance Standards With Improved Reliability... Tung-Sol compactrons provide several advantages that can contribute to lower costs and improved performance. For example, the increased number of pins permit greater heat dissipation. As a result, compactrons run cooler with higher reliability than conventional tubes. The exhaust tubulation is situated between the pins so that broken tips rarely occur. This also permits the use of top

caps for very high voltage designs. In addition, the compactron design readily lends itself to combining multiple tube elements within a single envelope.

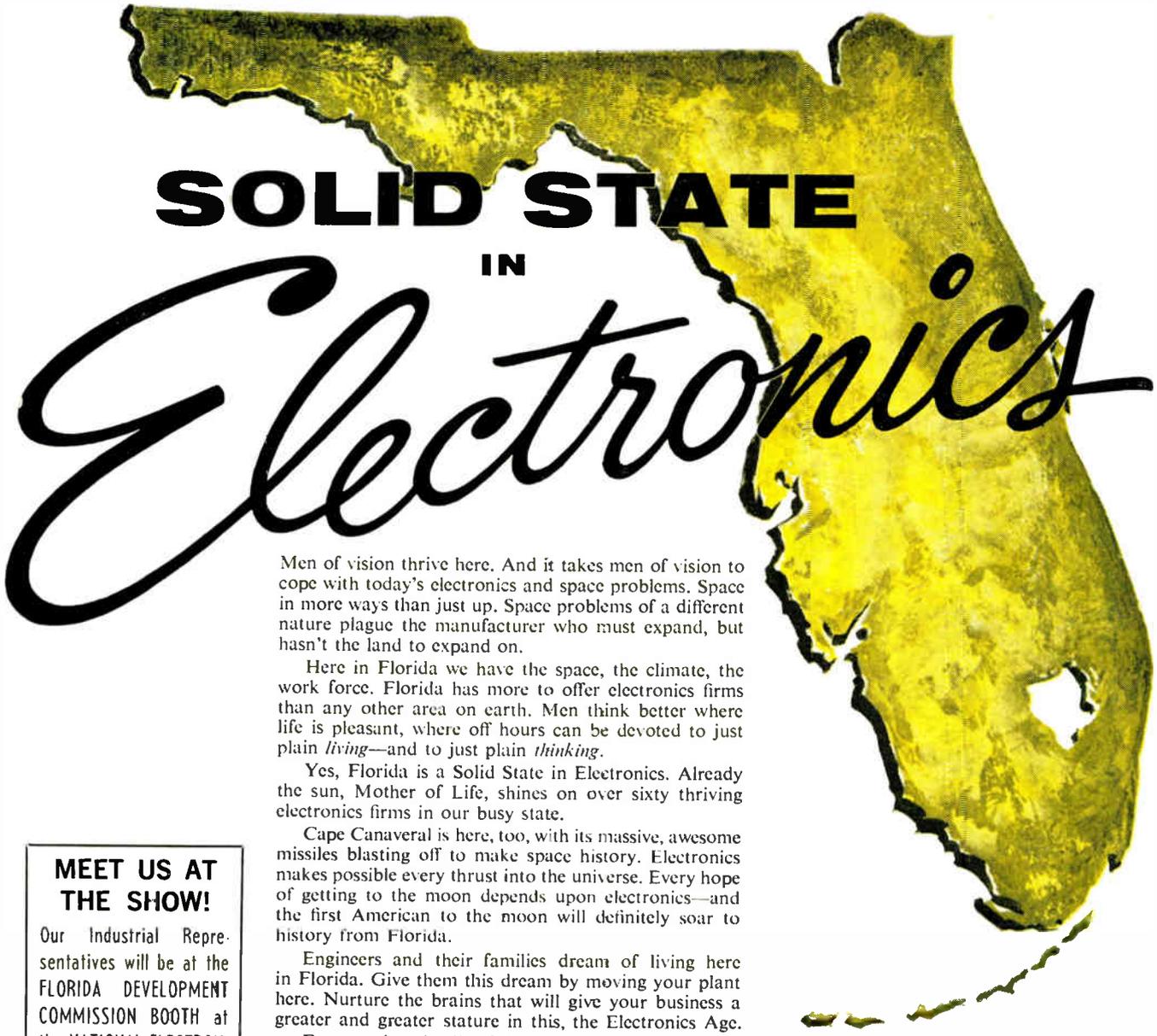
Compactrons require less space on the chassis or printed circuit boards, less height than conventional tubes, less air cooling volume per function. More space between pins improves element isolation, allows higher voltage ratings, simplifies printed circuit and chassis design.

Tung-Sol compactrons are available in production volume for numerous circuit requirements, including radio, tv, hi-fi and stereo, controls and instrumentation equipment. Write for Tung-Sol compactron data file which includes the following types: 6AX3, 6GE5, 6Q11, 12AX3, 12GE5, 8149, 8150 and 1AJ2. Other types will soon be available and special designs will be considered. Tung-Sol Electric Inc., Newark 4, N.J. TWX: NK193.



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BOOKS

Electrical Engineering Fundamentals

By Robert B. Angus, Jr. Published 1962 by Addison-Wesley Publishing Co., Inc., Reading Mass. 516 pages. Price \$8.00.

The author's approach to electric circuits and networks is to first develop fundamental concepts as applied to circuits excited by d-c sources; later in the book he re-examines these concepts as they apply to circuits with sinusoidal and other time-varying excitations. Concepts and definitions are explained in detail.

Fundamentals of the Laplace Transformation

By C. J. Savant, Jr. Published 1962 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36 N. Y. 229 pages. Price \$7.75.

Laplace transform method of solution of differential equations which arise in connection with electrical, mechanical, and electromechanical systems is covered. Mechanical and electrical circuit analysis and all mathematics are included. Modern engineering examples from mechanics, electronics, and electromechanical systems show how the method is used. Problems are included at the end of each chapter.

Books Received

Loud Speakers

By N. W. McLachlan. Published 1960 by Dover Publications, Inc., 180 Varick St., New York 14, N. Y. 399 pages, paperback. Price \$2.25.

The Scientific Basis of Illuminating Engineering

By Parry Moon. Published 1961 by Dover Publications, Inc., 180 Varick St., New York 14, N. Y. 608 pages, paperback. Price \$2.85.

Selected Papers on New Techniques for Energy Conversion

Edited by Sumner N. Levine. Published 1961 by Dover Publications, Inc., 180 Varick St., New York 14, N. Y. 444 pages, paperback. Price \$2.85.

Tube Substitution Handbook, Vol. 4

Published 1962 by Howard W. Sams & Co., Inc. 201 East 46th St., Indianapolis 6, Ind. 112 pages. Price \$1.50.

Data Acquisition and Processing in Biology and Medicine

Proceedings of the 1961 Rochester Conference. Edited by Kurt Enslin. Published 1962 by Pergamon Press, Inc., 122 East 55th St., New York 22, N. Y. 150 pages. Price \$6.50.

North Electric Components Handbook, Revised 2nd Edition

Book is available from the Field Promotion Engineer, Galion, Ohio. 130 pages. Price \$2.00 advance payment.

Symposium on Electrical Conductivity in Organic Solids

Edited by H. Kallmann & M. Silver. Published 1962 by Interscience Publishers, a division of John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 398 pages. Price \$12.50.

Basic Industrial Electronic Controls

By Jacob H. Ruiter Jr. & R. Gordon Murphy. Published 1962 by Holt, Rinehart and Winston, Inc., 383 Madison Ave., New York 17, N. Y. 283 pages. Price \$6.95.

(Continued on page 84)



There are no stop signs in space There will be temporary barriers, and an ever increasing number of problems to face in space technology, but the challenge will continually be met with new and improved systems to combat and overcome these obstacles. The scientists and engineers at SES-Central will continue to play a significant role in the development of advanced communications and navigation systems and techniques to further man's knowledge in this vital field.

CONTRIBUTORS URGENTLY NEEDED to man current and anticipated space, surface and sub-surface communication, navigation and command and control systems projects. Staff and management openings exist at all levels for BS, MS candidates with backgrounds in systems requirements, design, development and research and familiarity with techniques employed throughout the frequency spectrum. In-house programs include the recently acquired MINUTEMAN radio launch control system contract for the U. S. Air Force Ballistic Systems Division. We are located ten miles northeast of Buffalo in the picturesque suburban community of Williamsville, New York.



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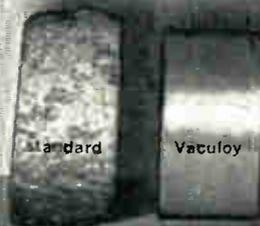
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A radio manufacturer had to pre-tin transistor leads prior to printed circuit assembly when using conventional 60/40 solder. A switch to Vaculoy 60/40 solder eliminated the need for pre-tinning.

A large manufacturer of resistors and capacitors uses an automatic dip machine to pre-tin leads. Thermal precautions limit the depth of the immersion. Pre-tinning of leads without heat damage is mandatory. Hence, rejects were high. A switch to Vaculoy process solder in the same alloy gave more complete tinning in less time, cutting down rejects.

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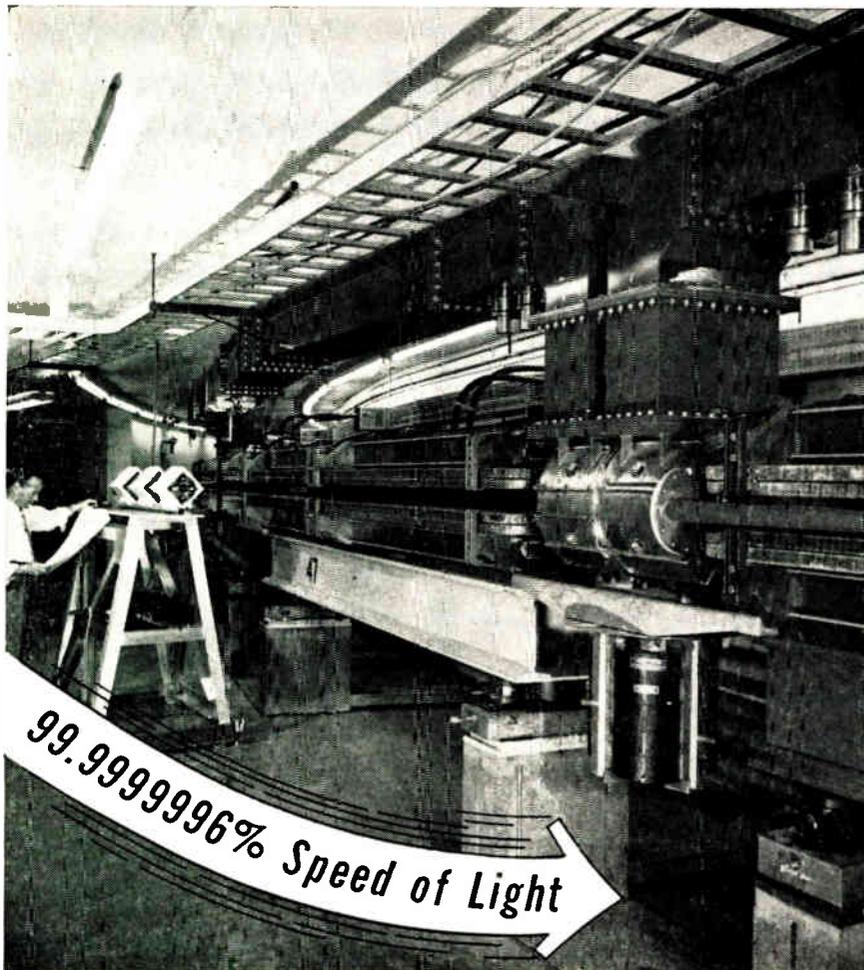
Every step of the way—from tantalum ore to finished capacitors—production, testing, and inspection stages were meticulously controlled within Union Carbide. The end result was solid tantalum capacitors representing the highest performance under the present state of the art.

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BOOKS

Understanding Transformers & Coils

By Edward J. Bukstein. Published 1962 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. 96 pages, paperbound. Price \$1.95.

ABC's of Radio Navigation

By Allan Lytel. Published 1962 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. 96 pages, paperbound. Price \$1.95.

Principles of Transistor Circuits, 2nd Edition

By S. W. Amos. Published 1961 by John F. Rider Publisher, Inc., 116 W. 14th St., New York 11 N. Y. 224 pages, paperbound. Price \$4.25.

Electronics for Everyone, 2nd Revised Ed.

By Monroe Upton. Published 1962 by The New American Library of World Literature, Inc. 501 Madison Ave., New York 22, N. Y. 352 pages paperbound. Price \$0.75.

Having Fun With Transistors

By Len Buckwalter. Published 1962 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. 128 pages, paperbound. Price \$2.50.

Amateur Radio Antenna Handbook

By Harry D. Hooton. Published 1962 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. 160 pages, paperbound. Price \$2.95.

Citizens Band Radio Manual, Vol. 2

Published 1962 by Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis 6, Ind. 160 pages, paperbound. Price 2.95.

A Cryogenic Data Addressed Memory

By V. L. Newhouse and R. E. Fruin. Published 1962 by General Electric Research Information Section, The Knolls, Schenectady, New York. Paper presented at the Joint Spring Computer Conference in San Francisco, May 2, 1962.

How to Make More Money in Your TV Servicing Business

By John Markus. Published 1962 by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36 N. Y. 340 pages. Price \$7.95.

Proceedings of the 1962 Spring Joint Computer Conference

Available from The National Press, 850 Hansen Way, Palo Alto, Calif. Postage paid if accompanied by remittance of \$6.00.

Catalog of Selected Foreign Electrical Standards

Available from American Standards Association 10 East 40 St., New York 16, N. Y. Price \$4.50. (Send check, money order, or ASA coupons with order to avoid invoicing charge.)

Communications Satellites

Contains papers given by a group of international scientists engaged in work with communications satellites. Published 1962 by Academic Press, 111 Fifth Ave., New York 3, N. Y. Price \$7.00.

Electromechanics

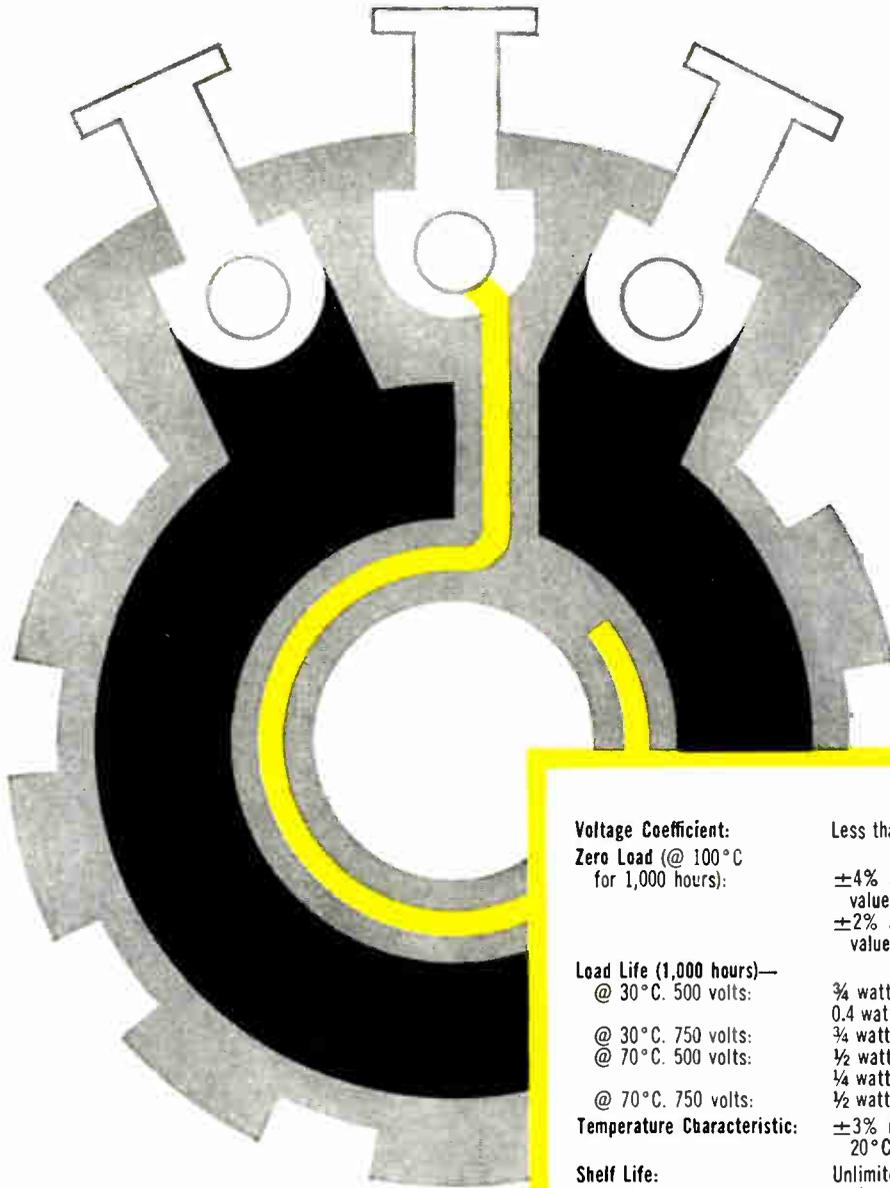
By Hugh Hildreth Skilling. Published 1962 by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N. Y. 475 pages. Price \$10.00.

Forty Years of Radio Research

By G. C. Southworth. Published 1962 by Gordon and Breach, Science Publishers, Inc., 150 Fifth Ave., New York 11, N. Y. Price \$6.50.

Proceedings of the Defense Planning Seminar

Held March 13, 1962 at Washington, D. C. Available from Electronic Industries Association, 1721 De Sales St., N.W., Washington 6, D. C. One copy has been provided for each person who attended; charge for additional copies is \$1.50 per copy. Checks should be made payable to EIA.



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Voltage Coefficient:	Less than 0.01% per volt.
Zero Load (@ 100°C for 1,000 hours):	±4% avg. resistance change, values to 100,000 ohms. ±2% avg. resistance change, values above 100,000 ohms.
Load Life (1,000 hours)—	
@ 30°C. 500 volts:	¾ watt to 1 watt (Series L, LX, D & T). 0.4 watt to 0.5 watt (Series F controls).
@ 30°C. 750 volts:	¾ watt (Series L, LX, D & T controls).
@ 70°C. 500 volts:	½ watt to ¾ watt (Series L, LX, D & T). ¼ watt to 0.4 watt (Series F controls)
@ 70°C. 750 volts:	½ watt (Series L, LX, D & T controls).
Temperature Characteristic:	±3% maximum resistance change. 20°C to 105°C
Shelf Life:	Unlimited (No measurable resistance change.)
Mechanical Life:	Less than ±3% change in resistance after 25,000 cycles.
Noise (7 vdc across terminals A & C):	3 to 8 millivolts, values below 250,000 ohms. 8 to 12 millivolts, values above 250,000 ohms.
Humidity Test (95% RH @ 40°C for 240 hours)—	
reversible change:	±5% maximum resistance change, values to 250,000 ohms. ±9% maximum resistance change, values above 250,000 ohms.

NEW DESIGN DATA BULLETIN 70-101 gives complete details. Write for your copy to: Electro-Mechanical Products Div., Stackpole Carbon Co., Johnsonburg, Pa.

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PERSONALS

Yale Barkan—named Systems Engineering Manager, Electronic Systems Div., Telecomputing Corp., Los Angeles, Calif.

Hughes Aircraft Co. announces the following appointments: **Dr. Malcolm L. Stitch**—named Manager of the newly-formed Laser Development Dept., Culver City, Calif.; **Bruce A. High-Strete**—appointed Assistant Manager, Research Dept., Microwave Tube Div., Los Angeles, Calif.; and **Dr. Dietrich Jenny**—appointed Manager, Semiconductor Div., Newport Beach, Calif.

W. F. Springgate—appointed Research and Engineering Manager, New Bedford, Mass., Div., Aerovox Corp.



W. F. Springgate



R. W. Fink

Raymond W. Fink—named Director of Quality Control, Electronics Operation, Electronics and Ordnance Div., Avco Corp., Cincinnati, Ohio.

Dr. Donald F. Eagle—named Senior Physicist, Magnetic Tape Laboratory, Ampex Corp., Redwood City, Calif.

Dr. Barlane R. Eichbaum—appointed Staff Scientist, Philco Scientific Laboratory, Blue Bell, Pa.

Jack M. Mitchell—named Associate Manager, Digital Computers, Scientific Data Systems, Inc., Santa Monica, Calif.

Edward A. Anderstrom—named Director of Manufacturing, LFE Electronics, Boston, Mass.

Harlan W. Frerking—appointed Manager of Engineering, Microwave Electronics Corp., Palo Alto, Calif.

Joseph G. Semmer—named Midwestern District Sales Engineer, Motorola Semiconductor Products, Inc., Phoenix, Ariz.

Anthony A. Guido—appointed Applications Engineer, PRD Electronics, Inc., Brooklyn, N. Y., subsidiary of Harris-Intertype Corp.

(Continued on page 92)

THIS IS OUR NEW SYMBOL

It is a reflection of our belief that we are not just another precision potentiometer manufacturer. We are a quality-conscious and reputable group of innovators and leaders in our specialty. We design and manufacture miniature and sub-miniature wire wound precision pots with new design and performance features that meet and surpass the environmental, electrical, and mechanical requirements of military specifications. Water's line of rotary, single turn pots for panel mount, printed circuit, and servo applications are available in types ranging from multiple-gang assemblies to models with calibrated dials for slider position indications. Diameters range from 0.3" to 2". Resistance ranges from 10 Ω to 500 K Ω .

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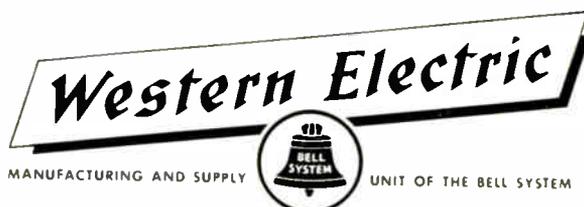
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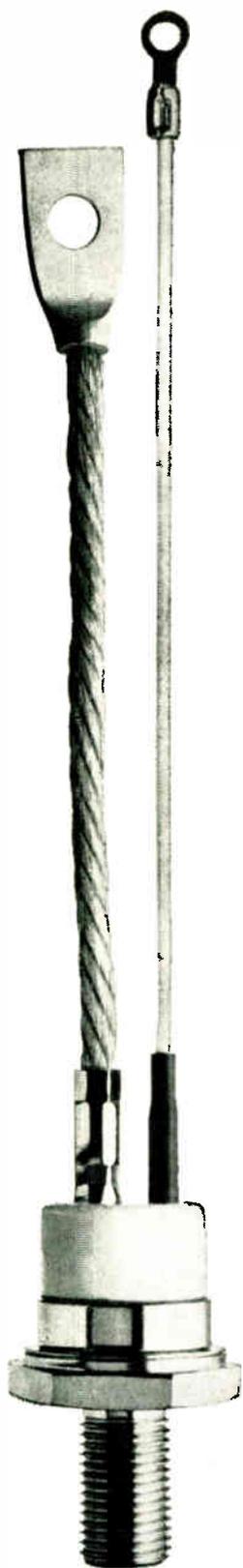


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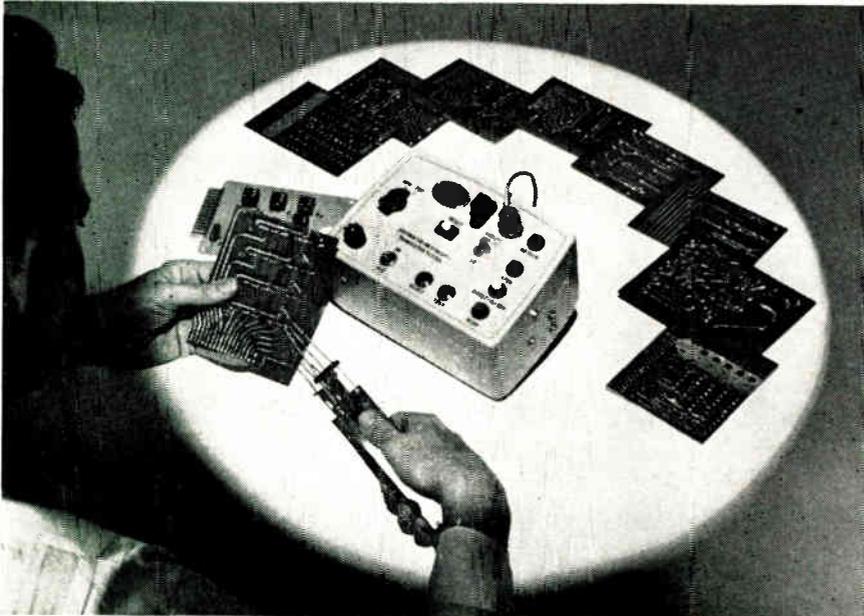
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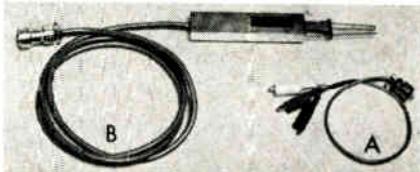
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Carl H. Rapp—appointed Process and Product Engineering Manager for Technical Ceramics, Centralab, Electronics Div. of Globe-Union, Inc., Milwaukee, Wis.



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F. C. Walton

Fred C. Walton — Named Program Manager for Integrated Circuits, Transistron Electronic Corp., Wakefield, Mass.

Robert A. Nagel—named a Midwestern area field specialist for Superior Tube Co., Norristown, Pa.

Fred W. Bauer — named Product Planning Manager, Univac Div., Sperry Rand Corp., New York, N. Y.

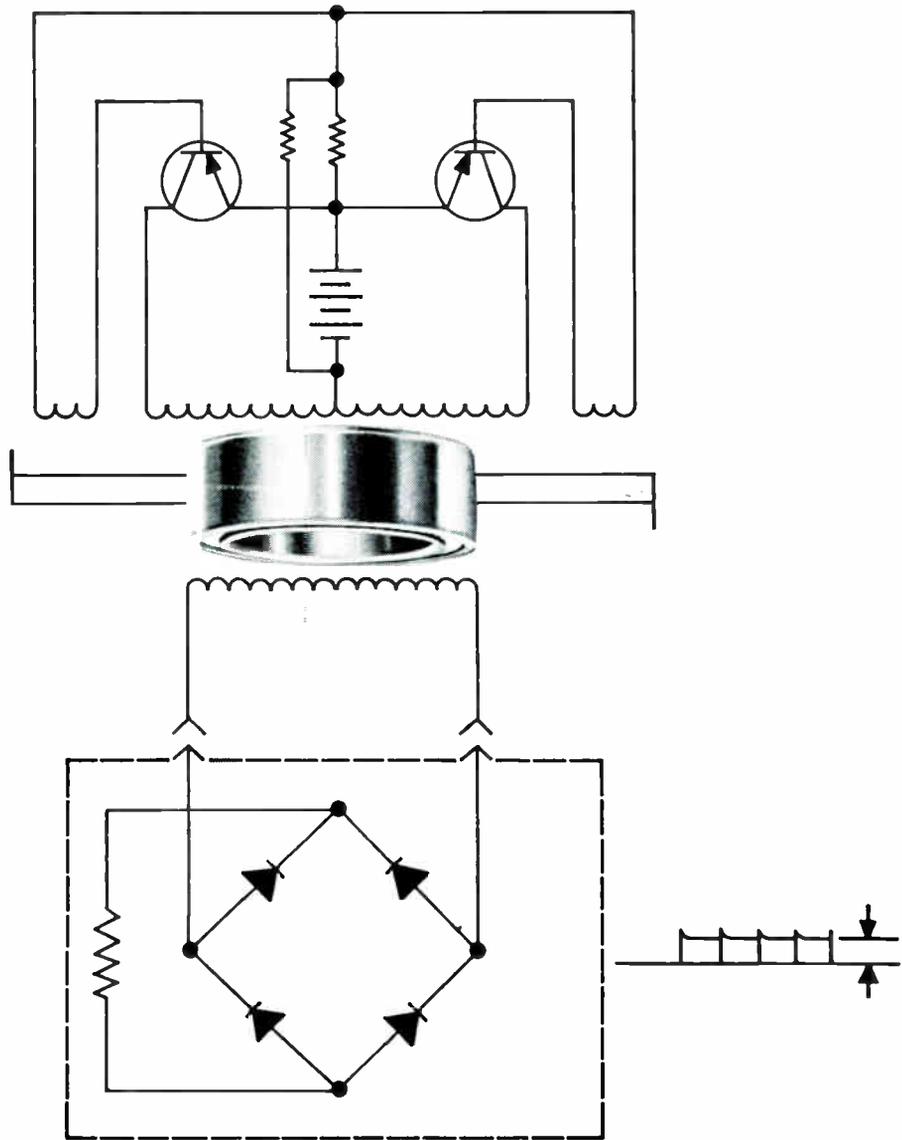
Chester Martowicz — appointed Chief Engineer, Custom Components, Inc., Caldwell, N. J.

Philip M. Kuhn—named Design Engineer, Transducer Laboratory, Chesapeake Instrument Corp.

Weston Instruments Div., Daystrom, Inc., Newark, N. J., announces the following appointments: **Gerald Stolar**—named Chief Engineer, Instruments; and **Robert Lender**—appointed Chief Engineer, Aerospace.

L. A. Wood—named Materiel Manager, General Dynamics/Electronics, San Diego, Calif.

Robert L. Sharkitt—named Research Metallurgist, National Beryllia Corp., Haskell, N. J.



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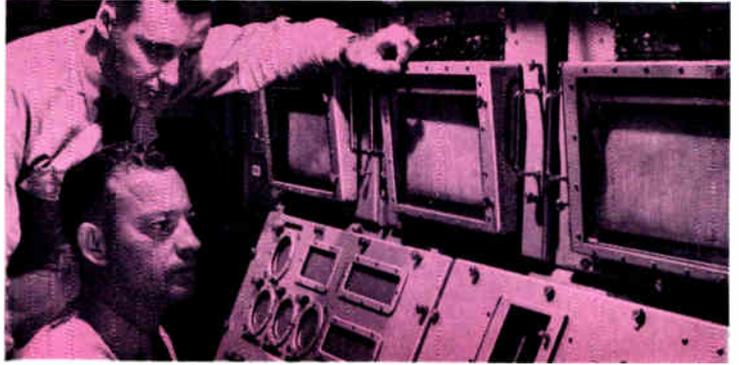
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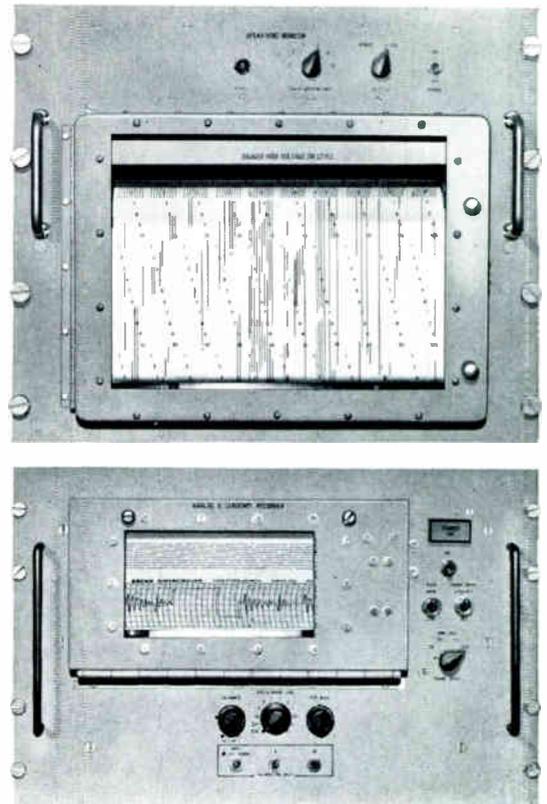
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specifying and buying equipment, and then gives some valuable design data in the form of charts and nomographs and an article on regulating circuits.

■ EFFECTS OF NUCLEAR RADIATION ON COMPONENTS AND EQUIPMENT

This is the fourth in our planned series on nuclear radiation effects outside the blast and heat zones. The past articles have been very popular with our readers and this one promises to be much in demand also—

because it gives the details on equipment knock-out and the effect on components, circuits, and packages. After a discussion of evaluation problems, it gives some imaginative tips on how to design to reduce these effects.

■ AVALANCHE SWITCHING

Circuits using this type of switching are important because of high switching speed and high pulsed current

that can be delivered to low impedance loads. The operation of the two basic circuits usually used is detailed.

■ TRANSIENTS IN RELAY DIELECTRICS

The unexpected failure in testing a relay's dielectric is usually due to a transient. But what causes the transient?

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REGISTERING MASKS FOR THIN-FILM MEMORIES

Present methods are inadequate to produce masks containing hundreds of fine lines 8 or 10 inches long which may be required to register with thousands of magnetic bits within a tolerance of a few ten-thousandths of an inch. Here are four ways to make masks to these registration tolerances.

IN MAKING THIN-FILM MEMORIES, a critical problem occurs in registering sense, word, and bit lines with the magnetic bits.* This is especially true on planes with high density, and small size, bits and with the corresponding fine line wiring. The problem may be separated into three areas: producing the masks and associated artwork; producing the wiring sheets and bits; and, assembling the array. Only the first area will be discussed.

One common method for making masks is to scribe a pattern into an opaque coating on a glass plate or on a transparent plastic sheet. For small and intricate patterns, this artwork may be done at 20 or 100 or more times size then reduced photographically. If the mask contains an orderly repetition of the pattern, the artwork is repeatedly photographed and moved in steps until the array is complete. This may be done before or after the reduction. If done before, misregistration will be reduced with reduction to final size.

The above method is suitable for masks having a full size of about 6 inches square (or less), and whose registration needs are no better than about

0.001 in. This is true when the apparatus for stepping the pattern and the reduction camera can handle an array up to about 30 in. square. In this case, the pattern for a 6 in. square mask can be drawn and stepped five times. With a stepping error of 0.002 in. and a scribing error of 0.002 in., the maximum misregistration will be $0.002 + 0.002 \div 5$ or nearly 0.001 in. Further, if the registration of pattern to pattern is guided by cross lines instead of the pattern, the tolerance of cross lines will add to the misregistration.

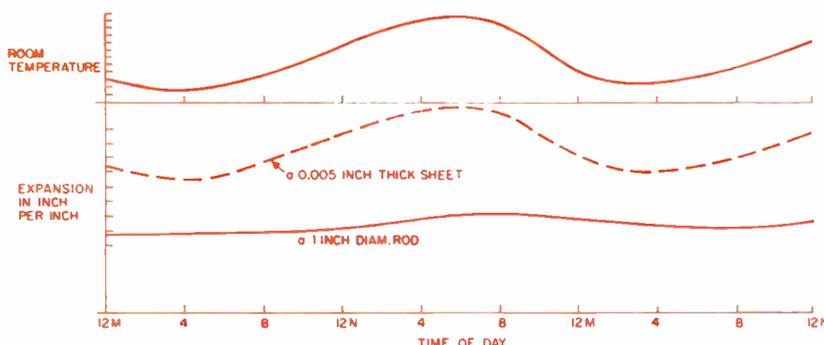
Clearly, the methods above are inadequate to produce masks which contain hundreds of fine lines 8 or 10 in. long. They may have to register with thousands of magnetic bits within a tolerance of a few ten-thousandths of an inch. Here are four approaches to meet these needs.

A: Standard Photographic Reduction

This approach involves the use of photographic methods without stepping the pattern. The entire array of patterns for each mask is drawn or scribed at about four times size, then reduced to final size. Scribing is done with the help of a "Coordinatograph"—a glass top table with gear racks along two

*Proebster, W. E., *Solid State Circuits Conf Digest*, Feb. 1962 and Simkins, Q. W., *J. of Applied Physics*, Supplement to Vol. 33, Mar. 1962 p. 1022.

Fig. 1: Hypothetical plot showing that a material of low thermal expansion coefficient and low mass may expand more than a material of high coeff. and mass.



By MAURICE BELIVEAU

Product Development Laboratory
Data Systems Division
International Business Machines Corp.
P. O. Box 390, Poughkeepsie, N. Y.

edges and meshing pinions which drive graduated dials.

Problems which must be considered in using this method include:

1. Reduction camera distortions.
2. Coordinatograph rack, pinion, and dial inaccuracies.
3. Dimensional changes in the coordinatograph due to temperature changes.
4. Dimensional instability of plastic sheets or glass plates.
5. The likelihood of making an error on the nearly finished scribing.

Camera lens distortion can be tolerated if it is the same in every mask to be registered. The objective is not dimensional perfection, but registration of one pattern to another. With undisturbed camera settings, each mask is reduced with matching distortion.

Every pattern in a mask has a specific dial setting (and a pinion-to-rack location) on the coordinatograph. These *same* settings are used for all pattern locations which are to register. That is, a program or list of dial settings is made for each direction, and these settings are used for all mask patterns, regardless of how the patterns are to register. The question now arises, with what accuracy or repeatability can an operator return to the "same dial setting" for each pattern of each mask?

If backlash of rack and pinion has been eliminated by always making the setting from the same direction, the remaining deviation arises in reading the dial. If, for example, difficulty is found in distinguishing 0.0015 inch from 0.0018 inch, dial gearing is inadequate.

The coordinatograph used has a dial graduated in hundredths of an inch. A vernier scale permits settings to thousandths, but gearing is such that dial periphery movement is only 0.006 in. for each thousandth setting by vernier. Thus, the width of the graduation lines on the dial is about the same as the dial movement. To keep repeatability of a setting close to 0.0001 in., user must be able to read the dial to a fraction of 0.0001 in. This can be done by gearing a second dial, graduated in ten-thousandths, from the first dial.

An experiment was made to measure the repeatability of settings on the coordinatograph. Several sets of two short parallel lines were scribed about ¼ in. apart on a glass plate. The same numerical settings of the dial were used for all sets to eliminate rack and pinion inaccuracies. To illustrate:

1. Set dial at 0.250 in. and scribe a line.
2. Set dial at 0.500 in. and scribe a line.

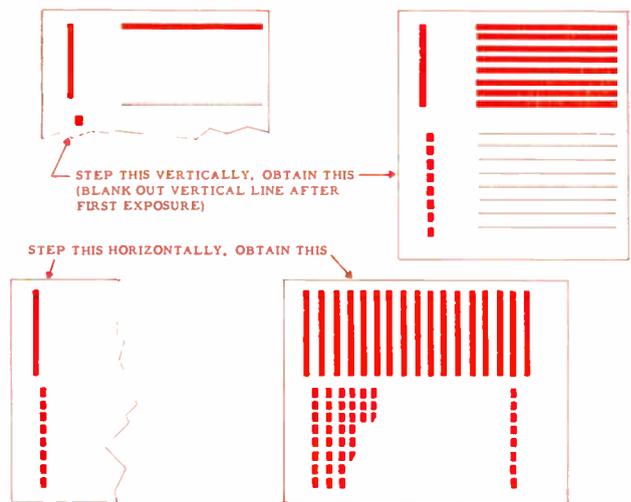


Fig. 2: Sketches illustrate Method C for thin film masks.

3. Move glass plate and repeat steps 1 and 2.

The change in distance between lines in a pair was measured with a 24 in. screen comparator at 50X magnification. The stage was equipped with 3 in. diameter micrometer heads, graduated in ten-thousandths. Reading error due to visual matching of lines with cross hairs on the comparator screen is estimated at ± 0.00006 in. (i. e. ± 0.003 in. $\div 50$).

The maximum difference in distance between lines in a pair was 0.0004 in., ± 0.00006 in.

The variation in distance between lines scribed with the "same" dial settings are due almost entirely to reading the dial. In this case, an attachment which permits settings to a fraction of one ten-thousandth of an inch is needed.

To summarize, only one program is used for the X-dimension for all masks, and another for Y-dimensions for all masks. Backlash is eliminated as described. Dial graduations of 0.0001 in. or better assure repeatability close to 0.0001 in. Again, dimensional perfection is not achieved, but registration within a few ten-thousandths is attained, regardless of inaccuracies in the rack.

Suppose the rack and pinion are of brass (coefficient of thermal expansion = 11×10^{-6} in./in./°F) or steel (7×10^{-6} in./in./°F). In 40 in. of rack length, we would expect a few ten-thousandths of an inch of expansion or contraction per degree (F) change of the rack. We must not conclude, however, that the result will be a few ten-thousandths of an inch misregistration, because while the rack is changing size, so is the glass plate which is being scribed. Also, the rack is unable to change temperature as fast as the room air. In fact, if the rack mass

THIN-FILM MASKS (Continued)

is large and its volume to surface ratio is large, the change due to hourly room air temperature change may not be detectable. The glass plate, if thin enough, will respond more quickly and the result will be the opposite of what we would expect. That is, the *lower* thermal coefficient material (glass) will show *greater* expansion than the brass rack (Fig. 1).

This can be avoided by checking a room temperature recorder. Draw (or scribe) one mask per day, using the same rack settings as the day before at the same temperature reading.

Whether instability is due to temperature or to humidity change, dimensional change of one sheet of patterns, relative to the others, will be negligible if the sheets are of the same material, same size, and are kept in the same environment.

One way to minimize errors is to use two operators: one reads the settings from the program list and sets the dials; the other, who does not see the program, reads the dial and calls out the setting for the first operator to check against the list.

B: Full Size Scribing

Another method is to scribe the whole pattern on emulsion coated glass at full size by using a ruling engine (or a similar machine such as a jig bore or a high accuracy coordinatograph).

In this case, two criteria must be considered:

1. Edge definition of the scribed pattern.
2. Availability of special equipment.

We assume that the accuracy of the dividing engine is well above the needed registration tolerance so that the masks can be scribed as in Method A. That is, all the patterns scribed in all the masks. The problem is to have a scribe which will not tear the emulsion and cause ragged edges. This becomes critical with lines in the order of ± 0.002 in. wide. I have not

fully explored this but I have assumed that it can be done. Perhaps a scribe could be devised which is composed of two cutting edges on each side of a scraper.

If low usage is anticipated, the cost of a special unit can be avoided by selecting an equipped shop with skilled operators. Costs dictate the course to follow.

C: Stepping & Repeating Whole Patterns

A third method is to scribe on one sheet of glass at about four times size, one pattern from each mask. Reduce photographically to full size. Step and photograph in both X and Y directions, the four patterns simultaneously. (See Fig. 2.)

The following must be avoided:

1. Reduction camera distortions.
2. Stepping camera inaccuracies. (Problems 2, 3, 4 and 5 of Method A are negligible here.)

Suppose that the bit and sense lines, now 40 in. long, were to be reduced to 10 in. and stepped perpendicular to the long axis. Image distortion, due to the camera lens, would bow the lines if they did not pass through the center of the lens. A bowed line will not register with a row of bits obtained by stepping along the line axis. This can be avoided by moving the object (the 4 times size artwork) so that one of the long lines does pass through the lens center. Likewise, move the image film or plate to accept the images at sufficient spacing, as shown in Fig. 2, upper left. Now all patterns are ready to be stepped from one sheet, and distortions are minimized.

As stated, the standard way of stepping each pattern *separately* could not provide registration within a few ten-thousandths of an inch unless the stepping camera drive was of very high accuracy (less than 0.0001 in. variation from true setting). By stepping all patterns together from the same sheet errors in stepping are nullified, since they occur on all masks at the same locations.

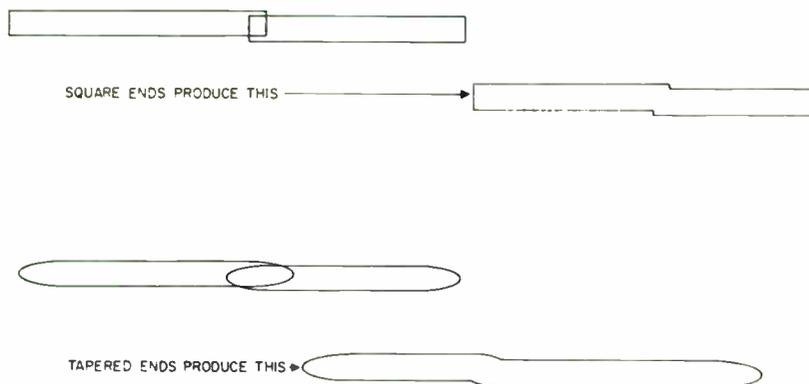


Fig. 3: One method of overcoming mismatch of line segments is to taper the ends

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A test of camera lens distortion was made by reducing two lines, 32 in. long, 0.010 in. wide, to one-fourth size. These lines were drawn 16 in. apart and placed symmetrically in the camera so that each line was equidistant from lens center.

The lines bowed away from the center of the lens by 0.0005 in. That is, superposition of the ends of the lines gave a mismatch of 0.001 at the centers. Therefore, we must place the pattern so that the long lines pass through the center of the lens.

D: Stepping & Repeating Pattern Segments

This method is like Method C, except that we scribe only a short segment of bit, word and sense lines, reduce to full size and step from one sheet.

Mismatch of ends of the short segments during the stepping, if it occurs, will be due to the camera tracks, or to lines segments out of parallel with the tracks.

Several corrections can be made to reduce the mismatch due to the camera tracks. One is to lengthen the sliding member which is guided by the track; another is to taper the ends of the lines segments as in Fig. 3.

Adjusting the segments parallel to the tracks may be done by trial and error.

Evaluation of the Methods

The success of Methods A and B depends mostly upon the ability to match errors in the masks. Thousands of careful dial settings must be made to repeat the coordinatograph scriber locations for each mask. Needless to say, this requires labor and time. Also needed is the addition of some hardware to most coordinatograph dials to permit better readings. Ruling engines or other high accuracy machines do

not have the tables for handling large areas. Therefore, masks drawn at full size need careful control of edge detail of fine lines. (The opaque coating has a tendency to tear in semicircular pieces a few thousandths in diameter from the action of the scriber.) An important risk with Methods A and B is the possibility of an error after having invested so many man-hours in the artwork process.

Method C was given one trial in producing some sections of four masks: bit, word and sense lines, and rectangular spots. The bit and sense lines were 8 in. long and were slotted into several fine lines a few thousandths of an inch wide. Superposition of these masks showed maximum misregistration to be 0.0005 in.

Method C, therefore, has at least two important advantages:

1. Coordinatograph inaccuracies are eliminated.
2. The amount of labor to produce masks is lower than with Methods A and B.

Method D more completely obeys the principle of matching errors and has the largest number of important advantages:

1. Reduction camera distortions are reduced to insignificance.
2. Artwork can be drawn at a larger scale than four or five times size, thereby permitting finer pattern detail.
3. Coordinatograph inaccuracies are eliminated.
4. The amount of labor needed to produce masks is low; especially if an automatically programmed step and repeat camera is available.
5. Undulations in the stepping camera track can be tolerated to a greater degree than other techniques, but mutual registration of the masks will still be maintained.

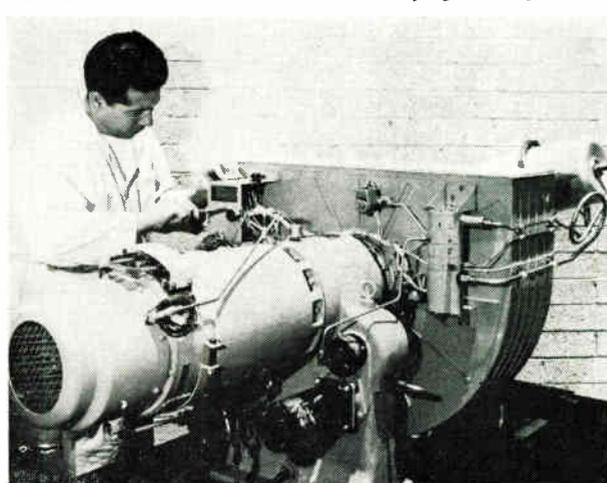
Pilot Plant Uses Packaged Power

A NEW MANUFACTURING PLANT with no windows on its outside walls and no electric wires leading into it will open for production in mid-November in Lexington, Ohio. The experimental plant is being built by the Hartman Electrical Mfg. Co. to mass produce a new line of subminiature electrical relays.

The 16,000 sq. ft. building will contain its own power package with energy supplied by two gas turbine engines. The building will be windowless to maintain a dust-free, controlled environment for producing hermetically sealed dry circuit relays.

The gas turbine energy package is a development of AiResearch Div., Garrett Corp., Phoenix, Ariz.
(Continued on page 213)

One of two AiResearch gas turbine energy packages for the Hartman Co. Turbines drive 270 KW, 420 cps generating units.



As semiconductor integrated networks become smaller, the problems of packaging and interconnecting these devices become major design considerations. The more important problems being faced are discussed and some suggested solutions evaluated.

PACKAGING AND INTERCONNECTING INTEGRATED NETWORKS

AS CIRCUITS AND SUBSYSTEMS BECOME smaller, the problems of packaging and connecting circuit elements loom larger. Integrated networks, are one of the most advanced approaches to electronic circuits. They have reached a point in development where the basic methods have been well established for the making of functional circuits. These include both active and passive elements, and the internal connections between them.

An integrated network is defined as a functional electronic building block consisting of a number of active and passive elements connected to form a circuit whose component elements cannot be removed, nor function individually.

Typical of manufacturers' and users' problems are those found at Sperry Semiconductor, where a number of packaging and interconnecting means have been investigated. It has become evident that common packaging and interconnections are not adequate for the integrated network approach.

These problems must be solved if we are to exploit

potential advantages of integrated networks regarding size, weight, reliability, and operating speed.¹

General

Integrated networks are being produced by methods well known to the semiconductor industry—oxide masking and protection, diffusion, evaporation, and epitaxial growth; and, while these methods are evolving rapidly, they are already capable of producing practical and usable devices. We can, therefore, assume that it is possible to produce in large quantities, at low cost, the working parts of the circuits suitable for both digital and analog applications.

1. Bowe, J. J. "A Growing Field—Solid Networks," *Electronic Industries*, pp. 120-122, May 1961.

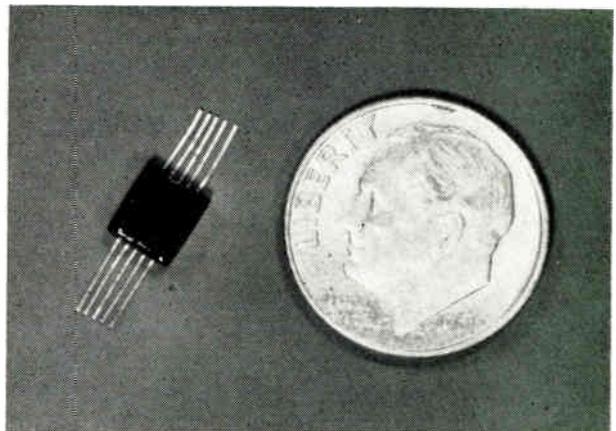
By **EDMUND G. SHOWER**

Sperry Semiconductor
Div. of Sperry Rand Corp.
Norwalk, Conn.



Fig. 1. When network is assembled into a TO-5 type case, it requires about 0.02 in.³, not including the leads.

Fig. 2. Using a less common package for the network still requires 0.002 in.³, not including leads.



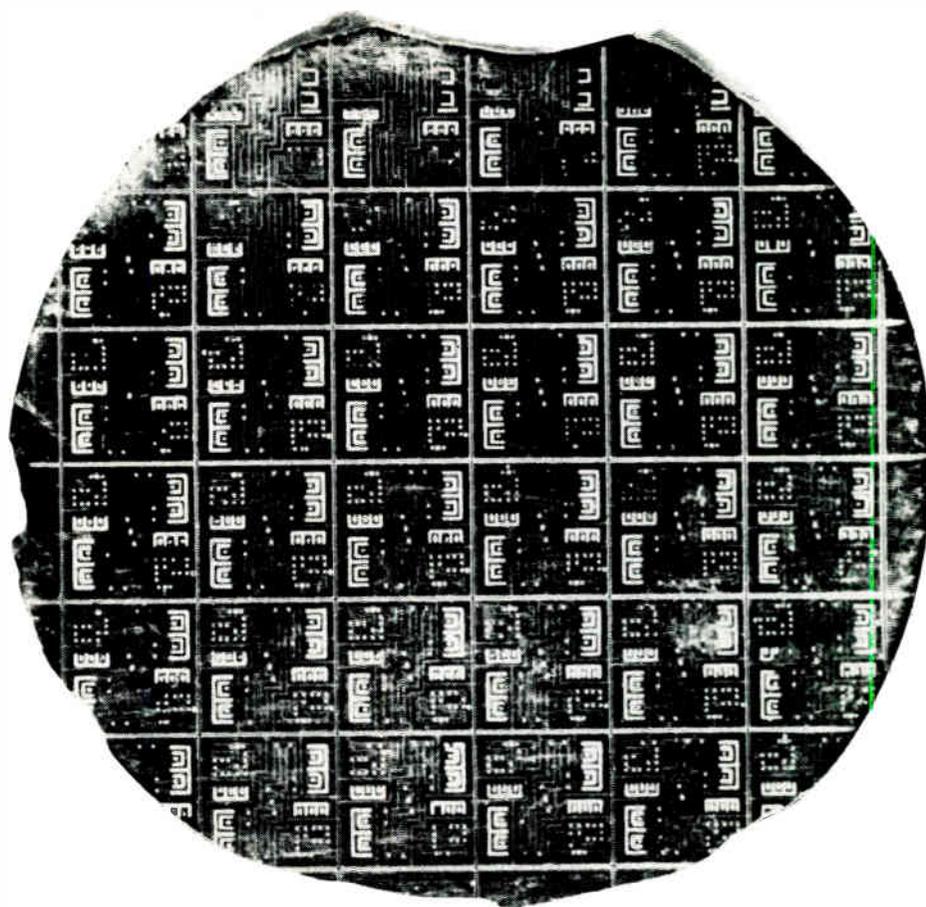


Fig. 3. Slice of silicon about $\frac{3}{4}$ in. in diameter, on which have been produced by masking and diffusion, 20 or more integrated circuits, each a complete circuit function.

Space & Weight Problem

These networks are packaged in various ways, some less common than others. When we examine these packages—we find that the package and its means for connecting the device into the system occupies a larger volume than the working part of the circuit. For example, a typical SEMI-NET² embracing as many as four transistors, six diodes, and ten resistors can be produced on a silicon wafer 0.120 x 0.120 x 0.005 in., thus occupying 0.00005 in.³ However, when this network is assembled into a TO-5 type case, it requires about 0.02 cu. in., not including the leads. (See Fig. 1.)

Possible Solution: By using a less common package (Fig. 2), we improve by an order of magnitude to 0.002 in.³ But this is still almost two orders greater than the ultimate 0.00005 in.³ and we have not accounted for the space required for the leads. Therefore, a problem still remains. We have not approached the ultimate to within even one order of magnitude, although we are aware that there is a lower limit imposed by power dissipation in the unit.

Reliability Problem

Reliability is affected in a less obvious fashion, but for many types of application it is even more impor-

2. Trademark—Sperry Rand Corp.

3. McGuigan, W. D. "Maintenance Minimization in Large Electronic Systems," *IRE-PGRC-1*, pp. 22-23, August 1952.

tant. Maintenance records³ show that solder joints, sliding connections, and welds are high on the failure list. In fact, analysis of such data shows that any interface between dissimilar materials is a potential failure. This is true for the internal part of a device as well as its exterior connections. An example of this is the interface between the cathode sleeve and oxide coating in an electron tube—a well known source of mechanical and electrical failure. The modern semiconductor device is, or can be made to be, relatively free of these interfaces. The critical regions—the junctions—are for the most part buried within the solid semiconductor material. Difficulty begins when we attempt to bring ohmic connections from the device to the outside. Proceeding from the inside, the first critical spot might be the connection between an evaporated metallic pad on the surface of the device to the inner end of a terminal (Fig. 3). Common means for making this connection is by a fine wire thermocompression bonded on one end to the pad and on the other to the lead. Here are a pair of interfaces which are vulnerable to mechanical and chemical forces that can, and frequently do, cause failure.

Possible Solution: Careful choice of materials and elimination of thermo-compression bonding can vastly improve this situation. We are still faced, however,

INTEGRATED NETWORKS (Continued)

with the next set of connections as we proceed from the basic circuit into the subsystem and system. These can become very complex, particularly in digital systems. Reliability can be improved by use of printed or etched circuit boards instead of sliding connections or by the use of welded leads. However, these steps leave us with the same number of interfaces and their potential unreliability.

Speed Problem

Before examining other solutions to the reliability problems, let us examine the third factor which is an inherent advantage of integrated networks. This factor is speed, or its equivalent—high frequency operation. The network itself, by virtue of its size, can be made to operate at high speeds, provided its components are so designed. This is possible, since the components are achieved by the same methods as equivalent discrete devices. There are certain distributed parameters inherent in the integrated structure, but these sometimes can be turned to advantage. However, when we load this fast network with the

Fig. 5a. (top) Two adjacent networks with selected elements interconnected by means such as a printed board, shown schematically as a bus bar. Fig. 5b. (bottom) The same two elements are connected by a metallic film in the same manner as is now used between elements in the same network.

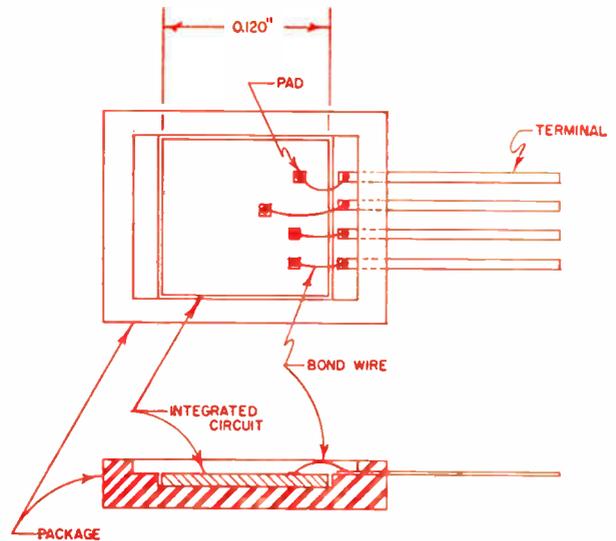
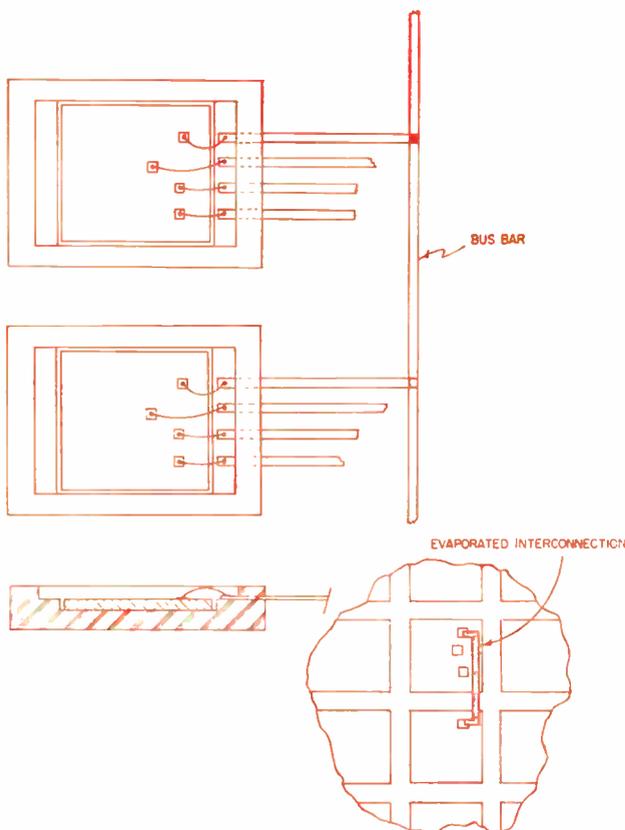


Fig. 4. Connection between evaporated metallic pad on the surface of the device to inner end of a terminal is vulnerable to chemical and mechanical forces that cause failures.

inductance and capacitance of the relatively long interconnections of a conventional package and connecting scheme, we have lost a part of the built-in speed. Hence, the solution, which is bound up with the solution to the reliability problem, must be one which reduces the length of the paths between elements of the system. This is tied in with reliability because, as we add length to the paths, we also include soldered or welded connections. These are found in printed circuit boards or more advanced configurations, such as welded self-supporting modules.

Possible Solution: One solution to the speed and reliability limitation is one which must be approached carefully, since it involved a number of trade-offs, and each type of application might have a different solution. Going back to the processes for making integrated circuits of the type we are discussing, the steps prior to the mounting of the circuit wafer in its housing produce the complex shown in Fig. 4. This is a slice of silicon about $\frac{3}{4}$ in. in diameter, on which have been produced by masking and diffusion, 20 or more integrated circuits, each a complete circuit function. The next step in the manufacturing process is to separate these into individual dice and then mount each die to a header, ending with a completed device as in Fig. 1 or Fig. 2. The user, in assembling a subsystem, connects these devices together to make, for example, the arithmetic unit of a digital computer. This operation brings in the long leads and the interconnections contributing to the loss of speed and reliability.

Returning to Fig. 4, we ask the question, "Why

break these dice apart when the customer is going to reconnect them by means which are less reliable and longer than those we can apply at this stage?" The connection means referred to here are those already available as intracconnections. These are evaporated metallic films across the surface of the oxide coating on the wafer. We are already using these individual networks. Their reliability is anticipated to be potentially higher than thermocompression bonds which they are replacing. By replacing bonds with metallic films we not only provide a more reliable connector, we eliminate a number of interfaces. Figs. 5a and 5b illustrate this concept. Fig. 5a shows two adjacent networks with selected elements interconnected by means such as a printed board, shown schematically as a bus bar. Here it requires as many as six interfaces, shown by the dots, to make the ohmic connection from one element to the other. In Fig. 5b the same two elements are connected by a metallic film in the same manner as is now used between elements in the same network. Here, there are only two interfaces, and the length of the connection is shortened almost to the ultimate. Thus we have gained in reliability by reducing the number of interfaces to one third. We have also reduced the length of the lead, and hence the inductance, and have increased the speed.

How the concept of multiple functions affects the package is obvious, but how far can one go in this direction? Since by definition these functions cannot be separated, it follows that the greater the functional content of a package, the greater is the value

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of the element which is thrown away upon failure. Again, as the content of the package increases, flexibility goes down. This comes about because the packages become more specialized as they encompass more of the system. On the other hand, we have the advantages of reliability and speed. We also have the advantage of even greater reductions in size and weight. Optimum content will depend upon the application, as stated above. For example, in a space application where reliability, weight, and space are of utmost importance, the content might be much greater than one where repairability and maintainability are important.

Conclusion

No matter what direction the development of electronic circuits takes in the future, it is safe to say that packaging and interconnecting will remain an important factor. In fact, as stated above, the package design assumes more importance as size of module shrinks toward the ultimate.⁴ Package materials will come under closer scrutiny as mechanical strength and heat conductivity become more significant, and interconnections will require basic attention, perhaps completely new approaches.

4. Wallmark and Marcus, "Minimum Size and Maximum Packing Density of Nonredundant Semiconductor Devices," *Proceedings of the IRE*, March 1962.

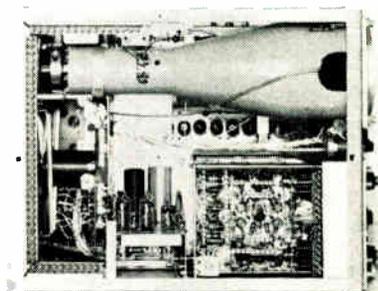
Portable Oscilloscope For Accurate Field Testing

THE ARMED SERVICES have a constant need for portable test equipment of laboratory or shop capabilities. Taking equipment to the shop for high accuracy test or tune-up uses valuable time. Portable equipment of high accuracy and wide bandwidth fills this void.

In line with these needs, Lavoie Laboratories, Inc., Morganville, N. J., has introduced their Model LA-285 Portable Oscilloscope weighing 40 to 45 lbs., with a vertical freq. response of dc to 30mc. This militarized unit uses readily obtainable components and tubes and measures 12 x 15 x 20 inches. The big factor accounting for the weight-to-accuracy ratio is the use of frame grid tubes in the vertical amplifier. Using these tubes, Lavoie has reduced the number required from 22 tubes to 8.

In keeping with industry and military policies of getting as much use as possible from equipment, the LA-285 will accept a wide variety of other manufacturer's plug-in units.

Side view, militarized cover removed. The sub-chassis at the middle (below tube neck) is the frame grid tubed vertical amplifier. Unit on right is the LA-265CA Differential Preamp.



AUTOMATIC CHECKING (Continued)

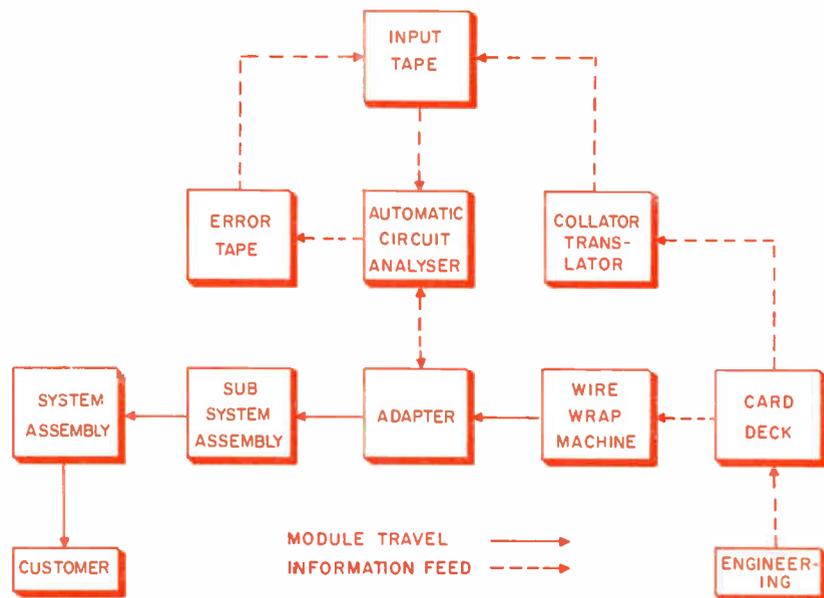


Fig. 3: Simplified diagram shows the integration of module travel and information feed which achieves the desired speed and standard of quality control.

This is not the only way modules may be checked. There are in use many systems with different circuitry and ramifications which may adequately check for errors in modules of a similar nature. However, the uniqueness of this system lies in the design of a 10,000-point adapter. An important requirement of this adapter is that each contact function independently—yet all contacts must be synchronous.

Adapter Design

Several criteria were made to maintain the objectives:

- All modules coming off the wire-wrap machine must be tested on the adapter.
- A minimum of time should be used as set-up time for any module.
- Equipment should have a high reliability factor.
- Cost must be such that a competitive status is maintained.

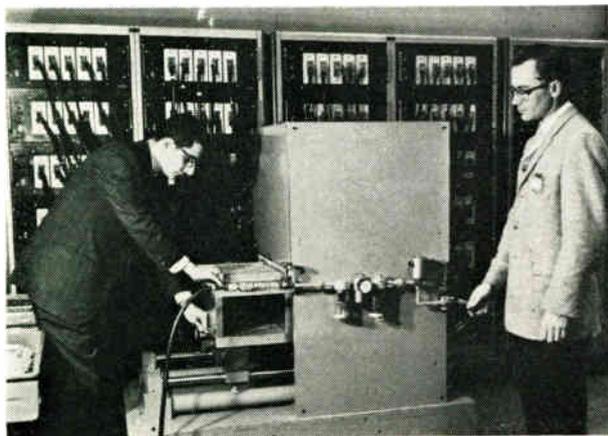


Fig. 4: Wired module enters adapter on movable carriage.

The project's first phase was to determine the general layout and the basic concepts which would be followed. Several designs were reviewed—all had some desirable features. With this information, the next step was to incorporate the better features into the best design. The results showed that the adapter would have the following:

A Malco plate interface.

10,000 spring-loaded contacts inserted into this plate.

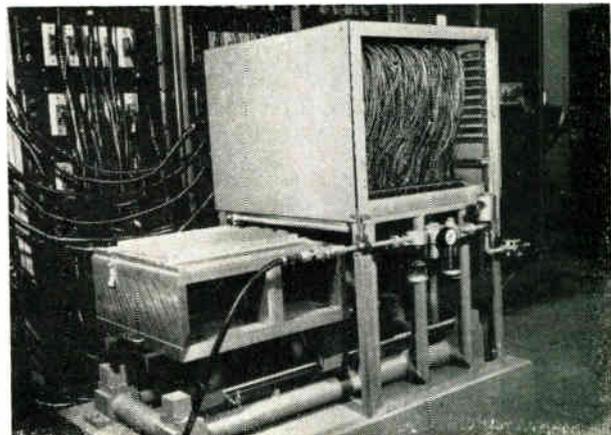
A movable carriage to support the module; and, this carriage would lift to engage the module with the spring-loaded contacts.

Shop air supply (90psi) to actuate the adapter.

Spring-loaded pin-connection directly to wire for the least contact points.

The most important aspect of the adapter was the spring-loaded pin construction. The basic design

Fig. 5: With cover removed, internal wiring maze is shown.



consists of a gold-plated brass pin, nylon tubing, and a coil spring. Several spring sizes were considered—from 1 oz. to 8 oz. when compressed $\frac{1}{4}$ in. The objective was to determine the minimum force required to actuate the pin under all operating conditions.

We studied the 1 oz. spring and found that 10% of the cases would result in pin hangup. The frictional forces, which accrued due to the wiring and nylon tube, overcame the spring force. This prevented the pin from returning to its original position when the module was removed from the unit. However, the ram force needed to lift the module enough to properly engage the pins was within range of the shop air supply and air piston available.

Tests with the 8 oz. spring showed that the hangup problem would be eliminated; but, the force exerted on the interface was well beyond the safety point.

After checking all the springs, it was decided that the 6 oz. spring would be used. This meant that the interface had to be supported and the ram size had to be increased to adjust for the extra spring force.

To reduce confusion in wiring the 10,000 points of contact, a 10-color code system was used. Each row of 100 contacts had one color which was repeated every 10 rows.

The wires were channelled in groups of 100 through the upper portion of the side panel and then

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fed down to their respective slots on the interface. Each wire was crimped onto a spring-loaded pin and the whole assembly pressed into position.

There were several safety features built into the unit. The movable carriage cannot be raised unless it has been moved to its full travel point. To operate the automatic circuit analyzer, two bars have to be pushed under the carriage to actuate two Micro-switches. These two bars keep the carriage in the raised position in case the pneumatic system fails.

When a module is ready for test, it is placed on the movable carriage with the wire-wrap pins pointing upward. Two locating pins restrict the positioning so that the X and Y coordinates of both the module and the adapter are in proper alignment. The carriage is moved under the 10,000-point interface. The pneumatic system is then energized to raise the carriage and module so that electrical contact is made between the wire-wrap pins on the module and the spring pins in the interface. Figs. 4 and 5 show the adapter and its movable carriage.

★ ★ ★

Marking Electronic Assemblies

A NEW METHOD for labeling terminal points has been developed at General Dynamics Corp.

The process is said to result in legends more precise, legible and durable than present methods.

The technique calls for etching, on thin sheets of brass, stencils used for marking terminal points on assemblies and circuit boards. These marks are provided by electronic manufacturers so users can make repairs in the field if necessary.

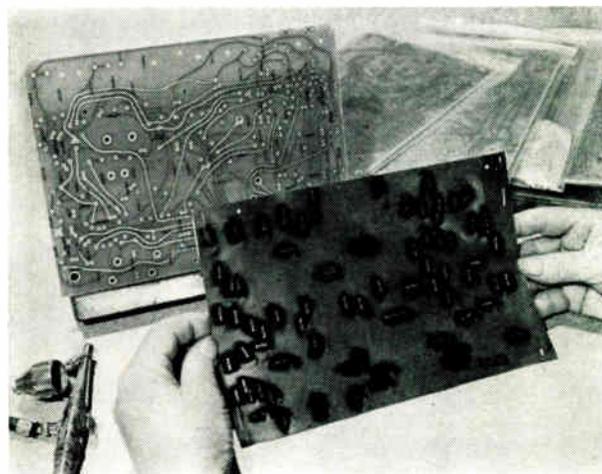
The three most common marking methods have never been adequate for the close tolerance identifications which, in some cases, require figures as small as 0.03 in.

Using the metal stencils, labels can be positioned accurately to within thousandths of an inch yet, because of the clarity of the letters, can be read as easily as a printed page.

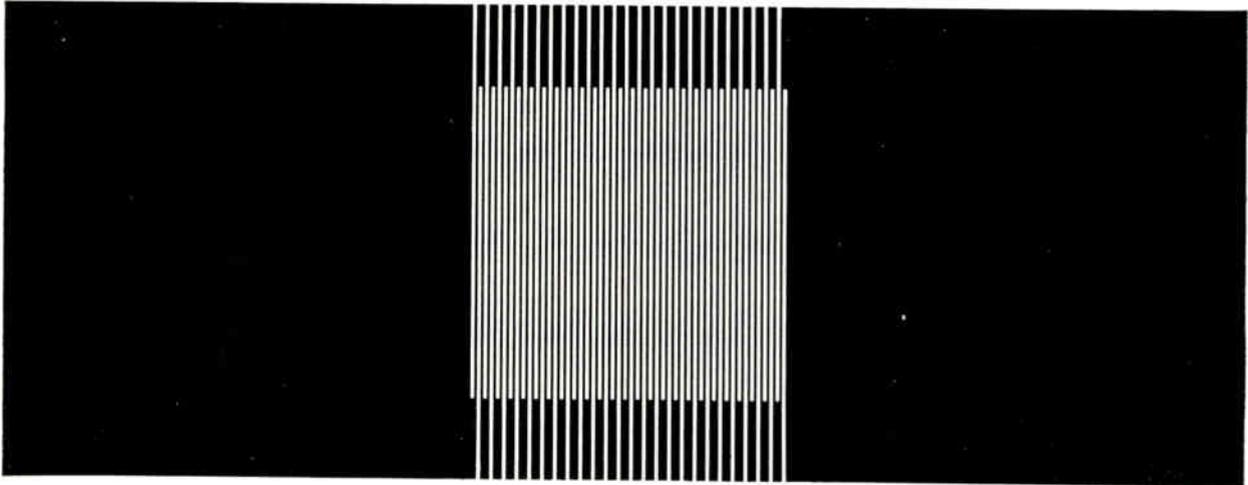
In the photographic etching process, engineering drawings are accurately reproduced on thin (0.004 in.) brass sheets that fit over the area to be marked.

The stencils can be made in any size, wear well and can be held firmly in position during inking.

Process for etching stencils on thin brass sheets results in legible and accurate marking of terminal board points. Brass stencil and completed circuit board are shown below. The stencils were developed by General Dynamics/Convair.



WHAT'S NEW



Blown-up view. Grid in middle is magnetoresistive material. Encapsulated unit has copper end-terminals for attachment.

Thin Film Magnetoresistive Elements For Control Circuit Applications

A THIN FILM, solid-state, magnetic flux-sensitive resistor was recently unveiled by American Aerospace Controls, Inc., 123 Milbar Blvd., Farmingdale, N. Y. Called "MistoR," the elements feature a high degree of transfer linearity, relatively high impedance, low noise and fast response.

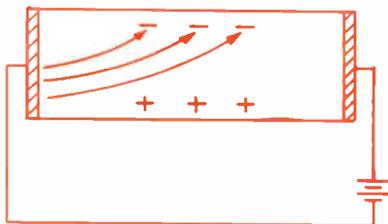


Fig. 1: Initial deflection of electrons in a magnetoresistive element by a magnetic field (perpendicular to page) to create a transverse electric field.

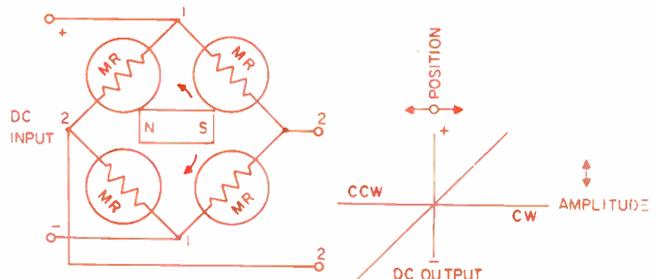
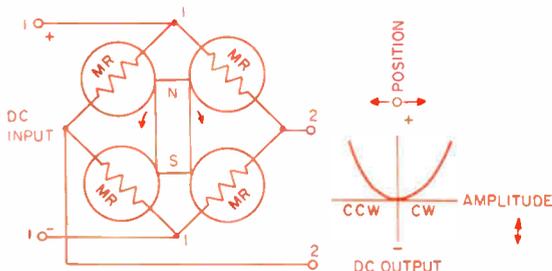
The phenomenon of magnetoresistance is closely associated with the Hall effect. When a conductor carrying an electric current is placed in a magnetic field, perpendicular to the direction of the current,

the charge carriers are deflected toward the conductor sides, Fig. 1. This deflection results in a piling up of electrical charge on the conductor sides, until the electric field exerts a force equal and opposite to that of the magnetic field. Another result of the deflection is an increase in the conductor resistance. Magnetoresistance results mainly from the fact that, not all of the current-carrying electrons have the same velocity. Hence, their contribution to conduction decreases, and the resistance of the conductor increases.

These epoxy encapsulated units are available in kits of four, with ratings of 1250, 2000, 3000, and 4000 Ω , $\pm 20\%$ in either series. Some of the applications include: transducers; flip-flops; oscillators; magnetic field probes; solid-state switches; multipliers; dividers; servo controls, Fig. 2; and high-gain, low-noise galvanometric amplifiers.

Fig. 2: Servo positioner with dc input. If the rotatable pole is held between terminals 1-1, the bridge output is 0 with output increasing with rotation in either direction.

If the rotatable pole is oriented between terminals 2-2, a reverse in the polarity of the output voltage is obtained with rotation through the null.



Gaseous Optical Masers Show Promise in Electro-Optical Systems

FIVE NEW GASEOUS OPTICAL MASERS, each using a different pure noble gas as the active medium, have been announced by scientists at Bell Telephone Laboratories. The masers, made of helium, neon, argon, krypton and xenon, emit continuous beams of coherent radiation at a total of 14 different frequencies. This variety of frequencies represents a major step in advancing optical maser technology.

Bell Labs is exploring the use of optical masers in future communications systems. Projected uses include electro-optical systems, optical communication systems and photo-visual detectors. Until this achievement in the gaseous maser field, it was thought that a wide range of frequencies would be available only from solid state masers.

The studies used a 2 meter quartz discharge tube with windows at a polarizing angle (the Brewster angle) and external confocal mirrors. A dielectric coating on the mirrors makes them strongly reflective at wavelengths near 2 microns.

The results suggest that stimulated emission is a way of improving methods used to investigate spectra in certain cases. Of the 14 coherent emission lines seen in the 5 gases, 3 had never before been observed. Many spectral frequencies can, in theory, be emitted by the noble gases in the infrared portion of the spectrum. Fluorescent emission of these frequencies is generally weak as one goes further into the infrared. Sensitivity of available photodetectors in this region is poor. When made to operate in an optical maser however, these gases may produce, at specific frequencies, beams of coherent radiation that are strong, and directional enough, to be easily observed when they are shown on a spectrometer.

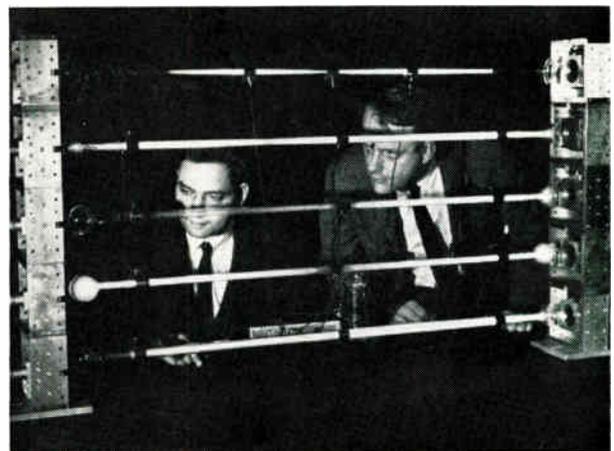
In masers filled with neon, argon, krypton or xenon, energetic free electrons in the discharge directly excite the atoms of the single gas into an upper energy level. From here they fall to a lower level, emitting coherent radiation at characteristic frequencies. Because helium does not have an electron configuration corresponding to those of the other four gases, it produces maser oscillation by a mechanism other than direct electron excitation. This is believed to be a two-stage process, wherein helium atoms are excited into the upper maser level through collisions with directly excited helium atoms.

Also announced was a helium-neon gaseous optical maser which can emit a bright red beam of visible coherent light. By replacing the dielectric coated mirrors reflecting in the infrared with mirrors designed to reflect strongly in the visible region, the new co-

herent optical wavelength is observed. A dc discharge imparts energy to the helium, marking a departure from previous r-f methods of excitation of gaseous mixtures.

Scientists report the red maser beam will be convenient for interferometric measurements, such as in gaging the surface regularity of a spherical mirror. This may also be useful as a generator of coherent light for experiments in optical communications.

Bell Laboratories Kumar Patel and William Bennett, Jr. check alignment of optical maser tubes containing the five noble gases—helium, neon, argon, krypton and xenon.



Gaseous Optical Maser Characteristics

Gas	Frequency (10^{14} cps)	Wavelength (microns)
Helium-Neon	2.683	1.114
	2.601	1.153
	2.586	1.16
	2.502	1.198
	2.485	1.207
	4.741	0.6328 (visible)
Neon-Oxygen, Argon-Oxygen	3.551	0.8446
Helium	1.456	2.0603
Neon	1.423	2.1019
Argon	1.854	1.618
	1.771	1.694
	1.677	1.793
	1.455	2.0616
Krypton	1.775	1.690
	1.771	1.694
	1.681	1.784
	1.644	1.819
	1.561	1.921
	1.418	2.116
	1.371	2.189
Xenon	1.495	2.0261
Cesium*	0.4178	7.180

*Developed by T.R.G., Inc., Syosset, N. Y. Device operates at temperature of 488 degrees Kelvin

ANALYZING DATA BY LEAST SQUARES

Least squares is a very useful statistical method of analyzing data having a common factor. In describing the characteristics of gyros, potentiometers, and displacement transducers, it can determine the most probable true value of a common factor with a maximum of accuracy.

LEAST SQUARES IS A STATISTICAL METHOD to determine the most probable true value of measured data. If a measurement is performed many times and is apparently the same value each time, the best estimate of the true value is the arithmetic average of the sum of the measured values; because, each value measured is not exactly the same in the sense of precise measurements. The most probable true value is determined by the method of least squares.

The maximum probability that the arithmetic average is the true value occurs when the root-mean-square (rms) of the deviations between the measured values and the average value is a minimum; or, the sum of the squares of the deviations is a minimum. The rms of the deviations is called the standard deviation. It is defined as the square root of the arithmetic average of the sum of the squares of the deviations. Since plus and minus deviations, above or below the average value, are equally likely to occur, squaring the deviations eliminates the possibility of plus deviations being allowed to cancel minus deviations which would give a false indication of accuracy.

The most probable curve to describe the characteristic behavior of related data is determined by the method of least squares. In this article, the most probable curve is assumed to be a straight line. The most probable true slope of the curve is calculated by the method of least squares, and the most probable true values of the dependent variable determined from the slope. When the rms, or the sum of the squares of the deviations between the calculated aver-

age value and the measured values of the dependent variable are a minimum, the calculated average values are called the least squares fit to the measured data.

If the measured data is unsymmetrical, or there is skewness present, the method of least squares can be applied by proper choice of the variable and transforming the measurements to a symmetrical set of values. This treatment of data can be applied unless the measurements are so widely scattered that there is virtually no connection between them.

Non-statistical methods of describing the characteristic behavior of related data are often used in industry to obtain a preliminary analysis. One method is the establishment of the *Most Favorable Straight Line*, a line drawn through a curve of measured data such that the maximum plus and minus deviations of the measured data from the most favorable straight line to three or more points are equal. This is usually done by visual inspection. It is merely an average value estimate whose accuracy is limited to the "eye ball accuracy" of the individual drawing the line.

Application Method

The method of least squares is used to describe

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the characteristics of gyros, potentiometers, accelerometers, displacement transducers and so forth. Here we consider linear displacement transducers; however, the system is applicable to any set of data having linear relationships.

The equation of a straight line is:

$$y = b + mx \quad (1)$$

or

$$b + mx - y = 0$$

where:

- y = measured value of dependent variable.
- b = value of dependent variable at origin of curve.
- m = slope of the line, or constant, which is typical change in y per unit change of independent variable.
- x = value of independent variable.

Eq. (1) is linear with two unknowns, b and m . The number of linear equations necessary to solve for the most probable values of b and m , in the sense of least squares, is equal to the total number of measurements. The simultaneous solution of the linear equations results in the most probable values of b and m .

To normalize Eq. (1) for m , both sides are multiplied by x (the coefficient of m), resulting in the following equation:

$$bx + mx^2 - xy = 0 \quad (2)$$

Summing n equations (where n equals the total number of measurements).

$$\sum bx + m \sum x^2 - \sum xy = 0$$

To normalize Eq. (1) for b , both sides are multiplied by the coefficient of b , which is one. The resulting equations summed with the following results:

$$\sum b + m \sum x - \sum y = 0 \quad (4)$$

$$\sum b = nb$$

therefore,

$$nb + m \sum x - \sum y = 0$$

The solution has been reduced to two linear equations with two unknowns as follows:

$$nb + m \sum x - \sum y = 0$$

$$\sum bx + m \sum x^2 - \sum xy = 0 \quad (5)$$

Solving Eq. (5) results in the most probable values of b and m . These values are substituted in Eq. (1) and solved for the values of the dependent variable for each value of the independent variable to determine the most probable straight line to

describe the measurements. The calculated value of the dependent variable is noted as yc ; the independent variable is the measured value, x , noted under Eq. (1).

The equation of the most probable straight line that fits the measurements is:

$$yc = b + mx \quad (6)$$

where

- yc = calculated value of dependent variable, determined for each value of independent variable.
- b = most probable true value of dependent variable, when independent variable is equal to zero.
- m = calculated slope of most probable straight line. This is a constant which is the change in yc per unit change of independent variable.
- x = value of independent variable.

Displacement Transducer Measurements

The following definitions are commonly used to describe transducer characteristics:

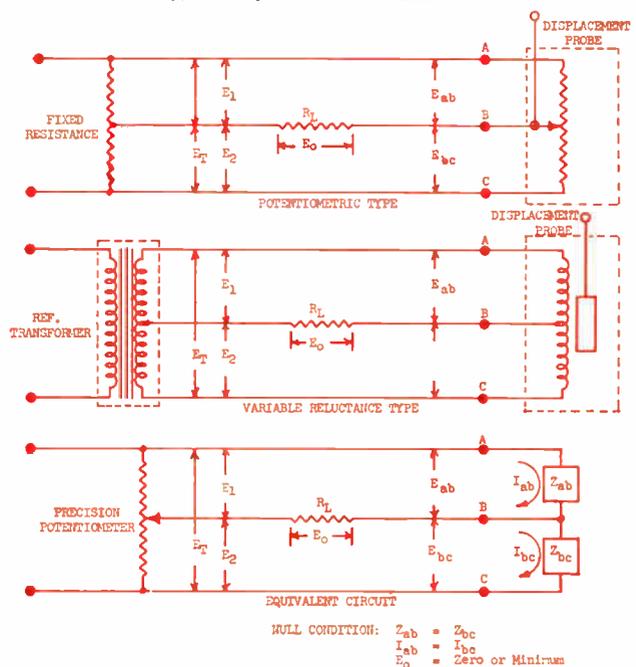
Gain: Ratio of output quantity to input quantity at each increment of input.

Sensitivity: Ratio of average gain to transducer excitation, or slope of curve describing output voltage ratio versus input displacement.

Average Gain: Slope of most probable straight line that fits gain measurements. Average gain is determined by method of least squares from gain measured at each increment of input.

Non-Linearity: Variation in gain above and below average gain expressed as a percentage of total measured output quantity to total input quantity.

Fig. 1: Some typical displacement transducers.



LEAST SQUARES (Concluded)

The measurement of resistance ratios or impedance ratios across the transducer with all inputs can be done with a very high degree of accuracy; however, direct measurement of output at, or near, zero input displacement usually has a low degree of accuracy.

Linear displacement transducer gain is a linear function of the impedance ratios across the transducer and the ratio of each impedance to the sum of the impedances across the transducer, Fig. 1. Since from Ohm's Law, impedances can be represented by the voltages developed across them, gain is proportional to the voltage ratio between either E_{ab} or E_{bc} and the excitation voltage E .

To determine the most probable gain and non-linearity by the method of least squares from the voltage ratios measured, substitute the following quantities in Eq. (1) through (5).

- y = Voltage ratio measured, with respect to excitation voltage (dependent variable).
- b = Voltage ratio at zero displacement input.
- m = Change in voltage ratio per unit change of displacement, or transducer sensitivity.
- x = Displacement input (independent variable).

The value of m is the slope of the most probable straight line describing the change in voltage ratio per unit change of input displacement. It is directly proportional to the transducer sensitivity expressed in volts output per volt excitation per unit input displacement. The equation of the most probable straight line is given by Eq. (6). Values of x extending and retracting from zero displacement are assigned appropriate positive and negative signs when solving for the most probable straight line.

Assuming that the transducer excitation is constant, the individual values of m can be determined between each input displacement from the measured voltage ratios, and the gain at each point of measurement calculated from the following equations:

$$m_x = \frac{VR}{x}$$
$$G_x = m_x E$$

where,

- m_x = transducer sensitivity at displacement x .
- G_x = gain at displacement x .
- E = transducer excitation.

VR = incremental change in measured voltage ratio at displacement x .

x = incremental change in displacement at x .

Then the arithmetic average gain could be used in determining the most probable true value of gain and the most probable straight line that fits the measurements. This involves making additional calculations which are usually unnecessary. Measuring voltage ratio at each input displacement is equivalent to measuring the gain at each displacement. The probability that the value determined by the method of least squares is the true value is increased if the number of measurements are increased.

Transducer Non-Linearity

The non-linearity of the displacement transducer output at each increment of input displacement is the difference between the measured value of gain and the average gain expressed as a percentage.

Since gain is a linear function of voltage ratios, the non-linearity in voltage ratio is equal to the non-linearity in gain. Therefore, non-linearity is determined as follows:

$$\frac{y - yc}{y_{\max} = y_{\min}} \times 100 = \% \text{ deviation from the most probable true value; non-linearity.}$$

where,

- y = Measured voltage ratio at the displacement x under consideration.
- yc = Voltage ratio at the displacement x under consideration, determined by the method of least squares.
- y_{\max} = Maximum voltage ratio measured at maximum positive displacement.
- y_{\min} = Minimum voltage ratio measured at maximum negative displacement.

Transducer non-linearity is often expressed as the *Average Absolute Deviation*. It is defined as the minimum value of the arithmetic average of the deviations between the most probable true values and the measured values, without regard to the algebraic sign of the deviations. If the most favorable straight line is used instead of the most probable straight line to determine deviations of the measured values, then the term *Average Absolute Deviation From The Most Favorable Straight Line* must be used when expressing transducer non-linearity. The average absolute deviation from a straight line, made by the method of least squares, is the most probable true value of the variations of measured data.

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GRAVITATION... FOR THE ELECTRONIC ENGINEER

Satellites and ultra-precise measuring instruments have renewed interest in gravitational experiments—for better understanding... for possible control. Here's how to develop an intuitive picture of what's being done... without having to learn Einstein's General Relativity.

SOME GRAVITATIONAL EXPERIMENTS considered lately are: measuring the energy loss of a gamma ray as it climbs up out of the earth's gravitational field; measuring the propagation velocity of gravitational interactions; generating and detecting gravitational radiation; measuring the interaction between a spinning satellite and the spinning earth; and, observing the radiation damping of rotating masses.

The major difficulty lies in the preliminary investigation of the idea, since Einstein's theory is quite complicated and difficult to apply to a practical situation. However, if we assume a physically realizable experimental situation, then Einstein's theory reduces to a system of equations which differ from the electromagnetic Maxwell equations by only numerical factors and a few signs. Thus, to first order, there is a direct analogy between electromagnetism and gravitation. Mass is analogous to charge; mass flow to current; gravitational field of a mass (except for sign) to the electric field of a charge; and, a new

gravitational field, caused by moving masses called the protational field, to the magnetic field generated by moving charges. These analogies have been carefully calculated from the linearized Einstein field equations and are given in Table 1.

This table is useful in calculating gravitational effects if a similar problem has already been calculated using electromagnetic theory. The equations describing the electromagnetic case can then be converted into gravitational equations by merely making the indicated substitutions.

If the problem must be calculated from scratch, the following outline will help.

Calculating a Problem

1. Decide on the distribution of the mass density $\mu(x',y',z')$ and the velocity at each point inside the body generating the gravitational field.
2. Calculate the gravitational vector potential $K(x,y,z)$ and the gravitational scalar potential $\chi(x,y,z)$ by doing the following integrations:

$$\chi(x, y, z) = -\frac{1}{4\pi\gamma} \int_V \frac{\mu(x', y', z') dx' dy' dz'}{[(x-x')^2 + (y-y')^2 + (z-z')^2]^{1/2}}$$

$$K_x(x, y, z) = -\frac{\eta}{4\pi} \int_V \frac{\mu(x', y', z') v_x(x', y', z') dx' dy' dz'}{[(x-x')^2 + (y-y')^2 + (z-z')^2]^{1/2}}$$

plus similar integrations for K_y and K_z .

$\mu(x', y', z')$ = density of mass at each point.

$v(x', y', z')$ = velocity of generating mass at each point.

(x, y, z) = point where field is being calculated.

(x', y', z') = point inside the body generating fields.

Since the analogy is only approximate, expand the



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GRAVITATION (Concluded)

denominator using the binomial theorem and keep only the first few terms.

3. Calculate the gravitational field \mathbf{G} and the rotational field \mathbf{P} .

$$\mathbf{G} = -\text{grad } \chi - \frac{\partial \mathbf{K}}{\partial t}$$

$$\mathbf{P} = \text{curl } \mathbf{K}$$

4. Decide on the mass, velocity and angular momentum of the test object that is to be affected by the fields.

5. Calculate the forces and torques on the test object that are caused by the fields.

$$\mathbf{F} = m \mathbf{G} + m (\mathbf{v} \times \mathbf{P})$$

$$\mathbf{N} = 1/2 \mathbf{L} \times \mathbf{P}$$

Usually, the sizes of these forces and torques will be so small as to discourage any further effort.* If one wishes to calculate the motion or path of the test object under the influences of the forces, then the following procedures should be followed because the benefits of the non-linear character of the Einstein equations will not be obtained if the usual $\mathbf{F} = m\mathbf{a}$ is used.

6. Calculate the correction factors using the vector potential, the scalar potential and the velocity of the test object.

$$g_{xx} = g_{yy} = g_{zz} = g = 1 - \frac{2\chi}{c^2}$$

$$\frac{1}{\Gamma} = \left(1 - \frac{2\chi}{c^2}\right)^{-2} = \frac{\mathbf{K}_x v_x + \mathbf{K}_y v_y + \mathbf{K}_z v_z}{c^2}$$

* If anyone using this approximate method comes upon a previously uncalculated effect which shows promise of being large enough to be observed, then the author will be glad to repeat the calculations using the proper tensor formulation to ensure that the result was not produced by the approximations involved in simplifying the theory.

7. Substitute the correction factors and the forces into the equation of motion and solve for the position of the test object as a function of time. $\{x(t), y(t), z(t)\}$

$$F_x = m G_x + m \left(\frac{dy}{dt} P_z - \frac{dz}{dt} P_y \right)$$

$$= \frac{1}{\Gamma} \frac{d}{dt} \left(\Gamma g_{xx} \frac{dx}{dt} \right) - \frac{1}{2} \left(\frac{dx}{dt} \right)^2 \frac{dg_{xx}}{dx}$$

plus similar equations for $y(t)$ and $z(t)$.

Since the vector and scalar potential are always small, the equations are best solved using the method of successive approximations.

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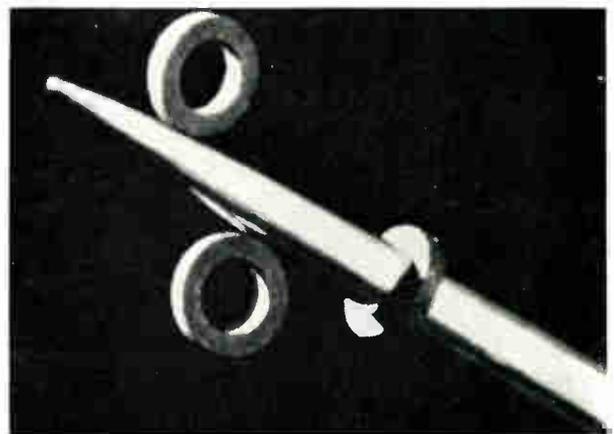
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TABLE I

	EM Symbol	Gravitational Symbol	Value or Definition
Force Vector	$-E \rightarrow$	\mathbf{G}	$= -\nabla\chi - \frac{\partial\mathbf{K}}{\partial t}$
Solenoidal Force Vector	$-B \rightarrow$	\mathbf{P}	$= \nabla \times \mathbf{K}$
Scalar Potential	$-\phi \rightarrow$	χ	$= -\frac{1}{4\pi\gamma} \int \frac{\mu}{r} dV$
Vector Potential	$-A \rightarrow$	\mathbf{K}	$= \frac{\eta}{4\pi} \int \frac{\mu\mathbf{v}}{r} dV$
Source Density	$\rho \rightarrow$	μ	$\frac{dM}{dV}$
Source Quantity	$Q \rightarrow$	M	$= \int \mu dV$
Current Density	$\mathbf{j} \rightarrow$	\mathbf{P}	$= \mu\mathbf{v}$
Current Quantity	$I \rightarrow$	T	$= \frac{dM}{dt} = \int \mathbf{P} \cdot \mathbf{i} dS$
Moment	$\mathbf{M} \rightarrow$	$\frac{1}{2} \mathbf{L}$	$= \frac{1}{2} I\omega$
Capacity of Space	$\epsilon \rightarrow$	γ	$= \frac{1}{4\pi\epsilon^2} = 1.19 \times 10^{10} \frac{\text{kg-sec}^2}{\text{m}^3}$
Permeability of Space	$\mu \rightarrow$	η	$= \frac{16\pi\epsilon^2}{c^2} = 3.73 \times 10^{-26} \frac{\text{m}}{\text{kg}}$

PINPOINT-SIZE MEMORY CORES

Tiny ferrite core, magnified here on a pin point, are used in two advanced computer memories—the first full-scale units to operate in less than a microsecond. The cores have a diameter of only 0.03 in. The computers were developed by the IBM Data Systems Div., Poughkeepsie, N. Y. The firm does not intend to sell either memory in its present form; however, the technology could be applied to tremendously fast computers of the future.



ENGINEER'S NOTEBOOK

#63 ECM NOMOGRAPH

IN THE STUDY OF RFI PROBLEMS, whether they be caused by electronic countermeasures or other sources, it is often necessary to compute received signal strength, signal-to-noise ratios, range ratios, etc. All are related by the general beacon equation.

The beacon equation is not simple, and much time can be spent in rearranging terms and computing.

Also, if a number of variables are varied to obtain a particular plot, the computational task can be very time consuming. Therefore, the beacon equation can be put to better use if an alignment chart or nomograph is used for the solution of problems.

The basic beacon equation is:

$$R_i = \frac{\lambda}{4\pi} \sqrt{\frac{P_i G_i G_T}{S}} \quad (1)$$

where: R_i = the range from the desired signal transmitter to the receiver.

P_i = the desired signal transmitted power.

G_i = the desired signal transmitter antenna gain.

G_T = the receiver antenna gain.

S = the level of the desired signal at the receiver.

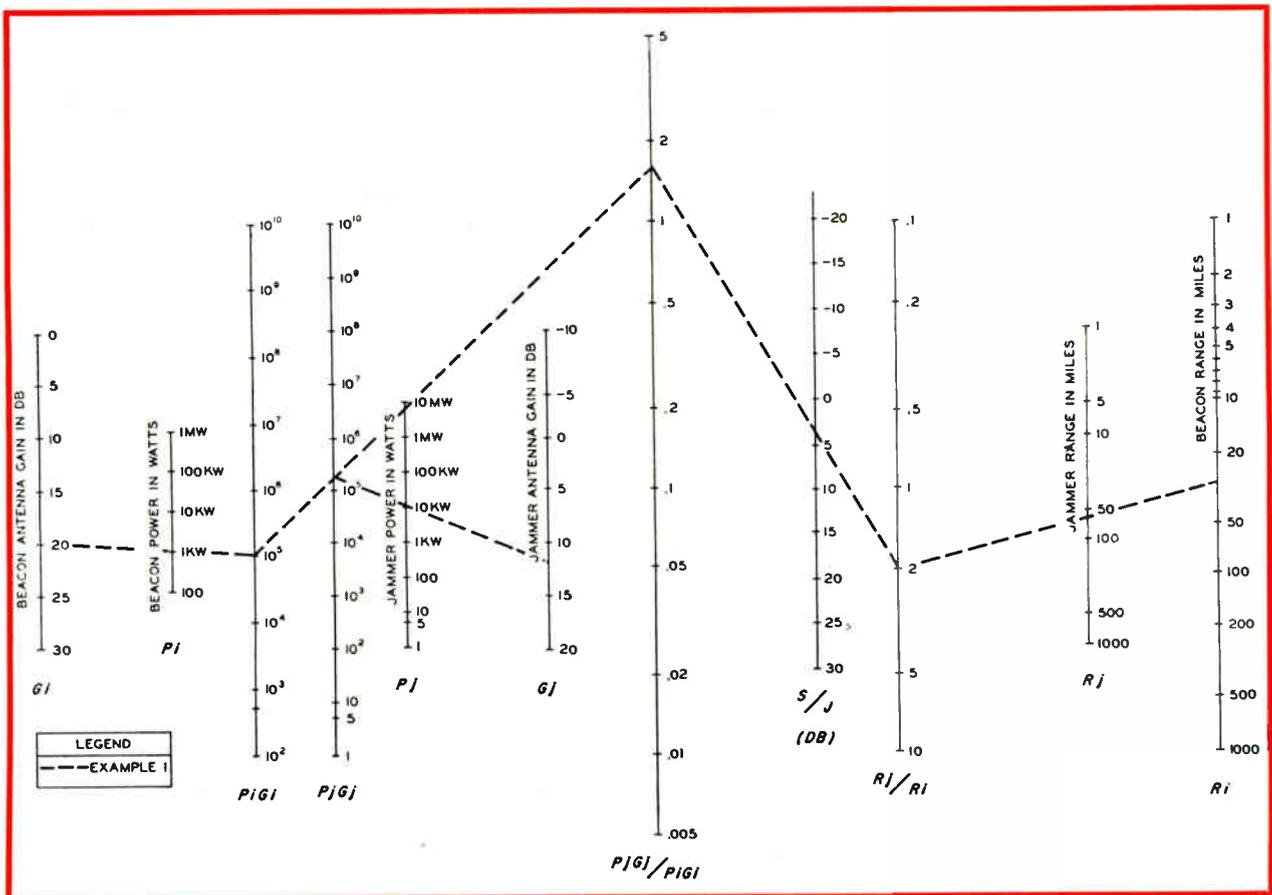
λ = the transmitted signal wavelength.

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Fig. 1: The prime objective in using the nomograph is to make use of the 3 basic scales as given in Eq. 3. They are range ratio, power ratio, and signal-to-noise/jamming ratio.

(Continued on following page)



ECM NOMOGRAPH (Concluded)

A similar expression can be written for the range from an undesired signal transmitter (or jammer) to a target.

$$R_J = \frac{\lambda}{4\pi} \sqrt{\frac{P_i G_i G_T}{J}} \quad (2)$$

where the symbol definitions follow from above.

Dividing Eq. 2 by 1

$$\left(\frac{R_J}{R_i}\right)^2 = \frac{P_J G_J}{P_i G_i} S/J \quad (3)$$

Eq. 3 is the basic equation for which the nomograph is constructed. It is made up of 3 basic parts: the range ratio, the power ratio and the signal-to-noise/jamming ratio. The S/J ratio is found from equipment susceptibility measurements, and represents the value of received signal strengths required to produce a particular effect at the receiver. The S/J ratio is usually stated in terms of decibels, with a negative value indicating that the undesired or jamming signal is stronger than the desired signal at the receiver input.

The nomograph is shown in Fig. 1. It was constructed by first altering the form of Eq. 3 and then applying standard techniques as given in References

2 and 3. The prime objective in using the nomograph is to make use of the 3 basic scales as given by Eq. 3. The remaining scales represent an auxiliary means for computing and locating desired points on the 3 basic scales. The scales can be used in any order depending upon the problem to be solved.

Example

1. Given a receiver 30 miles from a beacon transmitter and 60 miles from a jamming transmitter, a beacon power of 1 kw with a 20 db antenna gain, and a jammer power of 10 kw with a 12 db antenna gain, find the resultant signal to jamming ratio at the receiver.

Solution

(See Fig. 1.) Draw a line from the G_j scale to the P_j scale, through to the intersection on the $P_i G_i$ scale. Perform a similar operation with P_i and G_i to get $P_i G_i$. From the intersections on the $P_j G_j$ and $P_i G_i$ scales, draw a line through to the power ratio scale. This locates the point on the $P_j G_j/P_i G_i$ scale at about 1.7. Next find the range ratio by drawing a line from 30 on the R_i scale through 60 on the R_j scale to the intersection on the R_j/R_i scale. This intersection is at $R_j/R_i = 2$. A line drawn from the power ratio scale to the range ratio scale produces the S/J ratio of 3 db.

Air Leaks Detected By Ultrasonics



A NEW INSTRUMENT, which can detect and locate air or gas leaks as minute as 0.006 inch in diameter at a distance of 50 ft., has been introduced.

Called the Delcon Ultrasonic Translator, the portable leak and friction detector picks up high frequency sound energy from escaping air or gas molecules and translates it into audible, recognizable sounds.

As a friction analyzer, it can catch manufacturing irregularities in such assemblies as permanently sealed bearings by detecting inaudible squeaks amid abrasive sounds that precede heat and audible sound.

The eight-pound, mercury-cell powered unit responds to inaudible signals from 35,000 to 45,000 cps while eliminating all other sounds at any volume to permit leak detection and other analyses during actual factory conditions.

It is in this high frequency range that common phenomena, long considered silent, actually generate separate, tiny sounds that are as readily distinguishable as their audible counterparts.

Gases under only 5 psi escaping from a hole less than 0.010 inch in diameter, sound on the Ultrasonic Translator, exactly like the familiar hissing of

(Continued on page 141)

Two-sided printed circuits need reliable cross-overs. Electroplating provides this reliability, if the hole sides are first rendered conductive. Here's a way to make them conductive—and test results to prove its good.

ELECTROLESS COPPER DEPOSITION

PRINTED WIRING has largely replaced point-to-point wiring. Besides lowering labor costs, space and weight reductions are achieved.

Single sided circuits are preferred for maximum reliability and minimum manufacturing costs. Often, however, space and circuitry dictate wiring on both sides, with numerous cross-over connections. These cross-overs can be reliably made by electro-plating holes drilled between the two conductive circuits. The hole sides must, of course, be made conductive before electroplating. The electroless copper process is usually preferred over electroless nickeling, silvering, or graphitizing for forming the initial conductive film.

Fehling's solution can be used for copper deposition upon certain catalytic surfaces by adding formaldehyde as the reducing agent. Besides the electroless copper deposit on these surfaces, there is a tendency for copper particles to be formed throughout the solution. Since copper metal catalyzes the reduction process, the particles rapidly decompose the bath and mar the deposit.

Attempts to stabilize the Fehling-formaldehyde electroless copper solutions have been reported^{1, 2}; but, tests have shown that their useful life is only a few hours after make-up before they decompose.

A number of additives including thiourea, n. butylamine, gelatin, 2-mercaptobenzothiazole and certain surfactants were tested for their ability to suppress decomposition of electroless copper solutions.

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Based on these preliminary test results, we decided to investigate more fully the use of 2-mercaptobenzothiazole (MBT). Here are the results of deposition and stability tests using MBT stabilized Fehling-formaldehyde solution and several proprietary electroless copper solutions.

Procedure

Non-metallic surfaces can be rendered active for electroless copper deposition by use of a thin catalytic metal film, e.g., platinum, palladium, and gold. Immersions in stannous chloride and palladium chloride solutions are suitable for activating non-metallic surfaces for electroless nickel³ or electroless copper deposition. However, this leaves much to be desired when used for through-hole plating. An immersion deposit of the noble metal adversely affects the adhesion of electroless copper deposit, and subsequent electrodeposits, to the copper cladding on the board surface. Proprietary sensitizers are available which, in a single immersion step, sensitize plastics for electroless copper deposition without greatly reducing the adhesion of electroless copper to the copper cladding. One of these was selected, viz., Number 6F Catalyst.* This was used for all samples prior to electroless copper deposition tests.

Fehling's solution for preparing electroless copper solutions consisted of:

Copper Sulfate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)	34.6 g/l
Rochelle Salts ($\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$)	173 g/l
Sodium Hydroxide (NaOH)	50 g/l

Copper sulfate solution is added to a solution of the other constituents. This will be referred to as the 100% solution.

This Fehling's solution was diluted with water to form 50 and 25% solutions. The desired concentration of MBT stabilizer for each Fehling's solution

* Shipley Co., Inc., Newton, Mass.

DEPOSITION (Continued)

was conveniently attained by adding an appropriate quantity of stock solution consisting of 10 g/l MBT in 0.2N NaOH. The MBT addition to Fehling's solution was based on the volume of 100% Fehling's solution present rather than the total volume of the solution. Formaldehyde solution** additions to Fehling's solution were in the ratio of 1:10 by volume based on the actual volume of 100% Fehling's solution present.

Deposition tests were conducted upon 2 in. x 2 in. Mylar sheet, 0.003 in. thick. The plastic was cleaned and slightly abraded by brushing with a foaming cleanser; then, sensitized. After electroless copper deposition, the sample was weighed on an analytical balance. Next, the copper deposit was stripped by

** Assay 36.0% formaldehyde with 12 1/2% methanol present as preservative.

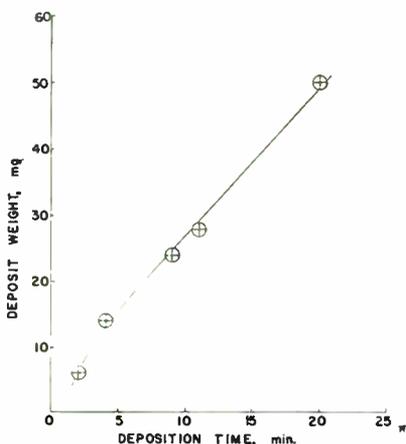
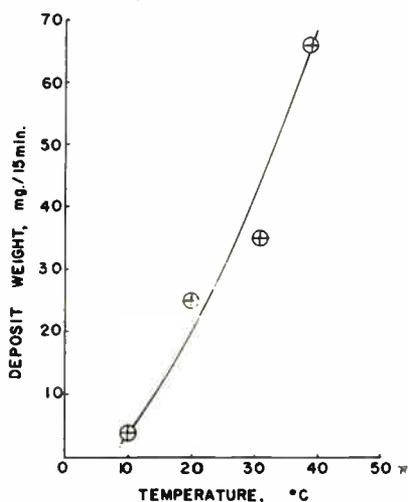


Fig. 1: The effect of immersion time on weight of deposition for FM 40-30.

Fig. 2: The effect of various temperature on deposition rate for FM 40-30.



immersion in 35% nitric acid. The copper deposit weight was obtained by weight difference.

The effect of MBT concentration in the various Fehling-formaldehyde solutions on deposition rate and solution stability was determined.

An MBT stabilized electroless copper solution was tested for the effect of time and temperature on deposition rate. An MBT stabilized electroless copper solution was compared with several proprietary formulations for deposition rate and stability

Experimental Results

The Fehling-formaldehyde electroless copper solutions, with varying quantities of MBT, stood at least one hour after make-up before deposition tests. Mylar samples were sensitized by immersion for 3 min. in proprietary sensitizer and rinsed before electroless copper deposition.

The weight of copper deposited after 15 minutes

Table 1
Electroless Copper Deposition on Sensitized Mylar (2 in. x 2 in.)
15 Minute Immersion at 25° C

Observation	Fehling's Solution* Concentration	PERCENT MBT**			
		0	0.0005	0.002	0.008
Deposit Weight, mg	100%	47	51	35	39
Deposit Appearance		Poor	Poor	Fair	Good
Solution Stability, hours		<3	<3	3 to 24	3 to 24
Deposit Weight, mg	50%	36	37	31	31
Deposit Appearance		Poor	Fair	Good	Good
Solution Stability, hours		<3	<3	3 to 24	>24
Deposit Weight, mg	25%	23	21	18	5
Deposit Appearance		Good	Good	Good	Poor
Solution Stability, hours		3 to 24	>24	>24	>24

* 100 ml formaldehyde added for each liter of 100% Fehling's solution present.

** Based on weight of MBT in volume of 100% Fehling's solution.

Table 2

Comparison of MBT Stabilized Electroless Copper Solution with Proprietary Solutions

Time After Solution Make-up for Deposition Test	Deposit Weight (mg) after 15 minute immersion in Electroless Copper Solutions			
	FM 40 32	Proprietary A	Proprietary B	Proprietary C
1 hr 27.5° C	39	12	30	31
23 hrs 28° C	31	12	26	—
47 hrs 28° C	22	7*	2*	—
71 hrs 27° C	19	4*	—	—
193 hrs 27° C	14	—	—	—
266 hrs 25° C	4*	—	—	—

* Poor appearing, non-continuous deposits.
— No deposit.

in the electroless copper solutions was determined. The appearance of the deposits and solution stability were noted, Table 1. Unstable solutions produce poor appearing deposits; because, copper particles formed in the solution tend to adhere to the electroless copper plate resulting in a dark powdery coating.

In general, dilution improved the stability of the Fehling-formaldehyde solution with and without MBT. Increasing the MBT concentration increased stability; lower MBT concentrations stabilized the more dilute solutions. Decreasing the Fehling's solution concentration, or increasing the MBT concentration, generally results in decreased deposition rate. With the 25% Fehling's solution and 0.008% MBT, the deposition rate was low and discolored deposits were obtained.

Compromise

A good compromise between solution stability and high deposition rate is 40% Fehling's solution with 0.003% MBT. This solution was tested and found to be quite stable at 25°C and yet was capable of satisfactory deposition rate. This solution is FM 40-30. The first group is the % Fehling's solution; the last, the ten thousandths of a % of MBT present.

FM 40-30 was tested for effect of immersion time on weight of copper deposited on sensitized 2" x 2" Mylar samples. The tests were run at ambient temperature, 27° to 28°C. The results are shown graphically in Fig. 1. A 10 mg deposit weight, equivalent to about a 0.009 mil thick deposit, is sufficiently conductive to readily enable further coating buildup by electrodeposition. It is considered the minimum acceptable deposit.

Deposition tests were conducted using FM 40-30 at various temperatures ranging from 10° to 39°C. Fig. 2. At 10°C, deposition was very slow; a usa-

ble deposit was not produced within 15 minutes. At 20° and 31°C, good deposits were obtained. Stability was adversely affected by increased temperature. At 39°C, deposits were very rough due to rapid general decomposition of the bath. Even at 31°C, slow decomposition of the bath was noted. A study of the best MBT concentrations at various temperatures is planned.

Since FM 40-30 was seen to be somewhat unstable at 31°C, a small additional quantity of MBT was added to increase solution stability. About 0.0002% additional MBT was added, bringing the total concentration to 0.0032%. This solution was then compared with several proprietary solutions for deposition rate and bath stability. The same proprietary sensitizer was used to treat the Mylar before electroless deposition. Table II shows the results of these tests.

The MBT stabilized solution deposited at a more rapid rate than the proprietary solutions tested. Commercial bath C, was completely decomposed within 24 hrs., while baths A and B were still capable of deposition. After 47 hrs. standing, and also after eight days, only the MBT stabilized solution was capable of producing usable deposits after 15 minutes immersion.

Conclusions

Electroless copper solutions composed of Fehling's solution and formaldehyde can be stabilized against decomposition by addition of small quantities of 2-mercaptobenzothiazole.

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MULTI-LAYER PRINTED CIRCUITS

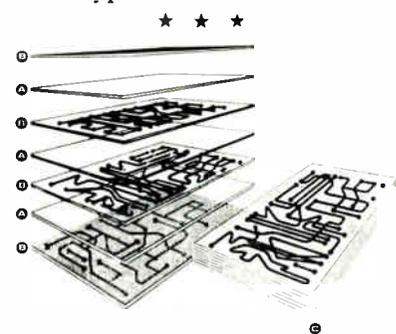
AVAILABILITY of a high reliability dry layup system for production of multi-layer high density printed circuits was announced by New England Laminates Co., Inc., recently. The system permits the dry mounting of discrete etched circuits into a compact, lightweight package suitable for military and other sophisticated electronic equipments.

An ultra-thin copper-clad epoxy glass laminate may be etched to provide any printed cir-

cuit configuration desired. From 3 to 24 of these individual printed circuits may be stacked between layers of woven glass cloth impregnated with an epoxy resin. Application of temperature and pressure (approx. 600 psi @ 340°F for 40 mins.) to the sandwich structure results in the completed high density circuit.

The new method is claimed to provide excellent registration, minimum weight, dimensional stability, machinability and high

resistance to electroplating stress. The system may be used for both "plated-through" and "clearance hole" type circuits.



Exploded view shows the NELCO Dri-Pli system: glass cloth (A), laminate (B), and multi-layer sandwich circuit (C).

High power electron tubes are essential for many military applications. Often, output power is limited by grid emission. Ceramic grids offer one method of reducing this detrimental effect.

CERAMIC REDUCES GRID-EMISSION

ONE DIFFICULTY OFTEN ENCOUNTERED in operating high vacuum electron tubes is the thermal emission of primary electrons from the grids. This undesirable effect can be the limiting factor in satisfactory operation at high power.

This article demonstrates the feasibility of using a ceramic body, titanium dioxide (TiO_2), as a grid material to suppress grid emission in tubes operating at grid temperatures of 800° to 1000°C .

In the past, studies of many materials indicated only partial success in overcoming this problem. Titanium (Ti), the most successful of these materials, is limited to operation below 900°C . This is due to its cathode poisoning effect above this temperature. TiO_2 shows no such effect at 1200°C !

Causes of Grid Emission

Grid emission stems from two main causes:

(1) Deposit of active evaporated products from the cathode on the grid. The low work function material activates the grid which emits when subjected to sufficient heat radiation.

(2) Electron bombardment heating of a clean grid affecting the temperature to the degree that it becomes a good thermal emitter.

The latter is more difficult to overcome. It is also the more serious of the two conditions; because, it can have a cumulative, and completely destructive, effect on a tube. Suppression of the second type is our main objective. Other possible, but lesser, sources are secondary emission and photo emission effects.

Undesirable Effects

Grid emission produces three undesirable effects:

- (1) It reduces grid bias.
- (2) It increases grid driving power.
- (3) It reduces plate current; hence, useful power output.

Reduction of the bias may reach the point at which the grid can be driven positive, drawing increasingly higher current with an avalanching effect in a short time.

Grid emission, if not destructive, depreciates tube capabilities, particularly in high power triodes. Thus, under any condition, it can

be considered only a detrimental factor in operational performance.

Method of Approach

Grid emission, a high temperature problem, can be minimized

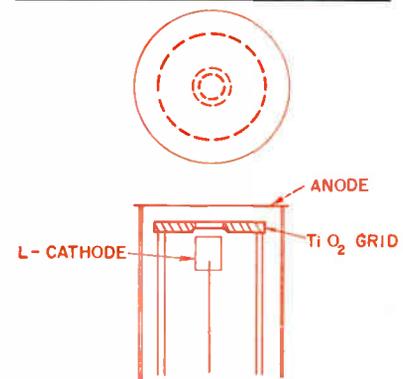


Fig. 1: With a 3% impurity, a commercially available ceramic can easily be adapted for simple planar triode use.

by reducing the grid temperature (water or conduction cooling) and by surface treating the grid material. However, TiO_2 is not dependent on either method.



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Many materials such as titanium, rhodium, platinum, carbon, palladium, gold, and combinations produce wide variations of effectiveness. Gold-plated grids widely used on tubes with closely spaced elements, operating at low temperatures, are the most efficient. This type shows an 85% decrease in grid emission; graphite-coated tungsten, a 40% decrease.

The ineffectiveness of metallic grids at high temperatures lead to ceramic grids. Previous studies on TiO_2 indicate its high temperatures suitability. A complete insulator, TiO_2 is readily transformed into an electrical conductor by reducing the oxide within the material by hydrogen

triode operation with the grid cool. Fig. 4 presents remote control cutoff characteristics for the plate current; Fig. 5, grid current *versus* grid voltage characteristics. No grid emission is evolved under these operating conditions.

Fig. 6 shows operating characteristics with the grid directly heated to 810° and $860^\circ C$ brightness, a condition intended to simulate grid heating by electron bombardment and thermal radiation from the cathode. These circumstances are favorable for grid emission, particularly with conventional grid materials.

Lower Curves 1 and 2 in Fig. 6 do show some grid current flowing with negative grid operation.

of grid emission to the other becomes apparent. At these temperatures, cathode deposits on the grid are evaporated, minimizing grid emission from this source. Thermal emission then becomes a primary source of difficulty. Data from the triode structure, Fig. 1, yield results indicative of some cathode deposits on the grid responsible for the emission.

To separate bombardment heating effects from cathode deposit effects, a second tube was made, omitting the regular cathode. This tube with a clean TiO_2 rod as the cathode of a cylindrical diode was evaluated as a source of primary electrons. Table 2 gives typical emission readings.

Aside from extraneous current

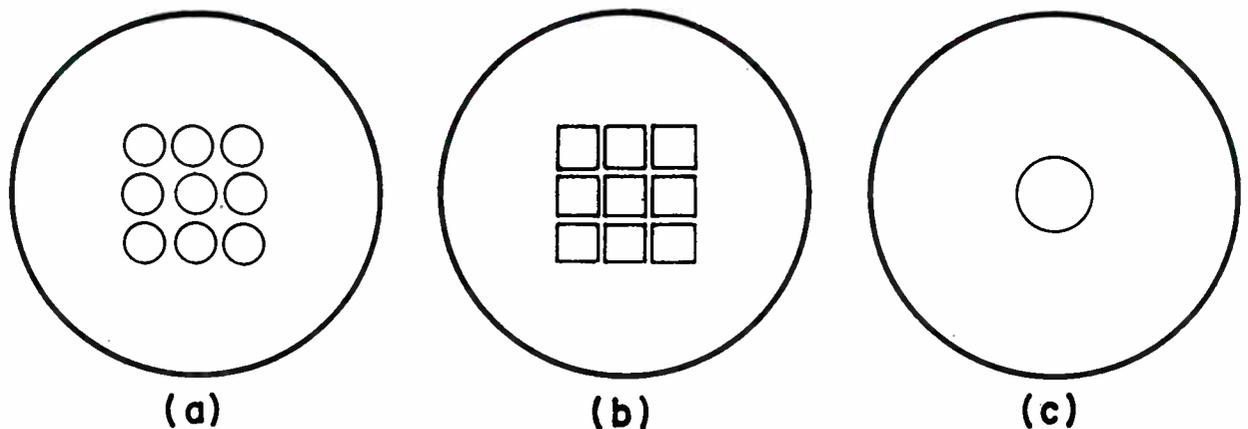


Fig. 2: Various grid configurations tried in the planar triode; plate current characteristics were sharp for (a) and (b), remote for (c).

or vacuum firing. Conductivity is controllable over a wide range of values. In Fig. 1, commercial TiO_2 with a 3% impurity content is adapted to a simple planar triode structure.

Different grid shapes produced the following results: Figs. 2(a) and 2(b) gave sharp plate current cutoff characteristics; Fig. 2(c), remote plate current cutoff characteristics. No effort has been made to design a tube for a given set of parameters.

Figs. 3 to 5 show static characteristics curves under normal

However, Curve 1 shows that less grid current flows with the grid operating at the higher temperature of $860^\circ C$. This seems to indicate the possible re-evaporation from the grid of products deposited on it as evolved from the cathode. At extended temperatures above $860^\circ C$, the decrease in grid current should be more pronounced. Table 1 gives a ratio of maximum grid emission to plate current for several temperatures.

Between 850° to $900^\circ C$ and higher, transition from one type

errors, that the emission current constitutes a significantly low order of magnitude and shows that TiO_2 is a poor primary electron emitter. As such, it contributes little to the grid emission source when heated by electron bombardment, or by radiation from the cathode. The secondary emission from this material, also measured as a function of primary electron bombardment (determined in a prior experiment), shows a small ratio of secondary to primary emission. Table 3 gives (*Continued on following page*)

CERAMIC GRIDS (Continued)

a tabulation of this ratio for various anode voltages.

Conclusions

TiO₂ can be successfully used as a grid material for high power electron tubes. There is more effectiveness at temperatures above 850°C where cathode deposits become a diminishing factor. A cylindrical grid geometry of TiO₂ rods is recommended because of thermal expansion characteristics. Like all ceramic material, TiO₂ is sensitive to thermal shocks and, as such, should not be subject to localized heating. Another disadvantage is the difficulty in fabricating and brazing. The characteristics for suppression of grid emission are excellent. A poor thermal emitter, TiO₂ yields low secondary electrons when bombarded with primary electrons, particularly at

high voltages. It is, however, subject to the same disadvantages of ordinary grids when exposed to barium evaporation from the cathode. Although use of coatings to TiO₂ grids have never been tried, a graphite spray coating could serve as an effective inhibitor of grid emission at temperatures below 850°C.

When operated at the higher temperatures, 850° to 1000°C, encountered in high power tube operation, grid emission is progressively reduced. Although operation at temperatures from 1200° to 1250°C is permissible, the electrical characteristics of this material are subject to gradual change, owing to a further reduction of the oxide. TiO₂ has a distinct advantage over titanium metal—it operates at much higher temperatures without fear of evaporation, even at 1200°C. Titanium, on the other hand, is restricted to temperatures below 900°C because of evaporation and

subsequent cathode poisoning effects. This is also the limiting factor in the use of gold.

TiO₂ as a grid is an effective means of minimizing grid emission in electron tubes at temperatures limiting the use of other materials.

The author desires to acknowledge the work of Mr. Peter Tandy, who carried out a major part of this program.

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Table 1

Maximum Grid Emission to Plate Current

Grid Temp °C	I_{gmax}/I_p
20	0/8 = 0
810	0.5/6 = 0.083
860	0.3/12 = 0.025

Table 2

Grid Emission from TiO₂ Rod

Temperature °C	Anode Potential Volts/cm	Emission Current Amps/cm ²
20	1130	0.15 x 10 ⁻⁹
700	1130	1.36 x 10 ⁻⁹
800	1130	1.37 x 10 ⁻⁹
900	1130	1.31 x 10 ⁻⁹
1000	1130	1.44 x 10 ⁻⁹
1100	1130	4.7 x 10 ⁻⁹
1200	1130	60.2 x 10 ⁻⁹

Table 3

Secondary to Primary Emission Ratio at Various Anode Voltages

E _A	I_{sec}/I_{prim}
200	0.024
400	0.011
600	0.009
800	0.009
1000	0.009
1200	0.066

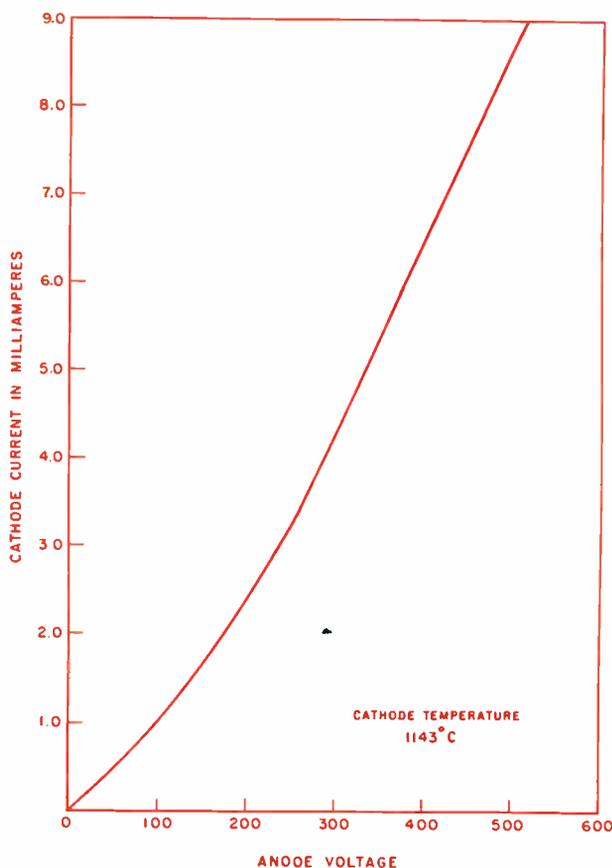


Fig. 3: This characteristic curve of the anode-grid current vs anode voltage is with the grid cool, under normal triode operation.

Tape Recording CC TV

A CLOSED CIRCUIT TELEVISION tape recorder, the MVR-10, has been developed by Mach-Tronics, Inc., 185 Evelyn Ave., Mountain View, Calif. At a recent technical presentation, actual recordings and play backs of tapes showed the fine quality of both the audio and video signals.

The recorder measures 24 in. x 11 in. x 15 in., weighs 90 pounds, and sells for \$10,300. F. O. B. Mountain View, Calif., with the integral 8 in. television monitor; without the monitor, \$9,800. This price is significantly lower than that of other closed circuit television recorders.

Additionally, the ability to store 96 minutes of information on a tape will be a very significant advantage in many applications of the recorder.

All tapes recorded on the MVR-10 are interchangeable with respect to their ability to be played back on any other MVR-10. This feature is extremely important in those cases where there is a very definite need to exchange instructional or training tapes prepared by educational institutions or various groups within the military.

The recorder uses the helical scanning principle with two video recording heads which are placed 180° apart. Each head records one field of television information so that a complete rotation of the scanning assembly makes one complete frame. Video frequency response is ± 3 db, from 30 cps to 3 mc with reference to 100 kc and down no more than 6 db at 3.5 mc. This frequency response plus a signal to noise ratio of 40 db or better RMS noise to peak to peak video results in picture quality equal or better to that seen on most home television sets.

★ ★ ★

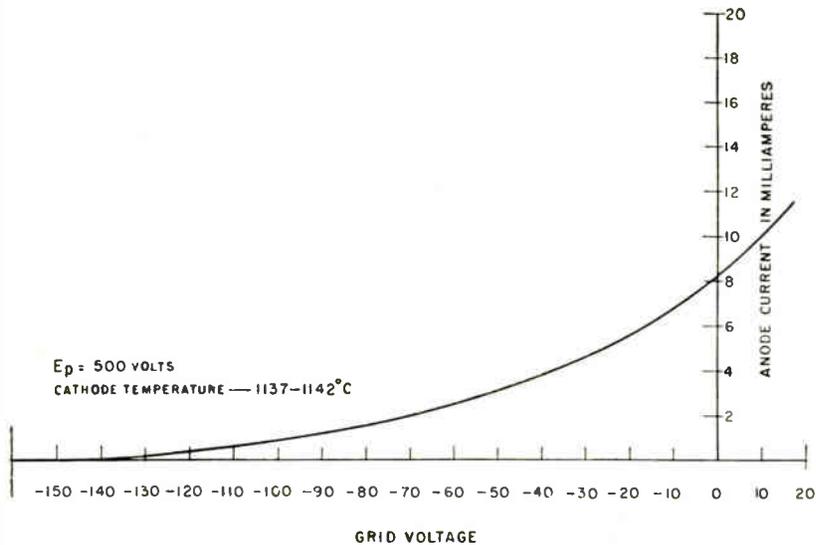


Fig. 4: This represents the remote control cutoff characteristics for the plate current with a titanium dioxide grid; grid is cool and no emission is involved.

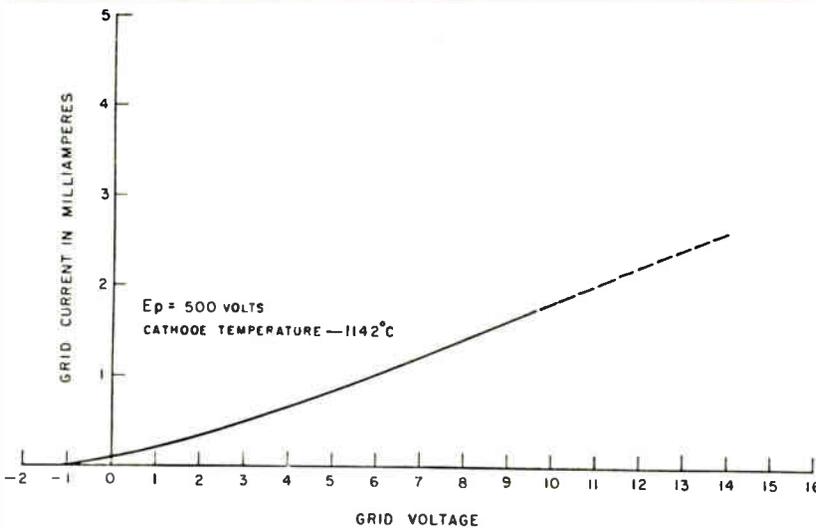
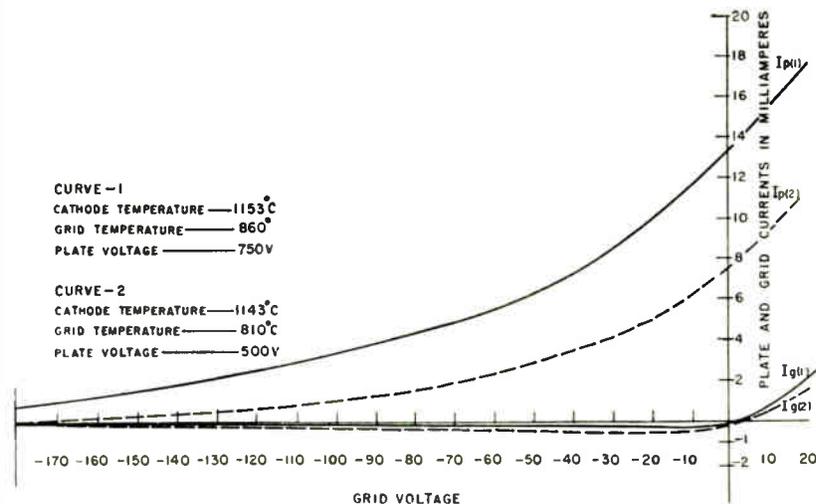


Fig. 5: The operating conditions for this static characteristic curve were the same as those for Figs. 3 and 4; this is the grid current vs grid voltage curve.

Fig. 6: The plate-grid current characteristics at different grid temperatures to simulate grid heating by electron bombardment and thermal radiation from the cathode. With conventional grid materials, such are favorable for grid emission.



NETWORK CURRENT NOMOGRAPH

A simple method for finding the division of current within a network.

THIS GRAPH PROVIDES AN EASY METHOD of finding the division of current within a network. With knowledge of the total current and the resistance value of each section, the value of the current in each section can be estimated within design tolerances using this nomograph.

Example

As illustrated in Fig. 1, a circuit with I_t equal to 40, R_1 equal to 2, R_2 equal to 3, when entered into the nomograph as follows:

- R_1 is entered on the right line,
- R_2 is entered on the next line.

These values are connected to intersect index "A". This value is transferred to index "B" via the guide lines.

Using this point and the value of I_t entered on the left line, the I_2 value is intersected at 1.6. Because the I_t value of 4 represents 40, this is read as 16. The value of I_t therefore is $I_t - I_2 = 24$. In this manner, current can be divided between branches.

Fig. 2 illustrates a network which reduces to the two branches illustrated in Fig. 1. The current in this network can be divided in turn by the nomograph in correct distribution as shown.

To find current distribution in a complex network, the network may be reduced in steps, a reduction per branch complex, until the network is presented as a simple circuit. Then the current is established in each branch of the simple circuit. It is then divided in the next more complex network. After this, the next. This is continued until the full network is identified current-wise.

This graph provides a simplified method of treating current in bridgeless networks. The calculations are reduced to a few manipulations of a ruler on a chart.

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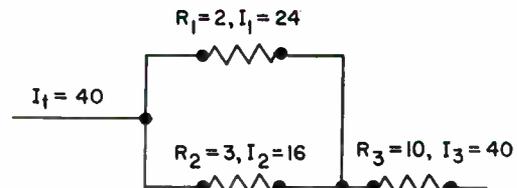


Fig. 1: Simple parallel circuit for trying nomograph.

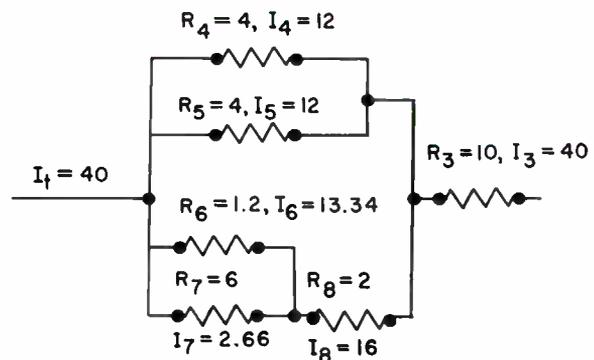


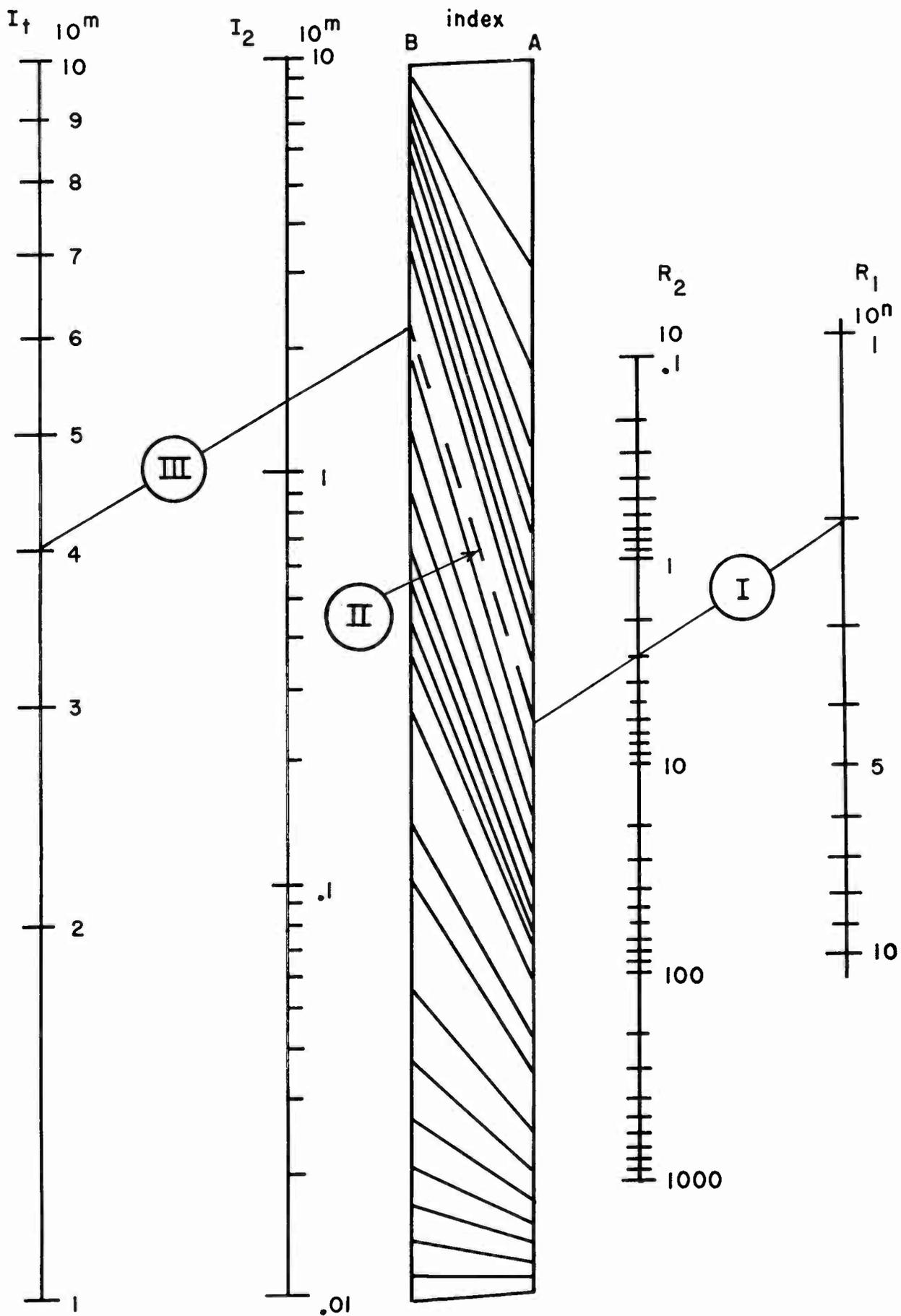
Fig. 2: This network can be reduced to circuit in Fig. 1.

Fig. 3 (right): Nomograph can be used to find the current within a network such as that shown in Figure 2.

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MEASURING COEFFICIENT OF FRICTION

A dynamometer for continuously measuring the coefficient of friction between a test sample and a rotating drum is described. Also described are the principles of the instrument along with design information for related equipment.

AN INSTRUMENT HAS BEEN DEVELOPED which continuously measures the coefficient of friction between a test sample and a rotating drum. The coefficient of friction to be measured was proportional to the tangential force on the sample and the drum. This, in turn, was proportional to the torque of the drive shaft. This torque was sensed by two transducers some distance apart on the shaft. Signals from these could be compared to show the twist in the shaft. With no load on the dynamometer, the transducers were placed so that their outputs were in phase. Any load which caused twist in the shaft altered the phase relationship between them. This relationship was detected electronically.

Equipment Used

Equipment used was: (1) the drive motor, drive shaft, and drum; (2) the transducers used to sense the torque in the drive shaft; (3) the instrumentation for measuring the phase relationship between the signals from the transducers; and (4) the holder for the test sample.

A 3/4-hp electric motor was used for motive power. It was connected to a specially designed drive shaft which supported the drum.

Measurements

Drum temperature was measured by a thermocouple. The thermocouple was mounted inside a well in the rim, with a liquid silicone to provide good thermal contact between it and the drum. This allowed constant measurement of average drum temperature while a frictional test was being carried out.

The drive shaft was designed as follows:

$$d = \left(\frac{16 T}{\pi S_s} \right)^{1/3}$$

where,

d = shaft diameter, in.

T = torque, in.-lbs.

S_s = allowable torsional shear stress = 8,000 psi (for steel).

T was found from an assumed test-sample pressure of 70 psi on a sample with an area of 1/2 sq. in., an assumed maximum coefficient of friction of 0.45, and a drum diameter of 3 1/2 in. Under these conditions, T would be 27.3 in. lbs. Then,

$$d = \left(\frac{16 \times 27.3}{\pi \times 8 \times 10^3} \right)^{1/3}$$

$$d = 0.259 \text{ in.}$$

Twist of the shaft was found from:

$$T = \frac{E_s \theta J}{L}$$

where,

T = torque, in.-lbs. = 27.3 in.-lbs.

J = polar moment of inertia of shaft, in.⁴ = 7.07×10^{-4} in.⁴.

E_s = modulus of rigidity, psi = 12×10^6 psi (for steel).

L = shaft length, in. = 1 in.

θ = twist of shaft, radians.

Under these conditions,

$$\theta = \frac{27.3 \times 1}{7.07 \times 10^{-4} \times 12 \times 10^6}$$

$$\theta = 0.32 \times 10^{-2} \text{ radian}$$

Thus, the twist was 0.32×10^{-2} radian or 0.18° /in. of shaft length. For a shaft 10 in. long the maximum twist was 1.8° . This occurred when the coefficient of friction was 0.45 between sample and drum. A



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coefficient of friction of, say, 0.10 twisted the shaft 0.40° . A phase shift of 0.40° at a speed of 1725 rpm equals a time delay (t) of:

$$t = \frac{0.40 \times 60}{360 \times 1725} = 38.6 \times 10^{-6} \text{ sec.}$$

A phase shift corresponding to this delay was not hard to measure, as shown by the experimental results. Measurements were made of coefficient of friction to values less than 0.10.

The shaft was $\frac{3}{4}$ in. in diameter and 22 in. in length, with a 10-in. portion reduced to the calculated diameter of 0.259 in. Twist was measured over the 10-in. necked-down portion of the shaft. The remainder of the shaft length was used to mount the drum, support bearings, and motor coupling.

A $3\frac{1}{2}$ in. dia. was chosen for the drum, with the width $\frac{3}{4}$ in. to accommodate the $\frac{1}{2}$ -in.-wide sample. The drum was mounted on a block of transite to thermally insulate it from the shaft. The block was the same diameter as the drum. It had a strip of abrasive paper cemented to it so that the samples could be ground to conform to the curvature of the drum before testing.

Twist Sensing

Twist of the shaft was sensed by the two transducers. These were made of 10,000 turns of No. 40 copper wire wound on a 2-in. length of $\frac{1}{2}$ -in.-dia. steel rod, tapered at one end. One transducer was mounted near each end of the necked-down portion of the drive shaft. A steel spur gear with 26 teeth was mounted on the shaft at each end of the necked-

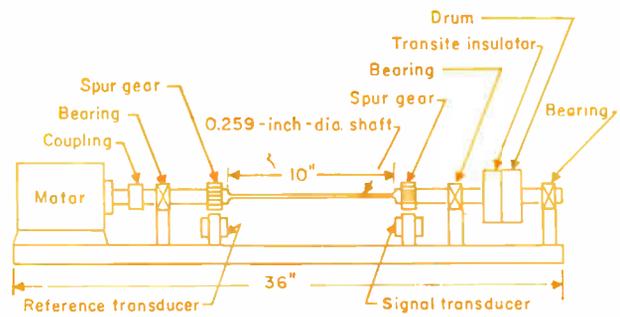


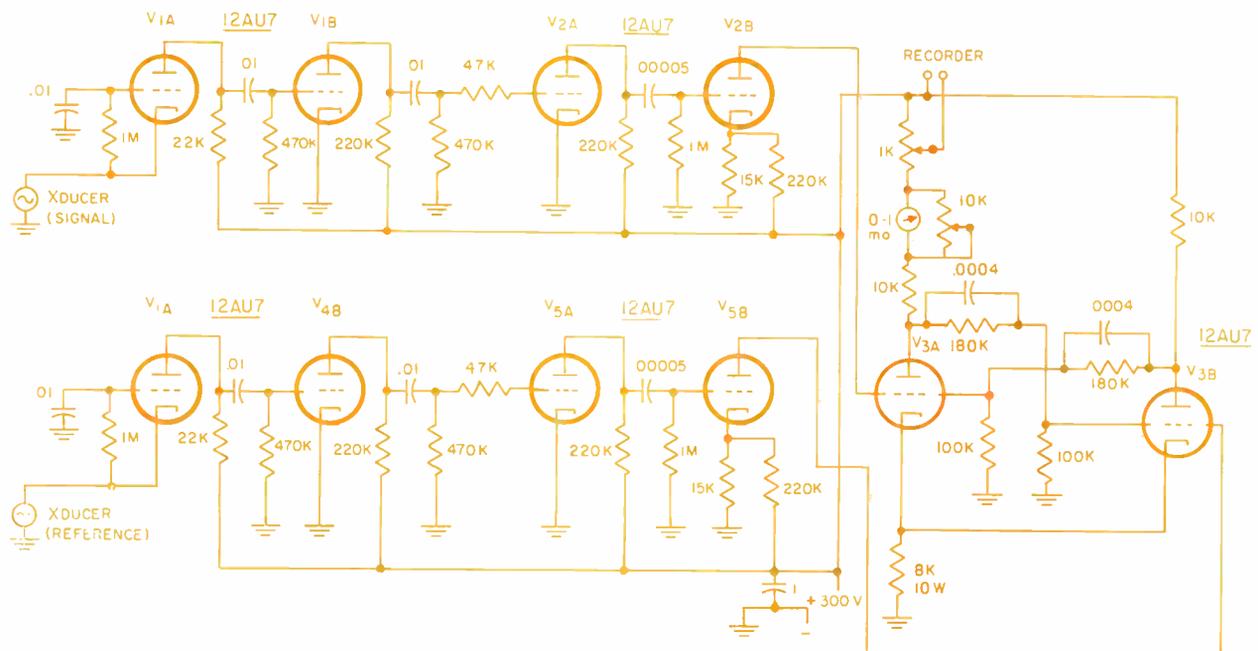
Fig. 1: Mechanical portions of the instrument, including the drive meter, drive shaft, and drum assembly are shown. The entire device was mounted on a heavy steel base 36 in. long to provide a rigid mounting. The transducers are also shown.

down portion. The transducers were mounted below the gears so that their tapered ends were near and parallel to the gear teeth. DC through the coils provided a magnetizing force. The gear altered the magnetic field each time a tooth passed the steel rod, causing a signal to be produced in the coil.

The signal was fed to an electronic unit. Here, it was amplified, limited to produce rectangular waves, and differentiated to produce a series of pulses. Pulses from the reference transducer (the one nearer the drive motor) then were used to turn a gate "on". Pulses from the signal transducer were used to turn the gate "off". Thus, current through the gate was directly proportional to the amount of phase shift in the signals from the transducers, and hence to the twist of the drive shaft. Current through this gate was connected to a meter and also to a strip-chart recorder

(Continued on following page)

Fig. 2: Circuit diagram of the electronic unit.



COEFFICIENT of FRICTION (Continued)

Electronic Unit

Power for the electronic unit came from a laboratory power supply.

This instrument was calibrated in terms of coefficient of friction.

$$\mu = \frac{\text{Friction force}}{\text{Applied force}}$$

where,

μ = coefficient of friction between sample and drum.

Applied force = radial force between sample and drum, lbs.

Friction force = tangential force between sample and drum, lbs.

The friction force may be found from,

$$F = M \times k$$

where,

F = friction force, lbs.

M meter reading of electronic unit.

k = a constant.

The constant, k , was found by applying a known friction force, with a prony brake, and observing the meter reading. A series of tests with a range of friction forces showed that k was constant over the range of interest. The coefficient of friction then was

found directly from,

$$\mu = \frac{\text{Meter reading} \times \text{constant}}{\text{Applied force}}$$

Or, the potentiometer in parallel with the meter could be adjusted so that, with the proper scale on the meter face, the coefficient of friction could be read directly from the meter.

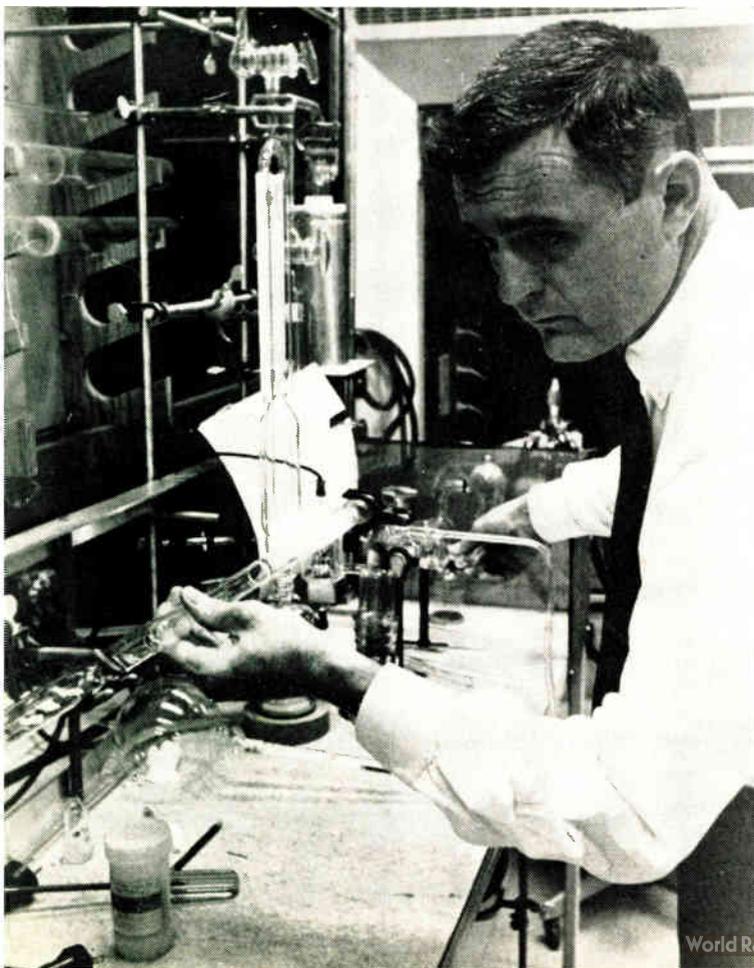
Operation

In operation, a test sample was mounted in the holder. It was then pressed against the abrasive material cemented to the thermal insulator next to the drum. This formed the sample to the approximate contour of the drum. It was then placed in contact with the drum. The sample was seated to the drum by drawing 400-grit abrasive paper between it and the drum, with the abrasive in contact with the sample. Finally, the drum was cleaned with abrasive to give a clean surface, and the test was run. Data were recorded on a strip-chart recorder.

Acknowledgements

The research project on which this instrument was developed was sponsored by the Grizzly Mfg. Div. of Maremont Corp. The author wishes to thank Maremont Corp. for permitting this paper to be published.

Purifying Gallium Arsenide for Tunnel Diodes



TWO NEW PREPARATION METHODS permit a significant increase in the purity of gallium arsenide. They were developed at International Business Machines Corp.'s Thomas J. Watson Research Center, Yorktown, N. Y.

In one method, commercial high-purity gallium and arsenic are melted together in a special aluminum nitride crucible, and a crystal is pulled from the melt. The key to the purity obtained with this method is the crucible material, which was developed at the Aluminum Company of America's Alcoa Research Laboratories. With the quartz crucibles ordinarily used, a considerable amount of silicon is liberated and incorporated in the gallium arsenide melt. This silicon is believed to be the chief electrically active impurity in most gallium arsenide. The source of silicon contamination is eliminated by using aluminum nitride crucibles.

The other process involves the addition of oxygen at carefully controlled pressures to the silica reaction tube in which gallium arsenide is made by zone melting. The oxygen suppresses the dissociation of SiO_2 in the reaction tube, thus reducing the amounts of electrically active silicon taken up by the gallium arsenide melt. *(Continued on page 213)*



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The teamwork of Education and Industry which creates electronic progress will be highlighted at the conference to be held Oct. 8-10 at Chicago's McCormick Place. Over 18,000 engineers and scientists and 500 exhibitors are expected to attend, making this the biggest NEC ever.

NATIONAL ELECTRONICS CONFERENCE HIGHLIGHTS EDUCATION-INDUSTRY TEAMWORK

THE THEME "EDUCATION AND INDUSTRY . . . Partners in Electronics Progress" keynotes the 18th Annual National Electronics Conference, which will be held Oct. 8-10 in Chicago's McCormick Place. Over 18,000 engineers, scientists and educators are expected to attend.

Thirty-nine technical sessions and 125 technical papers will be presented. Leading university and industry scientists will cover a broad range of key topics.

In keeping with the theme, student participation at this year's NEC will be greatly enlarged. Many technical sessions, demonstrations and workshops will be student-oriented.

Larger Attendance

An anticipated 20% increase in attendance will be paralleled by a 20% increase in exhibits. Over 500 electronic firms will be exhibitors.

Sponsors of the NEC are again the IRE, AIEE, Illinois Institute of Technology, Northwestern University and the University of Illinois. Ten participating sponsors include the ERA, SMPTE and eight other colleges and universities.

The 39 technical sessions, 12 more than last year, include five panel discussions.

Adding emphasis to the theme, ten colleges and uni-

versities will participate in a university program. They will make presentations pointing out university-industry cooperation, hold in-depth discussions of scholastic research programs, and stage exhibits to include publications and equipment.

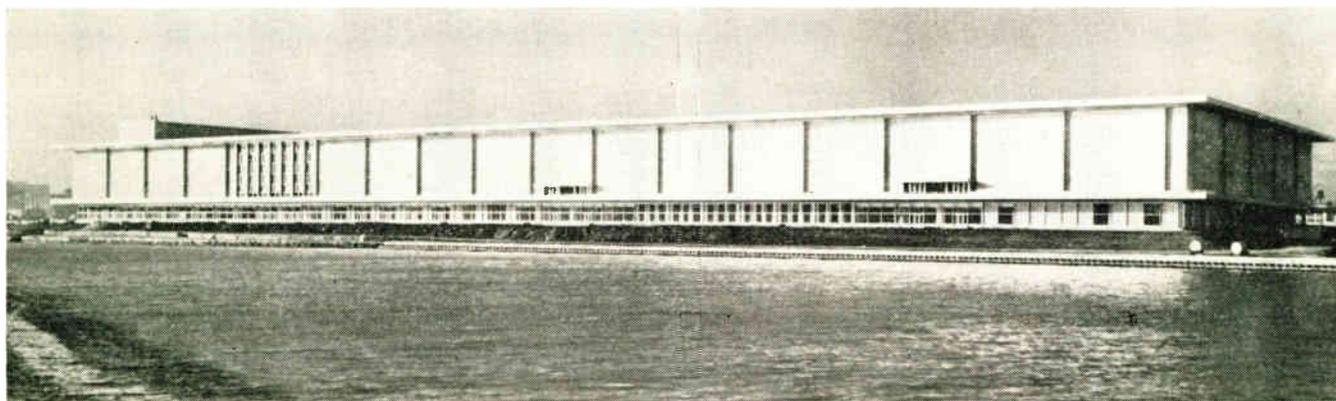
Other events of the three-day show include the NEC Industry Cocktail Party, Oct. 8; the Ladies Program; special breakfasts, luncheons and dinners for participating groups and organizations; awards programs; workshops, meetings and field trips.

Speakers at the Conference will include: Governor Otto Kerner, of Illinois; Henry T. Heald, Ford Foundation President; Patrick E. Haggerty, IRE President; W. R. Hewlett, Executive Vice President, Hewlett-Packard Co.; John Haanstra, President, General Products Div., IBM Corp.; James H. Allen, Reliability Manager, ADVENT Program, Aerospace Corp.; V. L. Grose, Reliability Director, Litton Systems, Inc.; Dean F. Babcock, Stanford Research Inst.; Neal Blake, FAA; Harold Johnson, Directorate of Telecommunications, USAF; and (tentative) Col. John A. Powers, NASA.

Technical Sessions

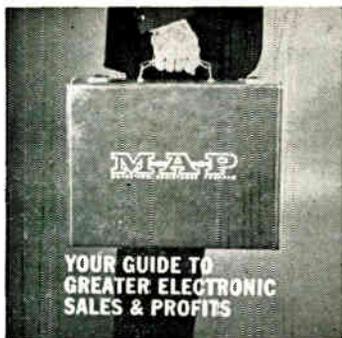
The technical sessions will each be presided over by
(Continued on page 132)

McCormick Place, Chicago's new \$35 million lakeside exposition center, scene of the 18th National Electronics Conference, Oct. 8-10.

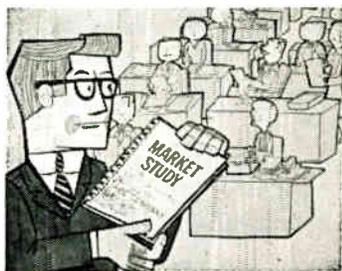


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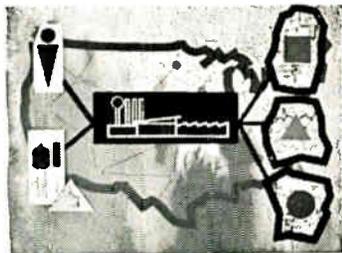


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What are the Characteristics of Today's Electronic Engineer?

- What is his average age? • His average income? • His net worth? • How many children does he have? • What is his education? • What are his ambitions? • What would prompt him to change jobs?

These and many other important questions about the personal and job characteristics of the electronic engineer are answered in **ELECTRONIC INDUSTRIES' Profile of the Electronic Engineer**—available as a handy deck of 2,000 punched IBM cards, or (in summary form) in a printed report.

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NATIONAL ELECTRONICS CONFERENCE (Cont.)

a chairman. Several papers will be presented at each, except for the panel discussions. These will consist of short addresses by the panelists, followed by question and answer periods.

Some of the topical highlights of the technical sessions are: "Energy Beams as Working Tools," "Timely Aspects of Space Science," "Medical Electronics," "Infrared Applications," "Electronics in Hydrospace," and "Trends in Aerospace Ground Equipment."

Scientific panels will discuss: "The Consultant's Role in Research and Development," "The Role of R & D in Future Profits," "Aerospace Control Systems," "The Role of Universities in Industrial Assistance," "Euromart," and "Reliability—Are We Spending Our Money Wisely?"

A special "Electronic Preview" session has been arranged. It consists of 10-minute presentations of the latest electronic developments. Topics of discussion are so new they could not be included in the regular program.

"Exhibitors New Product and Development Seminars"—a first with NEC—will be held concurrently with the technical sessions. These will be in a meeting room located in the exhibit hall. There will be no charge to NEC visitors.

Guided tours will be made to the Dresden Power Plant and the U. S. Steel installations near Chicago.

"NEC Proceedings"

Most of the technical papers presented will be included in the "NEC Proceedings." This hard-bound volume will be available at a modest price. Engineers can thus follow lectures from the text or have copies of those they cannot attend.

Another feature of the NEC is its awards programs. Authors of particularly outstanding papers in previous years may receive either the NEC Annual Award or the Award of Merit. Checks accompany these awards. An award is also presented for a paper on recent developments "selected from those of a synoptic or tutorial nature."

The Fellowship Award, valued at \$3,000, will be presented to enable an exceptional graduate to further his educational training.

Exhibitors who have displayed their products at NEC for 15 years will receive plaques at the Exhibitors Meeting.

The ERA and Electronic Sales Managers Association will sponsor a manufacturer-representative workshop on Oct. 9 from 8:30 a.m. to Noon at McCormick Place. Its subject will be "Forecasting Sales—Setting Quotas." Richard Lopata, well-known marketing con-

sultant, will be moderator and introduce the subject with a 30-minute presentation. Then each of four panelists will give a practical case study. This will be followed by discussions by workshop participants at individual tables.

NEC Mission

Rudolph Napolitan, Conference General Manager, said one of the missions of this year's Conference is to develop a greater industry awareness of services offered by universities and government agencies. He said the main role of the Conference, in line with its theme, will be to outline the role of technical universities in the expansion of electronics.

The site of this year's Conference, Chicago's new McCormick Place, is conveniently located a short distance from the Loop. The spectacular \$35 million structure offers the latest in exhibit facilities.

The Sherman Hotel once again is the official 1962 Conference hotel. Over 1,100 rooms have been reserved for NEC visitors. NEC has arranged for free shuttle bus service between the Loop area and McCormick Place.

Over 2,000 registrants will be attending the Fall General Meeting of the AIEE at a nearby hotel during the Conference. By coordination between the NEC and AIEE, joint registration procedures have been arranged.

The exhibit hall at McCormick Place will be open from 10 a.m. to 6 p.m. Monday and Wednesday and 10 a.m. to 7 p.m. on Tuesday. Times of the other events will be furnished at registration.

Conference Officers

Executive officers of this year's National Electronics Conference include: Virgil H. Disney, Chairman, Board of Directors; James H. Kogen, President; John S. Powers, Vice President; Dr. Edward W. Ernst, Secretary; Dr. James S. Aagaard, Treasurer, and Napolitan, General Manager.

Committee chairmen are: Dr. T. W. Butler, Jr., Program; R. R. Foley, Arrangements; Prof. R. J. Parent, Awards; Dr. E. Mast, Fellowship Award; J. J. Enenbach and R. W. Galvin, Industrial Advisory; W. C. Kotteman, International Activities; E. P. Kelly, Housing; W. C. Weber, Jr., Party; Dr. L. W. Von Tersch, Planning; Prof. M. G. Keeney, Procedures; Dr. A. C. Moeller, Proceedings; M. J. Eltgroth, Registration; Dr. A. C. Todd, Student Activities; and Dr. E. H. Schulz, Trust Advisory.

Participating sponsors besides those already named are: Iowa State University, Marquette University, Michigan State University, Purdue University, University of Michigan, University of Notre Dame, University of Wisconsin and Wayne State University.

★ ★ ★

NEW TECH DATA

for Engineers.

Logic Modules

This 64-page catalog entitled "Digital Logic" includes explanations of number systems, binary logic, and basic logic operations fundamental to an understanding of Boolean Algebra. Products groups described are the Harman-Kardon encapsulated Digital Logic Modules; Flexi-Cards, a series of standardized circuit cards, designed to accept an assortment of module types; and Facilogic Modules which form the basis for H-K's facilogic concept of systems interwiring for bread-boarding, construction of specialized test equipment and training of personnel. Included are outline drawings, comprehensive specs., photographs, and typical applications. Write under company letterhead to Data Systems Div., Harman-Kardon, Inc., Plainview, L.I., N.Y.

Circle 161 on Inquiry Card

Ultrasonic Cleaning

Kemiko Mfg. Co., 171 Burd St., Nyack, N. Y., is offering a bulletin giving detailed data on procedures and cleaning compounds for use in ultrasonic machines. Included is a listing of acid, alkaline and solvent cleaners for use on metals, glass, ceramic and plastic materials.

Circle 162 on Inquiry Card

Ionization Detectors

The operating characteristics (in tabular form) of ionization detectors, electronics and injection systems available for interchangeable use in the Jarrell-Ash Model 700 Universal Gas Chromatographs are included in a catalog available from Jarrell-Ash Co., 26 Farwell St., Newtonville 60, Mass.

Circle 163 on Inquiry Card

Microwave Components

NEICO Microwave Co., 19 Jones Rd., Waltham 54, Mass., is offering an 8-page brochure on their microwave capabilities. Information is included on their design/engineering, test and inspection, assembly, machine shop, and other departments involved in the production of microwave devices.

Circle 164 on Inquiry Card

Ranging System

AERIS (Airborne Electronic Ranging Instrumentation System) is a system for geodetic surveying and photogrammetry through rapid and continuous coordinate position determination and trilateration from lightweight, portable, automatic ground and airborne stations. This 24-page booklet covers specs., applications and also gives data on AERIS's capabilities. Cubic Corp., 5575 Kearny Villa Rd., San Diego 11, Calif.

Circle 165 on Inquiry Card

Communications Systems

This illustrated 36-page booklet covers communications systems and equipment available from Friden, Inc., 97 Humboldt St., Rochester 2, N. Y. In addition to an introductory discussion of wire and tape-to-tape transmission, accuracy checking systems, and wire leasing costs, the booklet describes communications machines such as the Flexowriter, Computer, Add-Punch, Teledata, Dual Teledata, and Teledata Switching Control.

Circle 166 on Inquiry Card

Semiconductor Catalog

This 15-page catalog includes basic specs. on a line of universal communications transistors manufactured by the PADT (Post Alloy Diffusion) process. Information is also included on a comprehensive line of germanium PNP and NPN audio (small and large signal), computer, switching (high and low speed) and vhf transistors for converter, mixer and oscillator uses. Catalog may be obtained by writing under Company letterhead to Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.

Circle 167 on Inquiry Card

Core Solder

Information, along with a sample, is available on "Cen-tri-core® Energized Rosin-Filled Solder." Information covered includes construction (center solder wire, rosin coated prior to extrusion of an outer solder sleeve); and the various core sizes available. Bulletin No. 456 is available from Alpha Metals, Inc., 56 Water St., Jersey City 4, N.J.

Circle 168 on Inquiry Card

Rotating Components

This 20-page condensed catalog covers a complete line of size 5 motors, motor tachometers, synchros; a size 8 line of motors, tachometers, synchros and resolvers; a size 11 line including motors, synchros, and resolvers; and size 15 and 18 lines of motors and motor generators. Included are servo motor and generator winding schematics, color code, standard output shafts, direction of rotation and generator output voltage. Daystrom, Inc., Transicoil Div., Worcester, Pa.

Circle 169 on Inquiry Card

Miniature Oscillator

Tech. data is available on the Miniature GMO Series Sinusoidal High-Stability Oscillator, which gives better than 1% freq. stability at 400cps over a temp. range of from -55° to +95°C. Wave form distortion is less than 5%; weight less than 1 oz. and volume less than 1 cu. in. General Magnetics Inc., 135 Bloomfield Ave., Bloomfield, N. J.

Circle 170 on Inquiry Card

Wire Forming Machines

The V-80 Verti-Slide wire and strip forming machine is described in a 6-page technical bulletin available from The Torrington Mfg. Co., Torrington, Conn. Bulletin No. 113 contains comprehensive information on the V-80 vertical 4-slide which is designed for high-speed production with minimal set-up time. Photographs and specifications are included.

Circle 171 on Inquiry Card

Solid State Inverters

Bulletin #37-562-3, 6 pages, describes ERA's line of Static DC-AC Inverters. Information covers non-regulated, semi-regulated, and sinusoidal output regulated types with power ratings to 500va. Design data, performance, characteristics and circuit descriptions are included. Electronic Research Associates, Inc., 67 Factory Place, Cedar Grove, N. J.

Circle 172 on Inquiry Card

Compression Connectors

This 4-page brochure describes Color-Keyed compression connectors. The brochure catalogs the different sizes of connectors in 5 basic categories: 1-hole and 2-hole lugs, splices, compression taps, and pigtailed. Color-Keyed installing tools for use with the connectors listed are also described. The Thomas & Betts Co., Inc., Elizabeth 1, N. J.

Circle 173 on Inquiry Card

DC Amplifier

Applications, circuit description and specs. for the Model 121A/A wideband, solid-state dc amplifier are included in a 4-page data sheet, 2-127 available from Cohu Electronics, Inc., Kin Tel Div., Box 623, San Diego 12, Calif.

Circle 174 on Inquiry Card

Instrument Motors

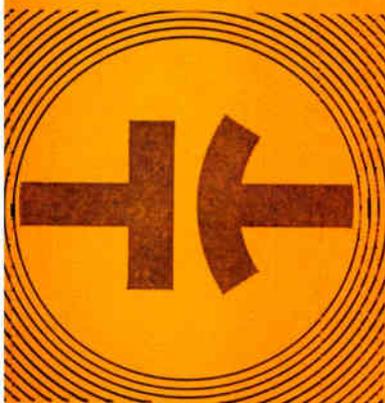
Bulletin No. 7-101, 8 pages, describes the selection and application of instrument motors. Information included covers application data forms, speed-torque curves for various motor types and tabulated data on performance factors. Holtzer-Cabot Corp., 125 Amory St., Boston 19, Mass.

Circle 175 on Inquiry Card

Digital Logic

This 12-page booklet describes and illustrates a line of digital logic modules. Available in 2 series—Series 200 for operation up to 200kc and Series 1000 for operation up to 1mc. Schematics and specs. are included. Bulletin C-12 available from Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.

Circle 176 on Inquiry Card



GOOD-ALL INTRODUCES MICROLAR

WORLD'S SMALLEST FOIL-WOUND CAPACITOR!

The design engineer is no longer limited by capacitor size in designing microminiature circuitry! A major capacitor breakthrough by Good-All Electric Mfg. Co. has resulted in the MICROLAR 608. Ideally suited for missile, space, communications and other high density circuitry, the MICROLAR 608 is 75% smaller throughout its full range than other miniature units meeting MIL-C-25C. It is even smaller than the popular "A"-size tantalum units in values up to .0033 microfarads.

The MICROLAR 608 features extended foil construction and utilizes .00025 Mylar® dielectric.* The tubular Mylar case with epoxy end fills provides electrical characteristics far exceeding most larger units. Special manufacturing techniques give the MICROLAR 608 mechanical ruggedness much greater than previously available in miniature units. These new capacitors easily withstand 4 lbs. axial lead pull.

Solve your space-limited design problems today with the new MICROLAR 608; they are immediately available through leading electronic distributors coast-to-coast.

MICROLAR 608 available in tolerances to 1%

*Not metallized ®Du Pont's trademark for polyester film

CASE SIZE COMPARISONS Capacitance in MFDS.	100 VOLTS		663UW		CP08	
	D	L	D	L	D	L
.001	.081 x 3/8		.156 x 1/2		.175 x 3/4	
.0015	.088 x 3/8		.156 x 1/2		.175 x 3/4	
.0022	.095 x 3/8		.156 x 1/2		.175 x 3/4	
.0033	.102 x 3/8		.156 x 1/2		.175 x 3/4	
.0047	.109 x 3/8		.156 x 1/2		.175 x 3/4	
.0068	.121 x 3/8		.156 x 1/2		.195 x 3/4	
.0082	.128 x 3/8		.156 x 1/2		.235 x 3/4	
.01	.135 x 3/8		.156 x 1/2		.235 x 3/4	
.015	.155 x 3/8		.187 x 1/2		.235 x 3/4	
.022	.176 x 3/8		.203 x 3/8		.312 x 7/8	
.033	.215 x 3/8		.218 x 3/8		.312 x 7/8	
.047	.252 x 3/8		.234 x 3/4		.312 x 7/8	

TANTALUM "A" Case Size = .125 x 1/4

SELECT FROM GOOD-ALL'S BROAD LINE OF FILM CAPACITORS

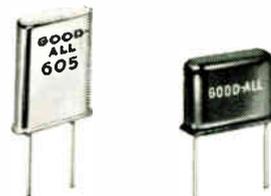
Years of experience in the film-capacitor field has given Good-All the capability to produce high-performance Mylar units in virtually any package configuration and with electrical characteristics meeting the most exacting requirements.

These devices show Good-All's broad capability in film capacitors. Call your TRW Electronics/Good-All representative today. He has the exact Good-All Mylar capacitor to solve your most stringent design problem.



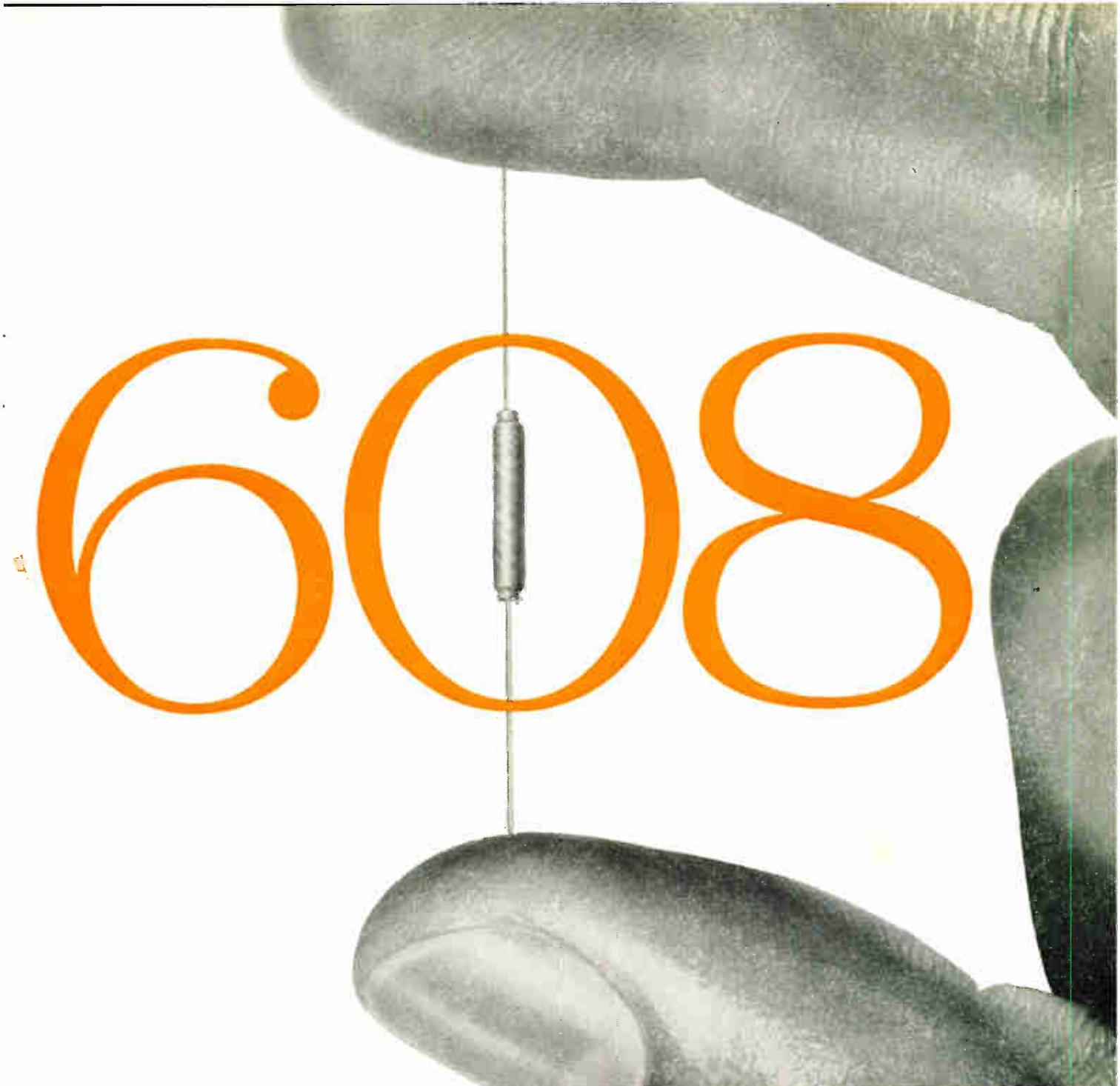
GOOD-ALL TYPE 663

- Instrument quality Mylar tubulars or flats
- Plastic-film, moisture-resisting case with epoxy end fills
- Capable of being produced to MIL-C-14157 and MIL-C-26244
- Highly stable capacitance and dissipation characteristics
- Extended-foil construction
- Metallized Mylar types available for even greater space saving



GOOD-ALL TYPE 605

- Metal enclosed, hermetically sealed Mylar—optimum enclosure
- Flat case allows better use of waste space above board for maximum space saving
- Ideal for Navy and marine applications to safeguard against extreme moisture conditions
- Meets all Military moisture resistance and immersion specifications
- Epoxy-dipped versions (Type 601) are still smaller in size!



608



GOOD-ALL TYPES 682-685

- Metal enclosed, hermetically sealed tubular Mylar—*optimum enclosure*
- Long life, high stability in miniature size
- Excellent capacitance stability at full load
- Exceeds all Military environmental specifications
- Available in all MIL-C-25C tubular case variations and a variety of lead arrangements
- Tolerances available to $\pm 1\%$



TRW Electronics



Good-All Electric Mfg. Co.

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OGALLALA, NEBRASKA • LAWNSDALE, CALIFORNIA

Circle 77 on Inquiry Card

World Radio History

ONE FOR EVERY JOB

meters to measure dc voltage
ac voltage
dc current
resistance

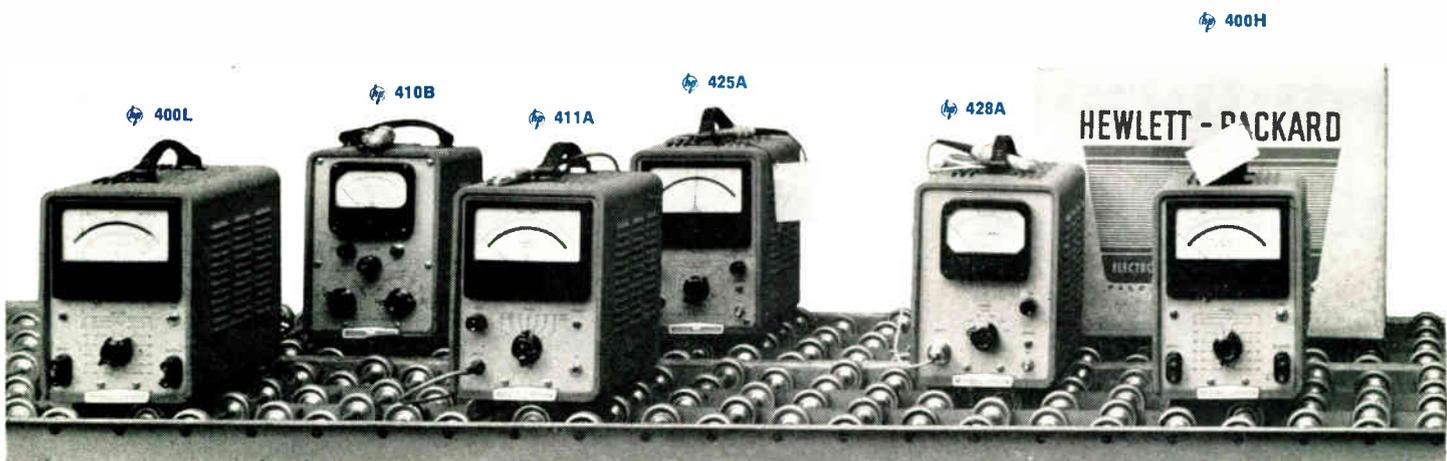
One of these Hewlett-Packard meters is designed for your measurement job. Each offers performance according to specs, long life, simple operation, conservatively designed circuitry, easy routine maintenance and, above all, value. Each proves that your best instrument buy is Hewlett-Packard. Ask your  representative to demonstrate them on your bench.

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

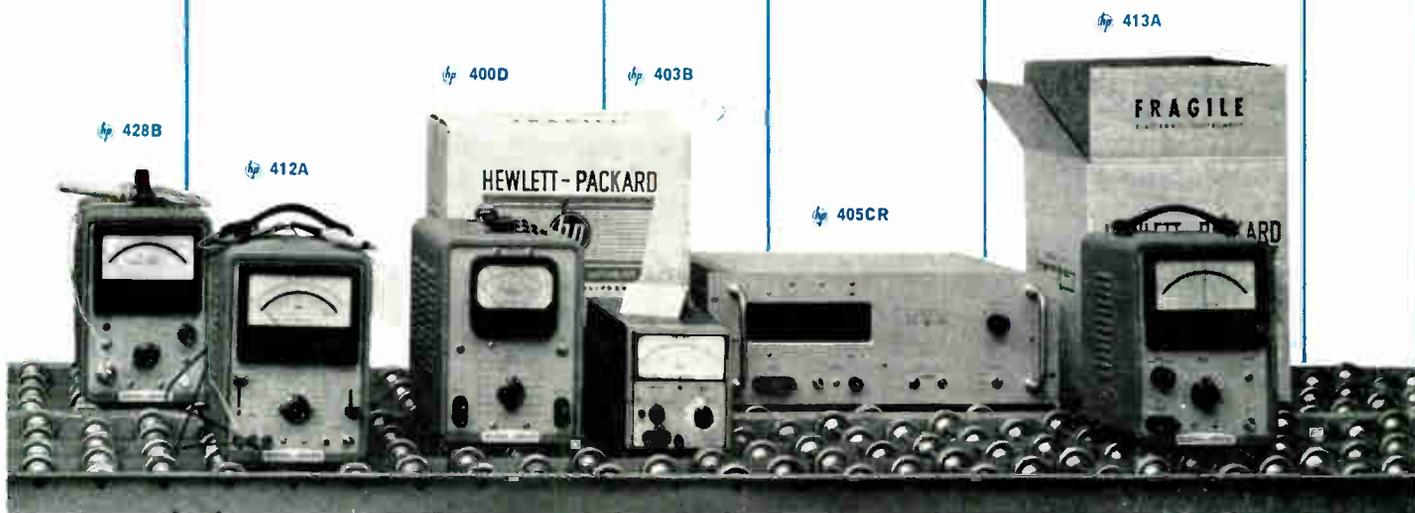
Today's highest accuracy in commercial meters is assured on many of the  volt-meters, with individual calibration of their meter scales. Each scale is photographically created to match its individual meter movement. No preprinted or approximate scales are used. This accuracy is yours, at no increase in cost, on the  400H, 412A, 413A and 425A.

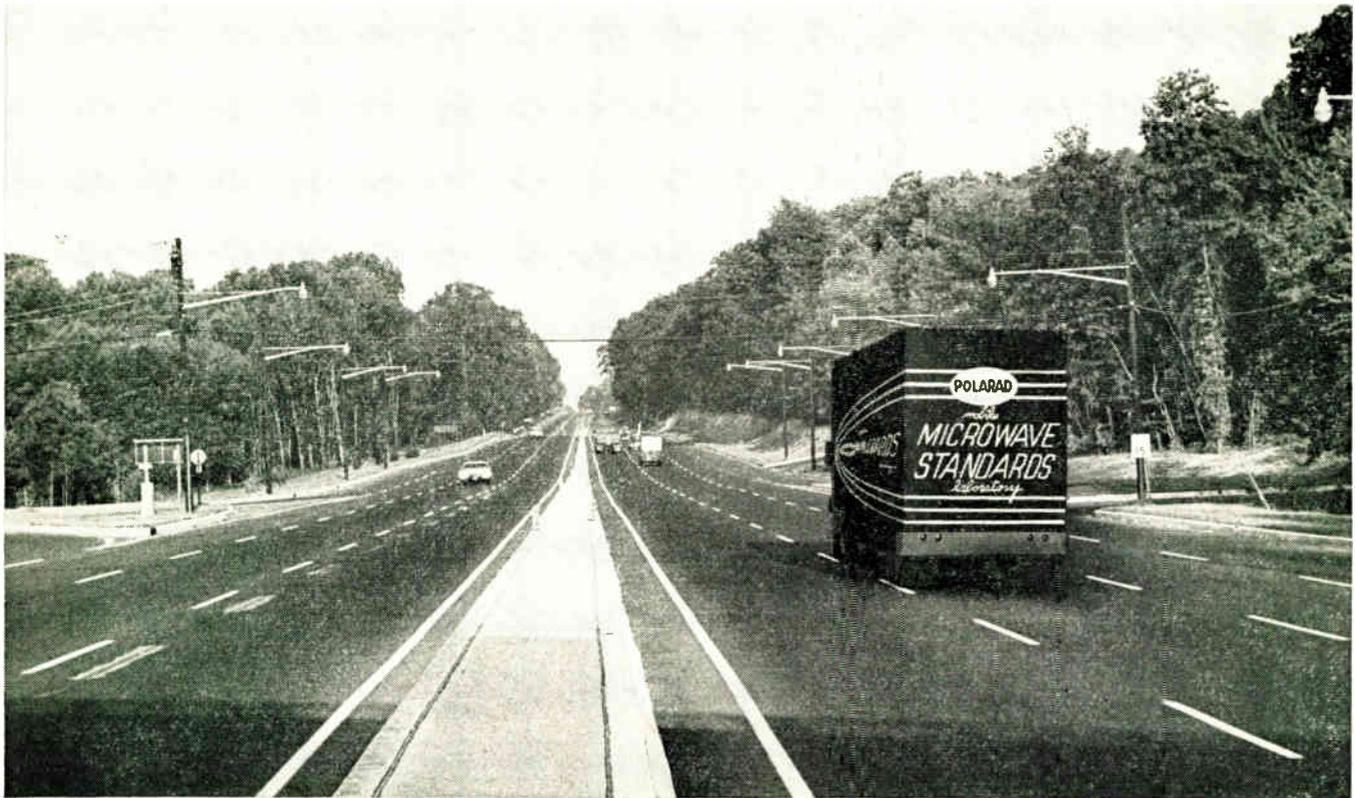
HEWLETT PACKARD COMPANY

1501 Page Mill Road, Palo Alto, California, Area Code 415, DA 6-7000
Sales and service representatives in all principal areas; Europe,
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Hewlett-Packard (Canada) Ltd., 8270 Mayrand Street, Montreal



hp Model	Primary Uses and Features	Frequency Range	Voltage or Current Range	Input Impedance	Price
400D	Wide range ac voltmeter. High sensitivity, 2% accuracy.	10 cps to 4 MC	0.001 to 300 v fs. 12 ranges	10 megohms 15 pf shunt, high ranges; 25 pf, low ranges	\$250.00
400H	Similar to 400D, 1% accuracy on extra-large 5" mirror-scale meter.	10 cps to 4 MC	0.001 to 300 v fs. 12 ranges	10 megohms 15 pf shunt, high ranges; 25 pf, low ranges	\$325.00
400L	Logarithmic 400H, log voltages, linear db scale. Accuracy $\pm 2\%$ constant percentage of reading.	10 cps to 4 MC	0.001 to 300 v fs. 12 ranges	10 megohms 15 pf shunt, high ranges; 25 pf, low ranges	\$325.00
403B	Solid state ac voltmeter, ac and rechargeable battery operated, portable. Fast, accurate, hum-free ac measurements.	5 cps to 2 MC	0.001 to 300 v fs. 12 ranges	2 megohms 40 pf shunt, low ranges; 20 pf, mid ranges; 15 pf, high ranges	\$310.00
410B	VTVM for audio, rf, VHF measurements; dc voltages, resistances. High input impedance minimizes circuit loading.	DC; ac, 20 cps to 700 MC	DC, 1.0 to 1,000 v fs.; ac, 1.0 to 300 v fs., 1.0 ohm to 100 megohms	DC, 122 megohms; ac, 10 megohms/1.5 pf shunt	\$245.00
411A	RF voltmeter. Millivolt, db readings, 2 linear scales.	500 KC to 1 GC	10 mv to 10 v fs. 7 ranges	Depends on probe tip, frequency and input voltage; typically 200 K ohms at 1 MC and 1 volt	\$450.00
412A	Precision VTVM. 1% accuracy; measures voltage, current, resistance; no zero set needed; 1 ohm to 100 megohm center scale for resistance measure, 60 db dc amplifier.	DC	1 mv to 1,000 v fs. 1 μ a to 1 amp fs. 0.1 ohm to 1,000 megohms	10 to 200 megohms, depending on range	\$400.00
413A	DC null meter, dc voltmeter, 60 db dc amplifier. 2% accuracy, floating input, 1 mv end scale sensitivity.	DC	1 mv to 1,000 v fs. 13 ranges	10 to 200 megohms, depending on range	\$350.00
425A	Microvolt - ammeter reads μ v, μ a; measures dc voltages, current as in medical, biological, physical, chemical work. 100 db amplifier.	DC	10 μ v to 1 v fs. 11 ranges; 10 μ a to 3 ma fs. 18 ranges	1 megohm $\pm 3\%$ (v) 1 megohm to 0.33 ohms (current)	\$500.00
428A	Clip-on dc milliammeter, eliminates direct connection, no circuit loading. Measures dc in presence of ac.	DC	3 ma to 1 amp fs. 6 ranges	Loading of measured circuit negligible	\$500.00
428B	Similar to 428A, wider range, recorder output for dc to 400 cps.	DC on meter, dc to 400 cps on recorder	1 ma to 10 amps fs. 9 ranges	Loading of measured circuit negligible	\$600.00
405CR	Automatic digital VM. "Touch and read", direct dc voltage measurements, digital readout. Automatic range, polarity; has 10-line readout for printer, system.	DC	0.001 v to 1,000 v (accuracy $\pm 0.2\%$ of reading ± 1 count)	11 megohms	\$925.00





Bringing the mountain to Mohammed!

Another Polarad First: On-the-Spot Microwave Calibration... Coast to Coast!

THE PROBLEM: All instruments require periodic recalibration. Microwave instruments are no exception . . . even the best of them (ours).

RECALIBRATION takes three things: *very precise equipment, very skilled personnel, and time.*

TIME is the villain. In most microwave facilities, Polarad instruments are workhorses, in use every day, all day long. Thousands of our spectrum analyzers, signal generators, receivers, and RI/FI meters have been in continuous service for five, ten, even fifteen years . . . many without a single recalibration! The engineers who use these instruments simply cannot spare them for the two to six weeks required (depending on paperwork, shipping conditions, and our workload) to return them to the factory for recalibration.

THE ALTERNATIVES are expensive—often prohibitively so. Microwave instrumentation is costly. Most budgets will not allow for a “running spare”. Very few facilities can justify the secondary standards for an in-plant recalibration setup. Even

then, specialized technician training cannot be sensibly “amortized” over a dozen or so calibrations a year. *What to do?*

THE SOLUTION: Bring the Mountain to Mohammed! We have designed the industry’s first MOBILE MICROWAVE STANDARDS LABORATORY—an air-conditioned, self-powered van, equipped (at a cost exceeding \$250,000) to perform secondary-standard calibration of the most sophisticated microwave instruments. *Every significant parameter is traceable to NBS.*

THE PLAN: The first mobile laboratory will travel over 20,000 miles this year, bringing its unique service to dozens of electronic centers, at a nominal charge far below comparable alternatives. Calibration will be done on the spot, by appointment. Certificates will be issued by the standards engineer in charge. The certificate will furnish all information necessary to satisfy MIL-Q-5923 and/or MIL-Q-5898.

WHY POLARAD? We have a major stake in the establishment and main-

tenance of dependable calibration standards—a responsibility we are more than willing to acknowledge and accept. Frankly, we hope that this latest of our many pioneering services to the industry will underscore for you our position as a “World Leader in Microwave Instrumentation”.

RESERVATIONS are necessary—the demand is bound to exceed capacity in the early months. We have prepared a portfolio describing the laboratory, test procedures, certifications, and costs. Call your Polarad field engineer (see list) for your copy, or write to us directly.

Program portfolios also available at WESCON Booth #761-762

Polarad Electronics Corporation

*World Leader in
Microwave Instrumentation*

43-20 34th Street
Long Island City 1, New York



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AIR LEAKS (Continued)

a tire leak. Machine bearings emit characteristic but inaudible high frequency squeaks long before heat or audible sound occur.

In operation, the fully transistorized Translator pinpoints trouble spots by means of its hand-held direction probe and volume control of the translated sound signals. Thus, ordinary human coordination of sight, hearing and hand is all that is necessary to survey a complex of possible trouble spots for tell-tale sounds. Similarly, human experience with familiar sounds is enough to diagnose the likely cause, eliminating the need for special training or expensive auxiliary equipment.

In industrial air pressure system, a single 1/8 in. leak in a common 100 psi line requires as much electric power as 100 50-watt light bulbs burning continuously. Such a sys-

tem can be surveyed for minute leaks from distances in excess of 100 ft. as opposed to existing methods of applying soap solutions to the entire system.

Leaks may be located without introducing foreign gases and, in vacuum systems, without reversing the pressures.

The Delcon Ultrasonic Translator inspects operating hydraulic systems for leaky valves and restrictions by picking up the high frequency sounds of cavitation.

The unit has proved successful in leak detection and location in low (5 psi) pressure telephone cable, inspecting large fabrications for missile test equipment, helium and hydrogen systems, and others.

Operable for one year on three mercury cells, the Ultrasonic Translator is manufactured by Delcon Corp., 943 Industrial Road, Palo Alto, Calif.

UNIQUE DATA CONVERTER

A machine enabling standard paper tape computer code to be converted into a field data code used in compiling map information is being tested by the U. S. Army Engineers.

Standard components are tied together through a special logic control matrix designed by IBM Corp. for the Army.

ULTRASONIC CLEANING



A 1kw, 20-KC solid-state generator and stainless-steel, 16-gal. magnetostrictive transducer tank are used to clean printed circuit boards at Westinghouse Industrial Electronics Div., Baltimore, Md. Fully-assembled boards emerge clean and undamaged after 42-sec. ultrasonic scrub. Process replaces long-handled brush cleaning, is used for almost all printed circuit board types.

ELECTRO-ACOUSTIC SYSTEMS LAB OPENED

The opening of an Electro-Acoustic Systems Laboratory in Avon, Mass., has been announced by Hazeltine Corp. This laboratory will be devoted to engineering and management disciplines needed for the advancement of acoustic and electro-acoustic systems.

The laboratory will be responsible for broadening the company's participation in the anti-submarine warfare (ASW) field. Hazeltine, through this laboratory, will contribute to the growing R & D of new electro-acoustic systems used in detection, localization and destruction of submarines.

WEATHER BUREAU COMPUTER

Weather Bureau meteorologists at the National Hurricane Research Project, Miami, Fla., are using a GE 225 computer to analyze storm data collected by reconnaissance aircraft. The project's goal is to build a mathematical model of a hurricane to permit more rapid forecasting.

The planes fly through live hurricanes and record the data on magnetic tape.

NEW TECH DATA

for Engineers.

Transistor Brochure

This 16-page Transistor Interchangeability Brochure contains specification information on 1,167 JEDEC-registered transistor types and the closest GE types for interchangeability. Outline drawings, construction and general use categories for each transistor are also included. General Electric Co., Semiconductor Products Dept., Bldg. 7, Electronics Park, Syracuse, N. Y.

Circle 315 on Inquiry Card

Traveling-Wave Tubes

A brochure explaining the steps in the manufacture of traveling-wave tubes is available from the Microwave Device Div., Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y. The 14-page booklet also explains the functions of the tubes and their possible future applications.

Circle 316 on Inquiry Card

Pushbutton Switches

Licon Div., Illinois Tool Works Inc., 6615 W. Irving Park Rd., Chicago 34, Ill., is offering a 4-page brochure on the 01 Series of miniature lighted pushbutton switches. Complete dimensional, electrical, and mechanical specs. are given for these combination panel indicators/pushbutton switches. Switch elements are rated to 10a 30vdc, 250vac.

Circle 317 on Inquiry Card

Potting Applicators

Bulletin No. 102A describes a line of Disposable Manual Potting Applicators for potting, encapsulating, sealing, etc. requiring viscose material. Philip Fishman Co., 7 Cameron St., Wellesley 81, Mass.

Circle 318 on Inquiry Card

Switch Design Handbook

This switch design handbook and catalog for electronic engineers, 44 pages, includes description of the various materials used in construction of switches along with application data. A glossary of switch nomenclature and instructions for switch circuit design are also included. The catalog features a number of "desk-top assembly" pages, which allow engineers to visually assemble a particular switch by simply turning pages in the catalog section. Over 289 switches are included. Detailed electrical and physical specs. on 10 basic types of rotary switches; lever switches; and 4 types of slide switches; printed circuit switches; etched circuit switch sections; special switches; and switch construction kits are also included. Centralab, The Electronics Div. of Globe-Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.

Circle 319 on Inquiry Card

Relay Circuits

"Relay Magic," 40 pages, contains 31 time-tested circuits. Included are circuits for dividing, multiplying, stretching and shortening pulses, for counting chains, storage, scanning and cycling systems, binary addition, decimal-to-binary, and binary-to-decimal conversion. In addition there are 6 seemingly practical circuits that should be avoided. Circular 1012 available from Automatic Electric Co., subsidiary of General Telephone & Electronics, 400 N. Wolf Rd., Northlake, Ill.

Circle 320 on Inquiry Card

Delay Line Brochure

This Delay Line Brochure gives a detailed analysis of delay line design considerations, applications, and testing procedures. Bulletin 101DL entitled, "Selecting the Correct Delay Line" is available from Shallcross Mfg. Co., Selma, N. C.

Circle 321 on Inquiry Card

Gas Laser

This pamphlet outlines the mechanics and advantages of Sylvania's GL-6211 Continuous Gas Laser. Information includes descriptions of the units contained in the laser and photographs of simple electromagnetic standing wave mode patterns. Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N.Y.

Circle 322 on Inquiry Card

Xenon Flash Lamps

Xenon Flash Lamps which have quartz to metal seals and are constructed of ultra-pure, clear fused quartz for max. lamp life, are available in 5 basic configurations: straight, helical, "U" shaped, cylindrical and "T" shaped. They are for use in photography, photo instrumentation, high power illumination for aerial photography and laser pumping. PEEK Labs Inc., 5024 Transport St., Palo Alto, Calif.

Circle 323 on Inquiry Card

Accelerometer Primer

Two booklets describing linear and angular accelerometers, their principles of operation, construction applications and techniques for measuring accelerometer accuracy, are available from Dynamic Measurements Co., 104 Terwood Rd., Willow Grove, Pa. "An Accelerometer Primer" explains the theory of damped spring-mass accelerometers, the importance of natural freq. and critical damping and the use of variable differential type pick-offs. "Accelerometer Calibration" describes the measurement of applied acceleration (Part 1) and the measurement of accelerometer output (Part 2).

Circle 324 on Inquiry Card

Insulating Materials

"Irvington" and "Fibremat" brand flexible insulating materials that have been tested for compatibility with epoxy resins are described in a brochure available from the Irvington Div. of Minnesota Mining and Mfg. Co., Dept. W2-236, 900 Bush Ave., St. Paul 1, Minn.

Circle 325 on Inquiry Card

Audio Transformers

Bulletin 40AN lists full specs. for 46 ultraminiature "J-TRAN" audio transformers for output, interstage, isolation, chopper, input, driver, and match-to-line applications. This 4-page bulletin is available from the Polyphase Instrument Co., E. 4th St., Bridgeport, Pa.

Circle 326 on Inquiry Card

Wire Reference

A pocket-size, quick reference table, giving specs on different gauge standard annealed copper wire is available from Hudson Wire Co., Ossining Div., Ossining, N.Y. The table includes standard AWG sizes; diameter per gauge (inches and mils); cross section measurement per gauge (circular mils and sq. in.); $\Omega/1000$ ft.; lbs./1000 ft.; and ft./lb.

Circle 327 on Inquiry Card

MM Wave Radar

OKI "Radar Image of Balanced Beauty—(High Resolution Power of Radar), is available from Butler Roberts Associates Inc., subsidiary of OKI Electronics of America Inc., 202 E. 44th St., New York, N.Y. Information is included on 2 millimeter wave radars, Model CPSH-2A and CPSH-2B. The 2B is in the 8.6 mm band, and the 2A is in the 9.2 mm band. Both models have a peak power output of 35kw. These high definition radars are for airport surface detection equipment, harbor radar, marshalling yard control, and precision survey radar.

Circle 328 on Inquiry Card

Epoxy Cement

Plastic Associates, div. of Laguna Scientific Industries, P.O. Box 36, Laguna Beach, Calif., is offering a comprehensive catalog covering their complete line of ready-to-use single-component and 2-component epoxy cements and protective coatings.

Circle 329 on Inquiry Card

Tape Length Chart

The May 1962 issue of "OMNI-DATA DIGEST," contains a chart for determining the length of paper tape on a given reel at any given times. Omnitronics, Inc., subsidiary of Borg-Warner Corp., 511 N. Broad St., Philadelphia 23, Pa.

Circle 330 on Inquiry Card

FROM STC THE FIRST...



PNP

SILICON POWER TRANSISTORS



For Technical Data and prices, contact:

SILICON TRANSISTOR CORPORATION

CARLE PLACE, LONG ISLAND, NEW YORK Pioneer 2-4100

Sixteen Different PNP Types:

11/16" hex ... 85 watts ... STC5550 through STC5555
Square package ... 85 watts ... 2P389, 2P389A, 2P424, 2P424A
TO-3 ... 75 watts ... STC5080 through STC5085
Characteristics: h_{FE} 10 to 30 @ 2 amps ... R_{CE} (sat) 0.5 ohms
@ 2 amps ... V_{CE} 80 volts ... I_C max 5 amps

NPN Complements:

11/16" hex 85 watts ... STC1550 through STC1555
Square package 85 watts ... 2N389, 2N389A, 2N424, 2N424A
TO-3 75 watts ... STC1080 through STC1085

NEW TECH DATA

for Engineers.

Semiconductor Guide

This 12-page, 2-color, product guide gives the latest data on RCA's full line of silicon and germanium transistors, silicon rectifiers, special computer diodes, tunnel diodes and varactor diodes. A handy "by-application" classification guide simplifies the process of locating the right transistor for any type of service. Photographs included. RCA Semiconductor and Materials Div., Commercial Engineering, Somerville, N. J.

Circle 331 on Inquiry Card

Heat Dissipators

This 8-page, short form catalog lists components for cooling and holding of electron tubes and semiconductor devices. The catalog contains part numbers, description and photographs for over 200 standard heat-dissipating electron tube shields and accessories and over 90 heat dissipators for transistor and diode thermal control. IERC Div., International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, Calif.

Circle 332 on Inquiry Card

Photomultiplier Catalog

A catalog listing over 35 photomultiplier tubes with typical performance curves and condensed applications data contains electrical and physical specs. for tubes from 1½ to 12 in. in diameter. Photographs and table of comprehensive specifications are included. Photomultiplier Tube Catalog T-1 available from Electron Tube Div., EMI/US, 1750 N. Vine St., Los Angeles 28, Calif.

Circle 334 on Inquiry Card

4-Layer Switching Device

This tech. bulletin describes the Type 2N2260 Dynaquad, an alloy junction pnpn device that can be turned on and off at its gate in the order of 0.1µsec. The solid-state switch is ideal for computer and control circuits. Included are electrical and physical specs., 10 typical characteristic curves, operating features, and schematics, and circuits used to measure the charge control parameters. Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N.J.

Circle 335 on Inquiry Card

Capacitance Calculator

The estimating of capacitance requirements for electronic cables of different types is simplified by a nomogram printed on laminated acetate to make a useful and easy-to-use calculator. The calculator gives an estimate of capacitance for a given size and type of cable or of the conductor size and/or insulation wall thickness necessary to meet a capacitance requirement. Publication No. WC-3131-F available from the General Electric Co.'s Chemical and Metallurgical Div., Bridgeport 2, Conn.

Circle 336 on Inquiry Card

Clean Room Bibliography

Controlled Environment, Inc., 915 Great Plain Ave., Needham 92, Mass., is offering a 20-page bibliography on "Clean Rooms and Contamination Control," and "Sampling and Monitoring Air in Clean Rooms." The publication contains detailed references on all known reports, specs., articles, speeches, and books on the subjects.

Circle 337 on Inquiry Card

Beryllium Oxide

Beryllium Oxide for semiconductor bases and heat sinks are described in a 4-page folder available from The Brush Beryllium Co., 5209 Euclid Ave., Cleveland 3, Ohio. Physical, mechanical and electrical properties of beryllia parts and diagrams and dimensions of beryllium oxide standard semiconductor bases and heat sinks are included.

Circle 338 on Inquiry Card

Tube Reliability

"Industrial and Military Tube Reliability Data Report," a 22-page report, defines failures, describes methods of determining failure rates and summarizes the results of tubes' intermittent life testing as specified in Mil-E-1D. Raytheon Co., Industrial Components Div., 55 Chapel St., Newton 58, Mass.

Circle 339 on Inquiry Card

Fuel Cell Electrodes

A paper entitled, "Radioisotope-Activated Fuel-Cell Electrodes" describes the development and use of a different concept in fuel cell electrode design. The Yardney fuel cell concept described in this paper involves the use of oxygen electrodes made of sintered porous silver and treated with radioactive isotopes. The paper is available from Yardney Electric Corp., 40-50 Leonard St., New York 13, N.Y.

Circle 340 on Inquiry Card

Indicator Lights

The Missile 400 Series Indicator Lights were developed for missile and ground support applications. They feature simplicity and ease of assembly and each complete unit may be combined with others to form a complete indicator area within the panel configuration. Missile 400 Series Technical Bulletin is available from Marco Industries Co., 207 S. Helena St., Anaheim, Calif.

Circle 341 on Inquiry Card

Germanium Hall Crystal

Tech. data is available on Germanium Hall Crystal intended for multiplier and magnetic field measurement applications. Kearfott Div., General Precision, Inc., Little Falls, N. J.

Circle 342 on Inquiry Card

Environmental Tape

A non-gassing, pressure-sensitive tape that prevents corrosion and pitting in electronic components is described in tech. data available from Mystik Adhesive Products, Inc., Industrial Div., 2635 N. Kildare Ave., Chicago 39, Ill. Mystik PD-496 has a 3-mil teflon backing and a thermosetting rubber-based adhesive. It is designed especially for insulating the coil winding of Class "F" hermetically-sealed components.

Circle 343 on Inquiry Card

Powered Switches

Condensed Bulletin A-262, 11 pages, 3 colors lists physical and performance details on rotary solenoids, powered stepping switches, circuit selectors, servo-step motors and rectifiers. Stock model illustrations include 186 rotary solenoids, 13 solenoid powered (multiple deck) circuit selectors, and a line of miniature, bi-directional and uni-directional, precision servo-step devices. Also included are silicon rectifiers with built-in surge protection; hermetically sealed switches; transient controls; and pneumatic rotary actuators. Ledex Inc., 123 Webster St., Dayton 2, Ohio.

Circle 344 on Inquiry Card

Tantalum Capacitors

The micro-miniature line of solid tantalum capacitors described in GLP electronics Bulletin MM-20 are designed for use in military and commercial applications. Information includes performance characteristics, dimensions, rating, construction, plus definitions of terms. GLP Electronics, Inc., Dept. MM, 350 Riverside Ave., Bristol, Conn.

Circle 345 on Inquiry Card

Antenna Positioner Data

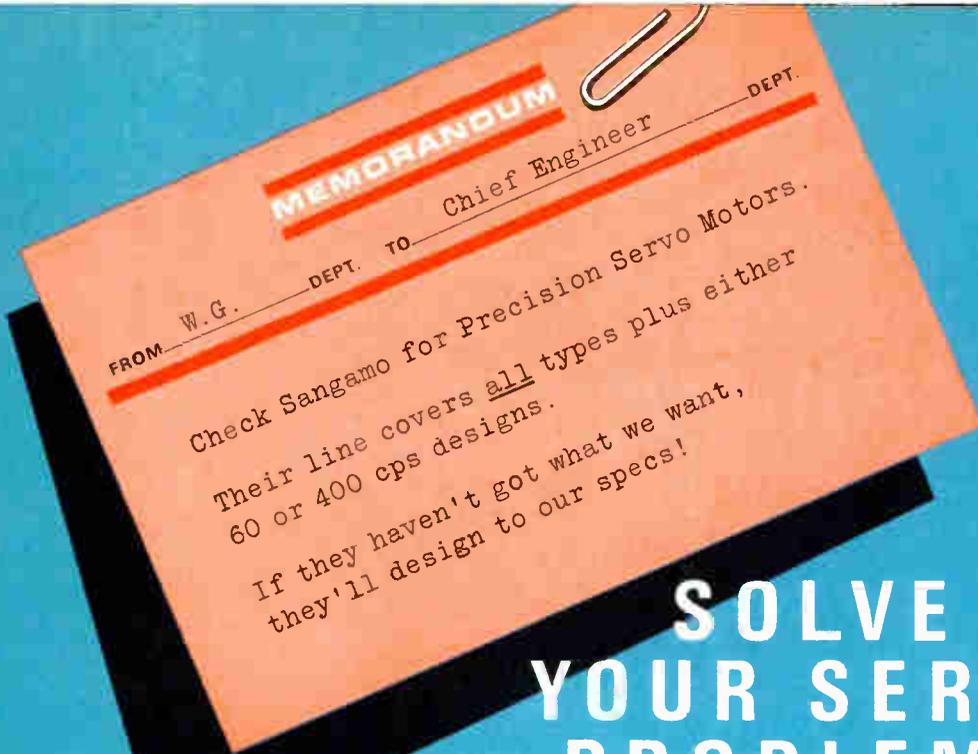
A complete data file describing Scientific-Atlanta antenna positioners plus a discussion of the terms used to specify and describe them is offered. Information includes detailed discussion of azimuth-over-elevation, elevation-over-azimuth, and azimuth-over-elevation-over-azimuth multi-axis positioners; polarization positioners; medium and heavy duty azimuth positioners; and elevation positioners. This 18-page data file is available from Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta 9, Ga.

Circle 346 on Inquiry Card

Thermocouple Wire

Metallic armored, thermoplastic, and fibrous thermocouple wires are described in a 10-page illustrated catalog entitled, "Thermocouple Wire." Information in this brochure Section 32-1, covers calibrations, gages, insulations, construction and applications for all types produced. Thermo Electric Co., Inc., Saddle Brook, N. J.

Circle 347 on Inquiry Card



SOLVE YOUR SERVO PROBLEMS SPECIFY SANGAMO

For special precision servo motors to meet your most exacting requirements—order from Sangamo. Sizes range from 5 to 25 with most designs available in either 60 or 400 cps.

For more than 20 years Sangamo has been manufacturing quality AC servo motors, induction generators, drag cup motors, synchros, PM generators, synchronous motors, and motor generators. Most of these types are available from stock and we are prepared to modify our designs to your system where necessary. If this is not possible, our engineers will design to meet your specifications.

You can solve your servo motor problems by discussing your requirements with a Sangamo Precision Motor Sales Engineer. Please write for further information on Sangamo's complete line.



SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS



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CONVERTERS**

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**DRAG CUP
MOTORS**

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NEW TECH DATA

for Engineers.

Microwave Catalog

Catalog 614, Supplement A, 8 pages, 2 colors, describes microwave signal generators, broadband crystal mixers, microwave preselectors and a tuning unit. Information includes models numbers, ranges, application data, performance characteristics, and operation features. Empire Devices, Inc., Amsterdam, N.Y.

Circle 389 on Inquiry Card

Test Equipment

A new in-circuit transistor tester, power measurement equipment, power sources, and wave analyzers are described in a quick reference catalog available from Sierra Electronics Div., Philco Corp., 3885 Bohannon Drive, Menlo Park, Calif. Brief descriptions and tech. references are included.

Circle 390 on Inquiry Card

C-Band Phase Shifter

Tech. data is available on a miniature electrically variable C-Band phase shifter, The Bendix TFP-1. The TFP-1 provides at least 0-90° of phase shift in the C-band region. The self-jigging construction of the unit insures minimum weight, ruggedness and stable operation. Engineering Data Release, Issue No. 39, File G-20, is available from The Bendix Corp., Red Bank Div., Eatontown, N. J.

Circle 391 on Inquiry Card

Solid-State Voltmeters

"Components for Test Consoles" 28 pages, 2 colors, gives full details on Theta Instrument's new dials, solid-state voltmeters, servos, phase shifters and decimal encoders for panel mounting. The theory of operation as well as the application of each instrument is discussed in detail, with illustrations and full specs. Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.

Circle 392 on Inquiry Card

PC Board Etching

Bulletin No. 119, 7 pages, contains information useful in setting up a continuous etching process for printed circuit boards. Advantages of the system are: constant etching time; adaptability of persulfate etching into automated production lines; and savings in down time and labor. Inorganic Chemicals Div., FMC Corp., 161 E. 42nd St., New York 17, N. Y.

Circle 393 on Inquiry Card

Boron Nitride

Information including electrical, chemical and other technical data together with suggested applications on Boron Nitride is included in a brochure available from The Carborundum Co., Electronics Div., Latrobe, Pa.

Circle 394 on Inquiry Card

Insulation Testing

Latest techniques and equipment for testing electrical insulation of components, cables, assemblies and complete systems as well as for testing samples of insulating material are described in Manual S-74 available from Associated Research, Inc., 3777 W. Belmont Ave., Chicago 18, Ill. Information is included on equipment for testing insulating oils, solids, sheets, tubes, tapes, liquids and films in accord with ASTM and Federal specs.

Circle 395 on Inquiry Card

Terminal Blocks

This 21-page catalog contains comprehensive information on terminal blocks, terminals strips, special connectors and accessories. Information is included on a group of basic blocks which are available for use with wire sizes ranging from AWG 21 to AWG 2. All may be grouped together on a single mounting channel to provide custom-tailored and labelled terminal blocks of any desired length or capacity. Photographs, selection charts, descriptions, and outline drawings are included. The Rowan Controller Co., 26 Bridge Ave., Red Bank, N. J.

Circle 396 on Inquiry Card

Terminals and Connectors

Waldom Electronics, Inc., 4625 W. 53rd St., Chicago 32, Ill., is offering their 32-page catalog of parts for industry. Featured are over 1,700 items of solderless terminals and connectors. Also included are a complete selection of electronic hardware, instrument and equipment knobs and dials, standard and printed circuit tube sockets, jack covers, and planetary drives.

Circle 397 on Inquiry Card

Connectors

The Sure-Lok line of electronic connectors covering computer and instrument applications features flexibility and easy wiring changes. Information is available from National Connector Corp., Science Industry Center, Minneapolis 27, Minn.

Circle 398 on Inquiry Card

Water Deionization

A 6-page gatefold reprint of a deionization process flowsheet and applications article is available from Penfield Mfg. Co., 46 Britannia St., Meriden, Conn.

Circle 399 on Inquiry Card

Bridge Rectifier

Tech data is available on a miniature silicon solid state—full wave 2a bridge rectifier. Max. input volts RMS and max. output amps dc at 25°C and 100°C are given on 6 types. Diodes, Inc., 7303 Canoga Ave., Canoga Park, Calif.

Circle 400 on Inquiry Card

Modular Core Memories

Series of coincident current core memories using silicon semiconductors, wide temp. Isodrive cores, and load sharing switches to give highly reliable memories operating from -30° to +80°C without special heating or current compensating circuits is described in tech. data available from Electronic Memories, Inc., 9430 Bellanca Ave., Los Angeles 45, Calif.

Circle 401 on Inquiry Card

Plastic Design Data

"Plastic Design Data for Engineers," 16 pages, is a design supplement to its general engineering handbook. It includes characteristics and values for Spaulding's glass base grades, fire resistant grades, copper clad, epoxy papers, glass filament wound, fibre boards, and certain special grades, as well as data on Spaulding's value analysis service. Spaulding Fibre Co., Inc., 310 Wheeler St., Tonawanda, N.Y.

Circle 402 on Inquiry Card

Digital Logic Modules

This 16-page condensed catalog gives specs. and prices on more than 300 fully-transistorized printed-circuit modules and a full line of card-mounting equipment, all designed for digital systems. The line includes flip-flops, counters, amplifiers, NOR logic, multivibrators, AND & OR gates, power regulators and supplies, and dual shift registers. Condensed Catalog D is available from Ransom Research, Div. of Wyle Laboratories, 374 W. 8th St., San Pedro, Calif.

Circle 403 on Inquiry Card

Spectrometer System

A 24-page catalog on the V-4502 EPR Spectrometer System is available from Varian Associates, 611 Hansen Way, Palo Alto, Calif. Beginning with an explanation of the theory behind Electron Paramagnetic Resonance (EPR), the catalog gives detailed descriptions of the 7 different EPR systems in the V-4502 family. Complete specs. are given on each component and accessory, including power supplies, sweep amplifier units, field modulation and control units, magnet systems, graphic recorders, and multi-purpose cavity.

Circle 404 on Inquiry Card

Precision Measurement

This 8-page ESI catalog describes a line of precision measurement instruments and components and includes illustrations and short-form specs. on bridges and accessories, standards, decade resistors and capacitors, decade voltage dividers, custom networks and the ESIAC algebraic computer. ESI-Electro Scientific Industries, 7524 S. W. Macadam Ave., Portland 19, Ore.

Circle 405 on Inquiry Card



TIPS (Technical Information and Product Service)

5 VALUE-ANALYZED DEVELOPMENTS

Circle 41 on Inquiry Card



Now from G. E.... new dry reed switch has life expectancy of 100,000,000 cycles

To answer the steadily increasing demand, the G-E Receiving Tube Department announces the 2DR15, G.E.'s first entry into the dry reed switch field. The 2DR15, in addition to being the first of the proposed line of G-E dry reed switches, offers such value-analyzed benefits as:

Long Life—Simplified design and construction, plus external magnetic actuation, result in a life expectancy of at least 100,000,000 cycles, when operated within ratings.

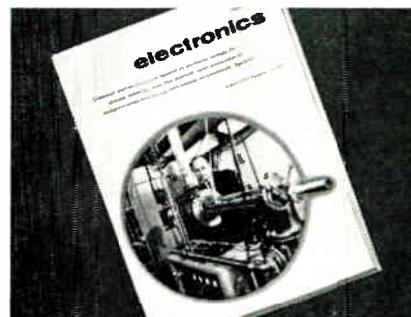
Trouble-Free Operation—Contact contamination is eliminated by hermetically sealing the reeds in an atmosphere of inert gas. High-purity gold is used as the contact material.

Versatility—The 2DR15 can carry loads ranging from 15 volt-amperes down to microamperes. Ideal for transistor-drive applications. Mounts in any position.

Low Cost—The 2DR15 is priced lower than most other relays or switching devices.

Existing applications for dry reed switches presently include: liquid-level controls, weight-measuring devices, temperature limiters, pressure controls, RPM counters, coin-operated devices, multiple relays, protective devices, etc. General Electric's Technical Information and Product Service (TIPS) group is ready to help you with present or potential applications involving the use of dry reed switches. Contact your nearest G-E sales office or write to TIPS, General Electric Company, Owensboro, Kentucky, for complete information.

Circle 42 on Inquiry Card



"Increasing use of nuclear energy in propulsion systems and weapons, as well as the exposure of space systems to Van Allen and cosmic radiation, is causing growing interest in the effects of nuclear radiation on complex electronic systems. One of the more significant phenomena that occur under high-level nuclear radiation is the transient effect, leading to circuit malfunction as opposed to permanent damage . . . shields or protective covers that surround typical electronic systems are almost completely transparent to these radiations." (ELECTRONICS, 2/10/61, Page 62)

G. E. offers three answers to nuclear radiation problems

Depending on the degree of miniaturization necessary, and on the type of nuclear tolerance desired, G.E. offers three answers to radiation problems: G-E 5-Star tubes, ceramic tubes, and TIMM circuits.

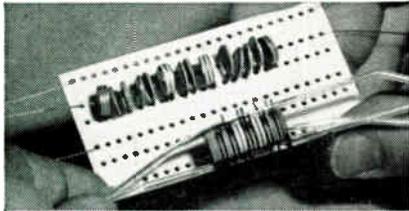
Five-Star tubes can tolerate an integrated gamma ray dosage of 10^9 roentgens, or more, and a 10^{18} integrated fast neutron flux (NVT) without detectable damage. Micro-miniature ceramic tubes exhibit steady-state tolerance to more than 10^{11} roentgens and 10^{19} NVT. TIMM circuits will tolerate more than 10^9 roentgens and 10^{19} NVT.

TIMM circuits also offer the highest expected tolerance to pulse radiation of any microminiature circuitry concept known today. Tests indicate that radiation pulses of 10^9 roentgens per second will have little, if any, effect on TIMM circuits.

Send for free Radiation Data folder.

FROM G-E RECEIVING TUBE RESEARCH

Circle 43 on Inquiry Card



TIMM high-temperature, microminiature circuit elements now available

TIMM (Thermionic Integrated Micro Module) circuits represent the *only known high-temperature (580°C.), radiation-resistant microminiature system* available today. Ceramic and titanium components tolerate 10,000 times the steady-state radiation of circuits employing solid-state devices. TIMM component densities of as high as 250,000 parts per cubic foot are possible.

Individual components are now available for breadboard experimentation, characteristics evaluation, and overall familiarization with TIMM microminiaturization techniques.

Resistors—1,000 ohms to 100,000 ohms rated at ½ watt (at 580°C.)

Capacitors—20 pf to 200 pf units to 300 vdc (at 580°C.)

Diodes

50 volts max. p.i.v.

2mA DC plate current....(at 580°C.)

2.3 v self-bias

Triodes—As a switch (at 580°C.)

off: $E_b = 10_v$, $E_g = 0_v$, $I_b = 100 \mu a$ max.

on: $E_b = 7.5_v$, $E_g = +2.5_v$, $I_b = 2.0 \text{ mA}$, $I_g = 200 \mu a$

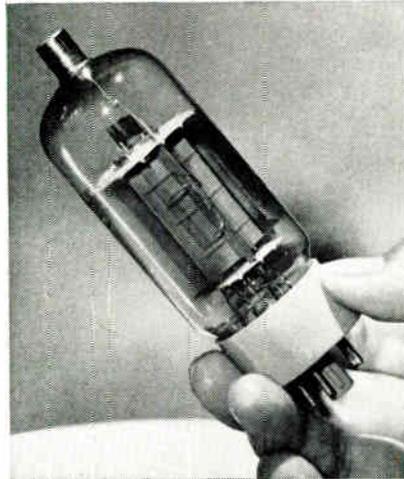
To help you *value-analyze* TIMM circuit elements at high temperatures, General Electric has prepared a TIMM accessory kit consisting of:



One mounted 1½"-dia. x 8"-long oven, two circuit mounting boards, quartz insulating sleeves, four circuit spacers, connecting wire and ribbon, asbestos tape, thermocouple (Cr-Al), end plugs, thermal insulating sheet.

Write for price and availability information today.

Circle 44 on Inquiry Card

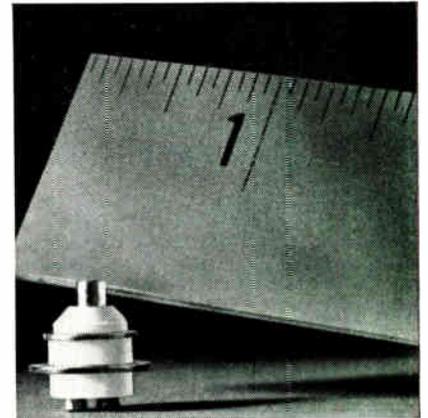


New 8068 beam pentode offers greater voltage-regulating capacity

G.E.'s new 8068 beam pentode can handle more power and voltage than any other previously available tube of its size. Designed for high-voltage series regulator use in both fixed and variable power supplies, the 8068 has a maximum plate-voltage rating of 3500 volts with a maximum plate dissipation of 35 watts.

Unique construction features of the 8068 include the use of lead glass to decrease electrolysis and envelope bombardment, the causes of early failure in high-voltage glass tubes; and high-temperature thermosetting compound used in the 8068 base.

Circle 45 on Inquiry Card



New "C"-band ceramic triode can reduce equipment size, weight and cost

G.E.'s newest metal-and-ceramic triode, the Z-2866, is intended, primarily, for use as a plate-pulsed oscillator, or amplifier, at frequencies up to 6,000 megacycles. Ideally suited for applications in radar beacons, navigation equipment, or microwave systems, the microminiature Z-2866 can replace klystrons, magnetrons and traveling wave tubes, thus providing a considerable savings in overall size and weight.

The Z-2866 is not only smaller than most of these devices but substantially lower priced. Complicated power supplies are unnecessary with the Z-2866 and frequency-shift problems are practically eliminated. Maximum ratings include: 1200 volts peak plate voltage, 1 watt plate dissipation, and 600 ma video peak plate current. Peak power output at "C"band is in excess of 50 watts.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

Please send me more value-analysis information about:

- G-E Dry Reed Switches
- G.E.'s Answers to Radiation Problems
- TIMM Circuit Elements
- 8066 Beam Pentode
- Z-2866 "C"-Band Ceramic Triode

G-E Receiving Tube Department
 Technical Information and Product Service (TIPS)
 Box 1757-B, Owensboro, Kentucky

Name.....

Title.....

Company.....

Address.....

City.....Zone.....State.....

SMALL SIGNAL



SMALL SIGNAL NPN SILICON PLANAR TRANSISTORS IN TO-18 AND TO-46 CASE STYLES

THESE DEVICES FEATURE:

- HIGH f_T : TYPICAL 100 Mc @ 5 mA
- LOW LEAKAGE: TYPICAL 1.0nA
- LOW CAPACITANCE: TYPICAL 4 pfd @ 5V

IN TO-46 CASE	IN TO-18 CASE	APPLICATIONS
2N2459 2N2460 2N2461 2N2462	2N2463 2N2464 2N2465 2N2466	For high frequency, high voltage linear amplifier, oscillator and non-saturating switching circuits. TYPICAL f_T of 150 Mc, four restricted beta ranges and two point control of h parameters.
2N2515 2N2516	31N2 (Improved 2N735) 32N2 (Improved 2N736A)	For linear amplifier, oscillator and non-saturating switching circuits.
2N2518 2N2519	34N2 (Improved 2N739) 35N2 (Improved 2N740)	For high voltage linear amplifiers and oscillators with typical Class A operation to 10 Mc. BV_{CEO} : TYPICAL 90V @ 10 mA.
2N2520 2N2521 2N2522	38N2 (Improved 2N758A) 39N2 (Improved 2N759A) 40N2 (Improved 2N760A)	For linear amplifier, oscillator and non-saturating switching circuits. Four point control of h_{FE} parameters.
2N2523 2N2524	41N2 (Improved 2N929) 42N2 (Improved 2N930)	For low-level, low-noise amplifier applications. h_{FE} : 50-80 @ 1 μ A; NF: 2 db @ 10 μ A.

Write for complete technical specifications.

SPERRY

SEMICONDUCTOR

DIVISION OF
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Circle 83 on Inquiry Card

SEMICONDUCTOR INTEGRATED NETWORKS (SEMI-NETS*).
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*Trade Mark, Sperry Rand Corporation

NEW TECH DATA

Illuminated Controls

This full color, illustrated brochure describes illuminated control system and features matrix-modular switches for the monitoring of commercial and military equipment. These illuminated switches are for use on sensing elements, for signaling the condition of equipment in the field or at some distance from the operation control center. Complete mechanical and electrical specs., and illumination characteristics are included. Illuminated Controls, Inc., Riverton, N.J.

Circle 348 on Inquiry Card

Logic Modules

Catalog H-2, 12 pages, 2 colors, details 20Mc H-PACs which can operate at system clock freqs. of dc to 20Mc. Information covers a line of compatible, high-reliability modules, including a 2,000-bit capacity recirculating memory PAC and variable freq. clock PAC. Specs., descriptions, and logic diagrams are included. Computer Control Co., Inc., Old Connecticut Path, Framingham, Mass.

Circle 349 on Inquiry Card

MM Wave Equipment

This 12-page catalog contains complete photos, specs. and dimensional drawings on millimeter wave equipment for the W size, 90 to 140Gc. Devices described include transmission line components, detectors, power absorbing units, horns, tees, freq. meters, phase shifters, shorts, tuners, and accessories. DeMornay-Bonardi Corp., 780 So. Arroyo Pkwy., Pasadena, Calif.

Circle 350 on Inquiry Card

Electrolytic Capacitors

This 51-page, 25th Edition catalog entitled, "Elmenco Capacitors" contains information on molded micas, Dur-Micas, variable compression mica, dipped Mylar™-paper, disc ceramics, precision plastic film type, and Arcolytic capacitors. Photographs, specifications, dimensional data, and characteristic charts are included. Information is also included on Arco kits, facilities and services. Arco Electronics Inc., Community Drive, Great Neck, N. Y.

Circle 351 on Inquiry Card

Resistance Alloys

"The Techalloy Handbook of Electrical Resistance Alloys and Forms," 48 pages, gives data on metals and alloys, with current carrying capacities of straight and helical coiled wire, as well as ribbons and strips. ASTM specs. and a comparison of wire gauges are also included. Techalloy Co., Inc., Rahns, Pa.

Circle 352 on Inquiry Card

Magnetic Heads

This folder contains typical configuration and spec. considerations for magnetic heads. Included are specs. for high-frequency types. International Electro-Magnetics, Inc., P.O. Box 7, North Chicago, Ill.

Circle 353 on Inquiry Card

Microelectronics

Bulletin SR 3099 describes a complete line of silicon nanocircuits and silicon zener diodes, silicon planar epitaxial and germanium transistors and silicon and germanium diodes. Included is comprehensive tech. data, dimensional diagrams, and applications information. General Instrument Corp., Semiconductor Div., 65 Couverneur St., Newark 4, N.J.

Circle 354 on Inquiry Card

Robinson-Patman Act

Two booklets (16 and 17 pages) on the Robinson-Patman Act are available from the Electronic Sales Managers Association, P. O. Box 1, Bellerose, L. I., N. Y.

Circle 355 on Inquiry Card

Delay Line Catalog

This 8-page catalog on magnetostrictive delay lines lists Deltime's entire line of standard delay lines and includes a general description of standard methods of evaluating delay times and drift due to temperature. Complete data is given including schematics of test setups. Deltime Inc., 608 Fayette Ave., Mamaroneck, N. Y.

Circle 356 on Inquiry Card

4-Layer Diodes

"Catalog of Shockley 4-Layer Diodes" includes information on 2 series, a commercial and military line. The commercial line is for use in operating temps. from -40° to 70°C. The Mil-line will operate in extended temp. ranges from -60° to 105°C, and from -60° to 125°C. Included are photographs, dimensional drawings, and comprehensive specs., along with characteristics curves. Shockley Transistor, Unit of Cleveite Corp., 1801 Page Mill Rd., Palo Alto, Calif.

Circle 357 on Inquiry Card

Magnetic-Tape Cleaner

Bulletin E describes the Cybetronics magnet-tape cleaner that handles most common types and widths of magnetic tape used in data processing, instrumentation, and telemetering. The cleaning process is entirely mechanical and requires no chemical solvents. Cybetronics, Inc., 132 Calvary St., Waltham, Mass.

Circle 358 on Inquiry Card

Pulse Transformers

"Genie-H" subminiature pulse transformers have a total volume less than 0.05 cu. in. and are designed for use in circuits requiring high component density. Included are 2 tables listing 44 different transformers and giving individual values for turns ratio, magnetizing inductance, leakage inductance, winding resistance, interwinding capacitance and effective distributed capacitance. A wiring diagram shows the various winding connections available. Technitrol, Inc., 1952 E. Allegheny Ave., Phila. 34, Pa.

Circle 359 on Inquiry Card

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SEMICONDUCTOR DIVISION OF SPERRY RAND CORPORATION

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Avnet Electronics Corporation
70 State Street
Westbury, Long Island, New York
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Milgray Electronics, Inc.
160 Varick Street
New York 13, New York
Telephone: YUKon 9-1600

1023 Vine Street
Philadelphia, Pennsylvania
Telephone: WAlnut 3-2210
Camden — 966-7750

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Film Capacitors

Complete information, including design specs. and operating characteristics is available on Aerovox miniature "wrap and fill" film capacitors. These miniature capacitors feature high insulation resistance and operating temp., and low power factor. Bulletin 142B2.1 is available from Aerovox Corp., 740 Belleville Ave., New Bedford, Mass.

Circle 360 on Inquiry Card

Computer Accessories

Six specification sheets on major G-20 High Speed Computing System accessory items are available from the Computer Div., The Bendix Corp., 5630 Arbor Vitae St., Los Angeles 45, Calif. Items described include a high-speed line printer, magnetic tape module, disc memory, card and printer coupler, control buffer, and data communicator.

Circle 361 on Inquiry Card

Logic Modules

Information is available on analog types—including scanner, signal conditioning cards, Piezo-electric transducer amplifiers, regulated power supplies, buffer and operational amplifiers; hybrid—including ladder networks, switching networks, sample and hold circuits, oscillators (keyed & free running); and digital—including flip-flop, lamp drivers, NAND gate, diode gates, monostables and logic modules. Short Form Catalog is available from Data Technology Corp., Inc., Box 10935, Palo Alto, Calif.

Circle 362 on Inquiry Card

Ferrite Isolators

"Microwave Ferrite Components" 4 pages, illustrated brochure, gives specs. and ordering information on 75 ferrite isolators and circulators including units for operation from 150mc to 70gc. ME-LABS, 3300 Hillview Ave., Stanford Industrial Park, Palo Alto, Calif.

Circle 363 on Inquiry Card

Voltmeters

This 4-page Short Catalog contains information on ac, dc and ac-dc Precision Voltmeters. Accuracy, size weight, readout and price data are included on this line of continuously self-calibrating, all-transistorized voltmeters. Calibration Standards Corp., 1031 Westminster Ave., Alhambra, Calif.

Circle 364 on Inquiry Card

Frequency Standards

Short Form Catalog No. 1000, 8 pages, gives full specs. and descriptions on a line of communications equipment, including, HF and UHF systems, exciters, receivers, amplifiers, stabilization kits, frequency standards, precise oscillators, crystal ovens, multipliers and dividers. Manson Laboratories, Inc., 375 Fairfield Ave., Stamford, Conn.

Circle 365 on Inquiry Card

Switching Transistors

Five bulletins on a new line of epitaxial planar transistors are available from Clevite Transistor, Waltham 54, Mass. Bulletins TB232-1, TB234-1 and TB237-1 give complete data on the 2N706 A and B, 2N708 and 2N914 series designed for computer logic and high freq. circuit uses. Bulletin TB233-1 gives data on the 2N707 series designed for high freq. oscillators, Class C power and high freq. amplifier circuits. Bulletin TBC236-1 gives typical performance curves for all the above series.

Circle 366 on Inquiry Card

Subminiature Connectors

The Micro Module Wafer Pak has a capability of packaging and connecting wafers, with thicknesses as low as 0.005 of an inch, and with 0.10 centers. The Pak features dimensional tolerances. A density of as many as 1500 circuitry wafers in a single row is possible. Key-mox, Inc., 125 So. Baldwin Place, Whittier, Calif. Included are photographs, schematics and outline drawings.

Circle 367 on Inquiry Card

A-D Converters

Navigation Computer Corp., Valley Forge Industrial Park, Norristown, Pa., is offering a 4-page brochure and price list describing the 2200 Series of Analog-to-Digital Converters. These converters have an absolute accuracy of 0.05% from 0° to +50°C. Descriptions of the individual modules, data sheets on the individual modules and block diagrams of a typical converter are included.

Circle 368 on Inquiry Card

Resistor Reliability

Certified Test Reports detailing results of testing conducted on Omtronics series "T" resistors to requirements of Mil-R-26C, is available from Omtronics Mfg., Inc., P.O. Box 1419, Peony Park Sta., Omaha 14, Nebr.

Circle 369 on Inquiry Card

Thermocouple Wire

Bulletin No. TC-2 contains information on platinum-10% rhodium and platinum-13% rhodium thermocouple wire. Information is also included on the care and use of platinum/platinum-rhodium thermocouples and the approximate max. operating temp. of platinum-6%/platinum-30% rhodium. J. Bishop & Co. Platinum Works, Malvern, Pa.

Circle 370 on Inquiry Card

Cooling Fan

Complete tech. information on the Rotron 400cps Saucer Fan is included in a data sheet available from Rotron Mfg. Co., Inc., Woodstock, N. Y. The Saucer Fan offers 310 CFM free air delivery and measures approximately 7 x 2½ in.

Circle 371 on Inquiry Card

NEW TECH DATA

for Engineers.

Oscillators/Amplifiers

Sprague Technical Paper No. 62-10 entitled "Distributed Network Oscillators and Bandpass Amplifiers," covers some recent work on Sprague Ceracircuits. The 14-page paper is divided into 2 main sections: the first dealing with an oscillator and the second describing a bandpass amplifier in which one stage is such an oscillator. Sprague Electric Co., N. Adams, Mass.

Circle 372 on Inquiry Card

Microwave Devices

"Solid State Devices," 7 pages, 3 colors, includes information on 13, 3-port broadband circulators, waveguide and coaxial for L, S, C, X, Ku and Ka bands. Information is also included on solid state oscillators and amplifiers, dc blocks, and solid state switches. Photographs and comprehensive specs. are included. Sylvania Electric Products Inc., Electronic Tube Div., 730 Third Ave., New York 17, N.Y.

Circle 373 on Inquiry Card

High Alumina Ceramic

This tech. data bulletin describes a line of high alumina technical ceramic products and components for the electrical and electronic industries. Bulletin L-7189A is available from Diamonite Products Mfg. Co., Shreve, Ohio.

Circle 374 on Inquiry Card

High Speed Printer

The 500 Series Digital Electronic Alpha Numerical Printer, through the use of fiber optics, is capable of printing 6000 characters/second. This 6-page brochure contains complete specs., description, diagrams, and a block diagram. Hull Instruments, 726 Mission St., So. Pasadena, Calif.

Circle 375 on Inquiry Card

Special Purpose Curves

The Conics Co., P.O. Box 14213, Dallas 34, Tex., is offering information on several "off-the-shelf" sizes of parabolic reflectors and information on facilities for application of special purpose curves based on conic sections, either concave or convex. Also covered are paraboloids and ellipsoids designed for use in sound and ultrasonic systems.

Circle 376 on Inquiry Card

Test Chambers

Catalog 1962 on environmental test chambers, 56 pages, includes illustrations and specs. on Conrad temp., temp.-altitude-humidity chambers in a wide variety of models from portables to walk-ins. Data on chamber instrumentation is also included. Conrad, Inc., 141 Jefferson St., Holland, Mich.

Circle 377 on Inquiry Card

Integrated Chopper

General Engineering Memo #7 entitled "The INCH—Discussion and Application" is available from National Semiconductor Corp., Box 443, Danbury, Conn. The INCH is an integrated chopper designed to operate as a chopper, commutator, demodulator or mixer depending on circuit requirements. Advantages are small size, high stability, low transfer resistance and high speed. Diagrams and charts are included.

Circle 378 on Inquiry Card

Coaxial Connectors

Engineering specs. for a complete line of closed-entry and standard socket, quick-assembly, microminiature coaxial connectors are available from DuTron Corp., 777 W. 17th St., Costa Mesa, Calif. Information includes complete mechanical and electrical specs., cutaway drawing and a list of standard 50, 75 and 96Ω plug, receptacle and adapter configurations.

Circle 379 on Inquiry Card

Ferrite Brochure

"General Information on Ferrites," 8 pages, includes a listing of ferrite products plus a brief description of their prime applications, selectivity guides to aid in the proper selection of materials and components, basic definitions, symbols and formulae. Bulletin 101 is available from Ferroxcube Corp. of America, Saugerties, N. Y.

Circle 380 on Inquiry Card

Stepping Switch Catalog

Chicago Dynamic Industries, Inc., Precision Products Div., 1725 Diversey Blvd., Chicago 14, Ill., is offering tech. information including dimensional drawings and electrical specs. on the Series RS-40-MD (motor or slosyn drive) and Series RS-40-SD (rotary solenoid) 36-pole, 24 or 32 position, rotary stepping switch with removable wafers.

Circle 381 on Inquiry Card

Programming Board

This 8-page brochure entitled "Selecto-board" contains all electrical and mechanical data on the Selecto-board cordless program board. The Selecto-board permits X- and Y-axis connections at the push of a single pin. Accessories permit insertion of diodes or other components at any desired coincident between the 2 axes. Sealectro Corp., 139 Hoyt St., Mamaroneck, N. Y.

Circle 382 on Inquiry Card

Coil Winding

Profile Electronics, Inc., Concord, N. H., is offering a comprehensive brochure illustrating their facilities and product capabilities in the field of custom coil windings.

Circle 383 on Inquiry Card

Relay Catalog

Tech. descriptions of hermetically sealed relays are included in a 20-page catalog available from Babcock Relays, a div. of Babcock Electronics Corp., 3501 W. Harbor Blvd., Costa Mesa, Calif. The 2-color illustrated catalog gives complete reference on all relay series including performance specs., coil resistances and operating characteristics. Dimensions, mounting types and terminal styles are also included. Catalog BR-6200.

Circle 384 on Inquiry Card

Thermal Instrumentation

This Short Form Thermal Instrumentation Catalog, 4 pages, includes data on thermocouples, Asymptotic™ radiometers, Asymptotic™ calorimeters, pyrohelimeters, slope calorimeters and thermal calibration facilities. Hy-Cal Engineering, 12105 Los Nietos Rd., Santa Fe Springs, Calif.

Circle 385 on Inquiry Card

Tantalum Capacitors

"85°C Foil Tantalum Capacitors"—GET 2976, 12 pages, illustrated, describes GE's entire line of 85°C, foil Tantalytic™ capacitors. Information includes applications, electrical characteristics, dimensions, ratings, performance curves, derating factors and life test curves. Units are available from 3 to 150v, 0.25 to 1450μf, and a temp. range of -55° to 85°C. General Electric Co., Schenectady 5, N.Y.

Circle 386 on Inquiry Card

Ovens

The Cenco Series 16 constant temperature ovens are available in 2 basic sizes with a choice of either gravity or forced draft air circulation. Both oven sizes have an operating range of 0 to 200°C, with a uniformity of ±1.5°C or better. These ovens are for constant temp. uses, such as moisture determination, aging, baking, incubation, curing and drying. Cenco Instruments Corp., 6450 W. Cortland St., Chicago 35, Ill.

Circle 387 on Inquiry Card

Pulse Rate Counter

Texas Instruments' application notes for May 1962 describes the operation of a transistorized pulse-rate counter covering from 5cps to 5kc in 3 decade ranges. The meter is also capable of automatically changing scales to provide accurate readings over a range of 3 decades, affording increased resolution. Included is a block diagram, a schematic of the pulse rate counter with automatic scale change, and characteristic curve. Texas Instruments Incorporated, Transistor Products Div., P.O. Box 5012, Dallas 22, Tex.

Circle 388 on Inquiry Card

Strip Chart Recorder

A comprehensive 8-page, die-cut brochure not only shows the actual size (6 x 6 x 8 in.) and shape of this 8 lb. portable null balance strip chart recorder but page-photo sequence enables the engineer to examine the unit internally section by section. Features, specs, and prices are included. Emcee Electronics, Inc., P. O. Box 36, Glenside, Pa.
 Circle 415 on Inquiry Card

High Voltage Rectifier

This 8-page tech. bulletin covers a complete line of double diffused silicon high voltage rectifier molded assemblies to 50kv riv and 18adc. Information includes complete specs. on single phase, half wave; single phase, center tap; single phase, full wave; 3 phase, half wave; 3 phase, full wave bridge; and 6 phase, star type assemblies. Bulletin No. SP 362 is available from Solitron Devices, Inc., 500 Livingston St., Norwood, N. J.
 Circle 416 on Inquiry Card

FM Signal Generator

Tech. data is available on the Model 412 Signal Generator which features a frequency range of 400-500MC (single dial control); freq. accuracy of 0.0003%; freq. stability of 0.0005%/hr; output of 0.1 μ v—Iv (accuracy \pm 1db); and distortion figure of less than 2%. Microdot Inc., 220 Pasadena Ave., So. Pasadena, Calif.
 Circle 417 on Inquiry Card

SCR Power Units

Packaged Silicon Controlled Rectifier power units designed for industrial use are complete with associated rectifiers, heat sinks, interconnections and terminal strips for external connections. Information includes rating correction curves for SCR power units, dimensional drawings, and circuit schematics. Electrologic Corp., 4165 S.W. 11th Terrace, Ft. Lauderdale, Fla.
 Circle 418 on Inquiry Card

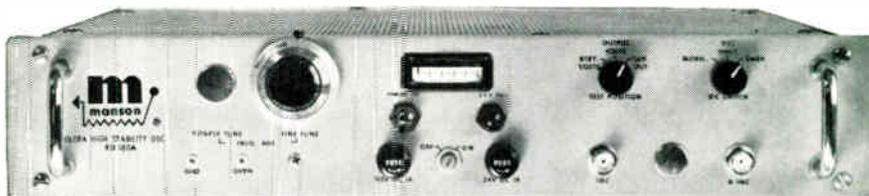
Miniature Computer

An illustrated brochure is available on the MICRO miniaturized computer. Information includes packaging, production and component techniques which emphasize the "off-the-shelf" status of the computer. Typical specs., performance parameters and numerous applications are also described. Arma Div., American Bosch Arma Corp., Garden City, N.Y.
 Circle 419 on Inquiry Card

Iron Core Components

Two 1962-1963 catalogs on iron core components are available from United Transformer Corp., 150 Varick St., New York 13, N. Y. Volume I features 52 pages on transformers, inductors, and magamps. Volume II features 20 pages on electric wave filters, high Q coils and inductors. Lines covered include: pin terminal transistor transformers and inductors for printed circuit use; flat case subminiature transformers and inductors for printed circuit use; and miniaturized low freq. high Q coils. Also included is a condensation and explanation of the applicable Mil specs.
 Circle 420 on Inquiry Card

PRECISE FREQUENCY CONTROL



1 to 2 Parts in 10¹⁰/Day Stability

The RD-180A Transistorized Frequency Standard.
 Available for immediate delivery.

Priced at **\$2400.**

1 to 2 parts in 10¹⁰/day frequency stability — just one indication of the performance that makes the RD-180A the most advanced crystal frequency standard available today.

Built to MIL-E-16400D, the RD-180A is ideally suited to systems applications. It has been specified as the timing base of the Pacific Missile Range and proven in satellite tracking, doppler navigation, and numerous other communications, navigation, and lab applications.

Features include self-contained power supply and integral standby battery pack, incorporating an instantaneous, automatic switchover system with no loss of stability in the event of line failure. It is reliable, rugged and compact, being fully transistorized and equipped for rack mounting. Shock mounts are available for bench or airborne applications.

The RD-180A is ready to solve your frequency standard problem now — available for immediate delivery — \$2400, complete with power supply. Manson welcomes the opportunity to quote this unit for systems applications.

Write or phone for detailed engineering data sheet.

SPECIFICATIONS

- Output Frequencies 100 Kc, and 1 Mc (5 Mc optional)
- Output Levels 0.75 v rms (+50/-10%)
- Output Impedance 50 ohms
- Ambient Temperature Range 0°C to +50°C
- Ambient Humidity Range 0 to 95% RH
- Frequency Stability:
 - 1. Aging 1 to 2 parts in 10¹⁰ per day after 6 months continuous operation
 - 2. 25°C Ambient \pm 25°C Less than 5 parts in 10¹⁰
 - 3. \pm 20% Change in 50-ohm load within one part in 10¹⁰
- Input Voltage Requirement 115 vac \pm 10%, 50-400 cps
- Battery Operating Time:
 - 1. Under full operation 35 hours
 - 2. Oven operation only 250 hours
- Over-all Dimensions 17½" wide x 16" deep x 3½" high
- Weight 38 lbs. (including batteries)

MANSON LABORATORIES, INCORPORATED

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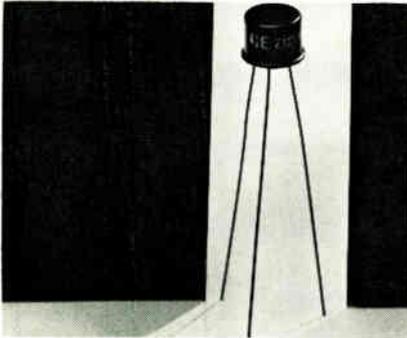


NEW PRODUCTS

...for the Electronic Industries

GATE TURN-OFF SWITCH

This 3-terminal pnpn power switch can block up to 400vdc.

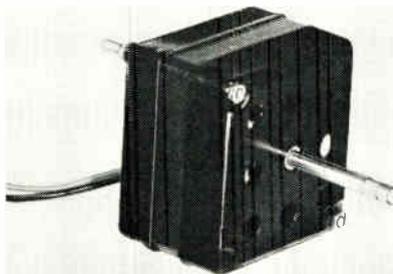


The ZJ224 can be turned "off" as well as "on" by means of its gate control terminal. Typical switching time "on" or "off" is $1\mu\text{sec}$. The unit is for use in low power inverter circuits, power flip flop circuits, high speed solenoid and relay drivers, saw tooth generators, oscillators and ring counters. The "L" and "H" (gate turn-off of 1 or 2a) series of the ZJ224 are each available in voltage grades from 25v to 400v. General Electric Co., Rectifier Components Dept., W. Genesee St., Auburn, N.Y.

Circle 291 on Inquiry Card

SHADED POLE MOTORS

Series of 2 and 4-pole units cover 1/1000 to 1/40 HP range.

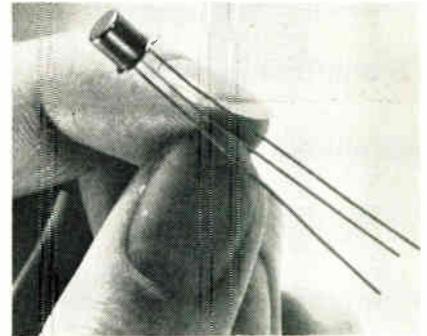


Type A motor is a $2\frac{5}{8}$ square center shaft motor of the inserted coil type. Type 2A 2-pole motor available in 1/1000 to 1/40 HP range. The 4-pole version is available in type 4A, a 2 coil consequent pole motor, or type 44A, a 4-coil motor for use where magnetic leakage is a problem. The motors use a small dia., low inertia, rotor that runs quietly. Rotor resistance options for high starting or high running torques are available. Uppco, Inc., 900 So. Desplains St., Chicago 7, Ill.

Circle 293 on Inquiry Card

SWITCHING TRANSISTORS

For use in computers and high frequency amplifiers.

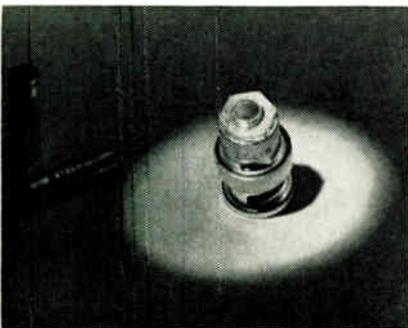


NPN Silicon Planar Epitaxial Switching Transistors are hermetically sealed in an inert Helium atmosphere. All units are stabilized at 300°C for 100 hrs. and power aging is at or beyond rated dissipation. Units include 2N706 A and B, 2N708, and 2N914 series designed for fast switching applications in computer logic circuits and high freq. amplifiers. The 2N707 series are designed for high freq. oscillators, Class C power and high freq. amplifier circuits. Clevite Transistor, Waltham 54, Mass.

Circle 295 on Inquiry Card

LASER DEMODULATOR

Solid state photomixer diode capable of demodulating laser outputs.

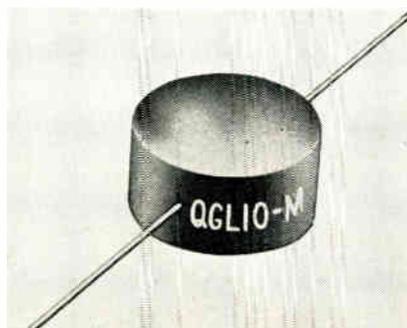


The L-4500, silicon planar epitaxial diode, detects the difference freq. between 2 closely spaced optical laser freqs. It provides high quantum efficiency and operates for all bandwidths up to 5gc. Capable of detecting 1 photon/sec. in a 1-cycle bandpass. At 7000\AA (angstroms), quantum efficiency is estimated to be 65% min.; 85% typical. It is packaged in a coaxial microwave housing similar to conventional K-band mixer crystals. Special Products Operation, Lansdale Div., Philco Corp., Lansdale, Pa.

Circle 292 on Inquiry Card

TOROIDAL INDUCTORS

For miniaturized missile-type uses from 1 to 100kc.



The QGL and QGM series provides a combination of small size and high "Q" in freq. range from 1 to 100kc. QGL Series available on special order with stabilized cores and specific inductance values from 1.0 mh to 4.0 h. QGM Series available to 500 mh on special order. Available in either microcrystalline wax dipped construction or molded in epoxy resin. Molded units are supplied with 0.020×2 in. gold plated nickel alloy leads. Microtran Co., Inc., 145 E. Mincola Ave., Valley Stream, N.Y.

Circle 294 on Inquiry Card

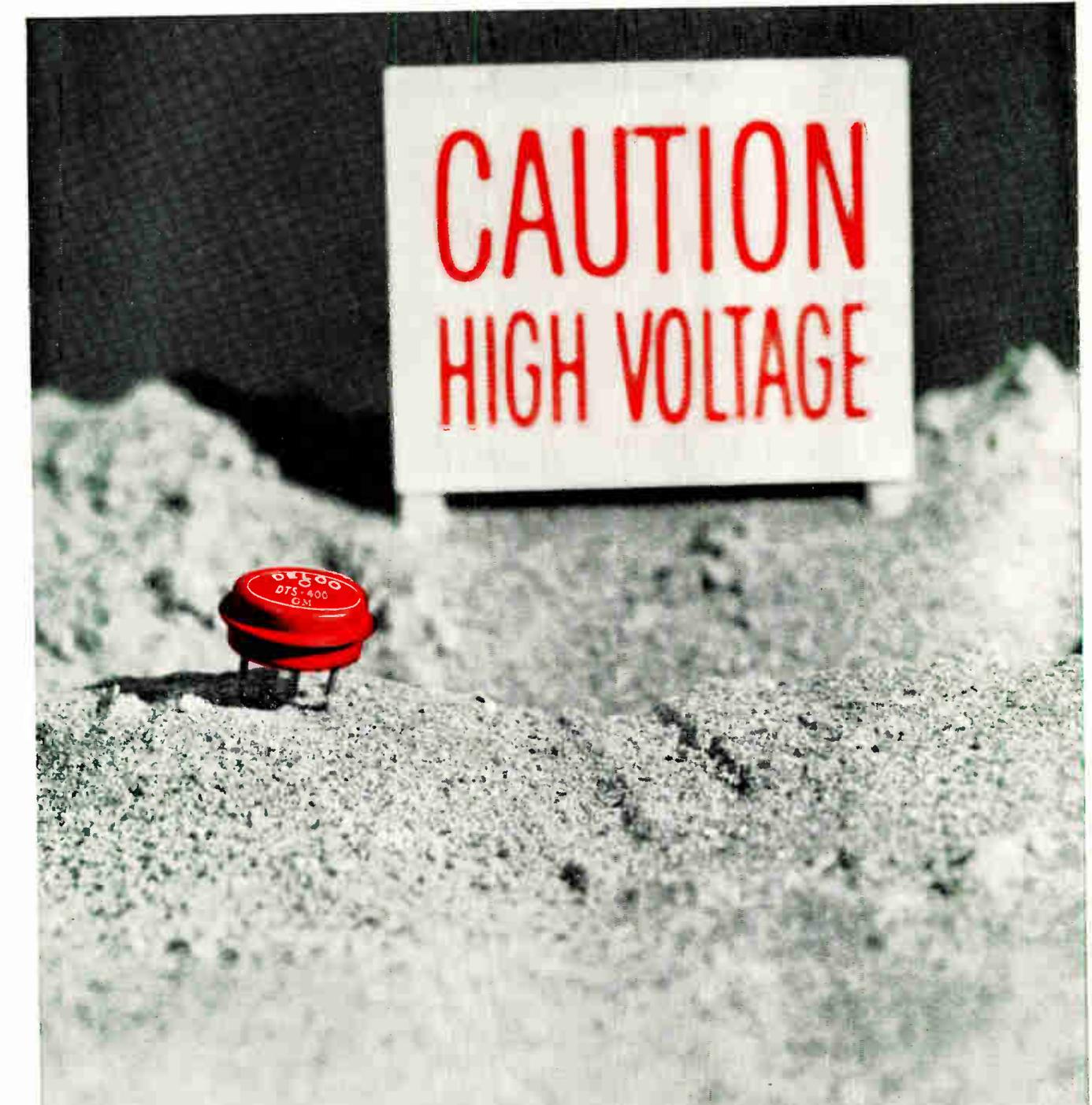
TRANSISTOR SOCKET

Teflon "Press-Fit" socket accepts dual npn silicon planar transistors.



Also accepts other semiconductors using the same 6-pin configuration. Lugs are made of brass, gold flash over silver plate, and are double turreted to accommodate transistor leads and associated circuitry. A seventh hole is for positioning the component. Minor diameter of Teflon body is 0.465 in.; shoulder measures 0.495 in. in diameter. RTC-650-T transistor socket available in white, or any of the standard EIA color codings. Sealectro Corp., 139 Hoyt St., Mamaroneck, N.Y.

Circle 296 on Inquiry Card



CAUTION
HIGH VOLTAGE



This is the new DTS-400 from Delco Radio . . . one of the highest voltage silicon power transistors available. The DTS-400 offers V_{ce0} , V_{cbo} and V_{ces} of 400 volts. Because of its high voltage capabilities and its ability to withstand high temperatures, this transistor offers a significant advancement in the art of power conversion.

The Delco DTS-400's capabilities make possible "direct to line" voltage hook-ups eliminating the need for transformers or other devices in between . . . and their related space and weight requirements. Production samples of the new DTS-400 silicon power transistor are available now to help you reduce the size, weight and cost of your power package. For complete engineering data, write or call our nearest sales office.

Union, New Jersey
324 Chestnut Street
MURdock 7-3770
AREA CODE 201

Detroit, Michigan
57 Harper Avenue
TRinity 3-6560
AREA CODE 313

Santa Monica, California
726 Santa Monica Blvd.
UPton 0-8807
AREA CODE 213

Syracuse, New York
1054 James Street
GRanite 2-2668
AREA CODE 315

Chicago, Illinois
5150 N. Harlem Ave.
775-5411
AREA CODE 312

DELCO
DEPENDABILITY
RADIO
RELIABILITY

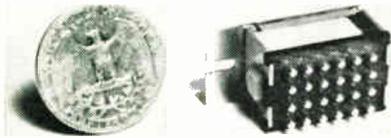
General Sales Office: 700 E. Firmin, Kokomo, Ind., Gladstone 2-8211—Ext. 500 • Area Code 317 • Division of General Motors, Kokomo, Ind.

NEW PRODUCTS

...for the Electronic Industries

BALL CONTACT PUSH SWITCH

This 8-C male-4 ball contact push switch has an 8PDT throw factor.

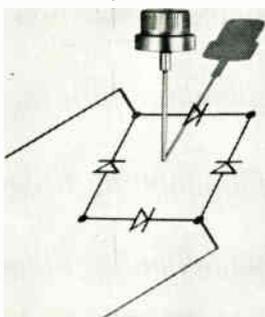


It has self-cleaning ball or roller contacts giving an infinite contact surface variation for long life and high current capacities in minimum of space. Approximately 16 oz. of actuating pressure change 16 circuits in the switch. For use in telephone equipment, instruments, computers, intercoms, paging systems, printed circuit plug-ins, and as a timed sequence switch. Chicago Switch Div., F & F Enterprises, Inc., 1733 Milwaukee Ave., Chicago 47, Ill.

Circle 297 on Inquiry Card

SILICON RECTIFIER

In press-fit case has 25a I_F at 175°C and PRV up to 600v.



This 25a diffused junction silicon rectifier operates at temps. up to 175°C with a PRV rating from 50 to 600v. For power supply applications, the press-fit case has a knurled base allowing insertion into a heat sink mounting hole by automatic production equipment. PRV trans. ranges from 100 to 800v. The I_R is scaled from 5.0ma at 50PRV to 2.0ma at 600PRV, and max. V_F at 25°C is 1.2v. The I_{SUR} at 150°C is 400a, and max. R_T , junction to case, is 1.2°C/w. Tung-Sol Electric Inc., 1 Summer Ave., Newark 4, N.J.

Circle 298 on Inquiry Card

MINIATURE ACCELEROMETER

Self-generating, high capacity unit measures vibration directly.

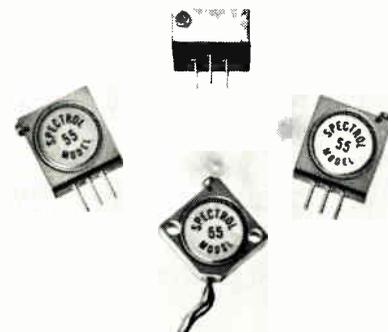


Model 5D41 maintains rated performance, without recalibration, under severe conditions of vibration. Capacitance is 9000pf. Dimensions are 0.71 x 0.620 in.; weight is 1 oz. With axial sensitivity of 6mv peak/g, peak, lateral sensitivity is 3% or less of axial sensitivity. Amplitude of linearity is $\pm 1\%$. Dynamic range is to 10,000g. Resonant freq. is at 30kc, with a freq. response of $\pm 5\%$ from 1cps to 6kc. Clevite Electronic Components, 232 Forbes Rd., Bedford, Ohio.

Circle 299 on Inquiry Card

TRIMMING POTENTIOMETERS

Model 55 is available in 4 different terminal configurations.

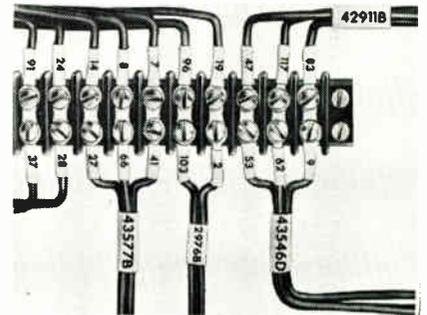


This line of square trimming potentiometers measures $\frac{1}{2}$ in. sq. x $\frac{3}{16}$ in. Configurations are: insulated leads 4 in. long; PC pins 90° and 180° from shaft; and PC pins from base. They are of humidity proof construction to Mil-STD-202A, Method 104, Condition A and Mil-E-5272C, Procedure I. The 42-turn units are available in ranges from 50 to 50k Ω , weigh 2 grams and are rated at 1w at 50°C. Spectrol Electronics Corp., 1704 S. Del Mar Ave., San Gabriel, Calif.

Circle 300 on Inquiry Card

PLASTIC SLEEVES

Designed for wire identification and insulation.

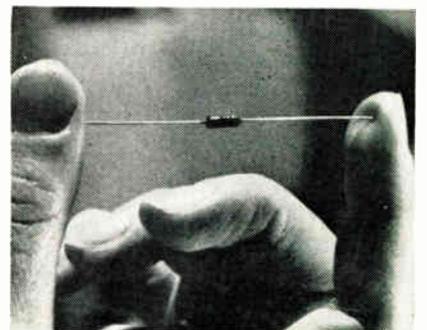


Perma-Code pre-cut, printed plastic sleeves are available in 10 sizes, #16 through $\frac{3}{8}$ inch diameter. Sleeves are printed on 2 sides with bold numbers 1 through 127. The sleeves are high quality polyvinyl chloride tubing. They are made to meet Mil-I-631C and other military and industry specifications. They are flame resistant, and will withstand constant temperatures up to 105°C (221°F). W. H. Brady Co., Dept. 746, 726 Glendale Ave., Milwaukee 9, Wisc.

Circle 301 on Inquiry Card

SWITCHING DIODE

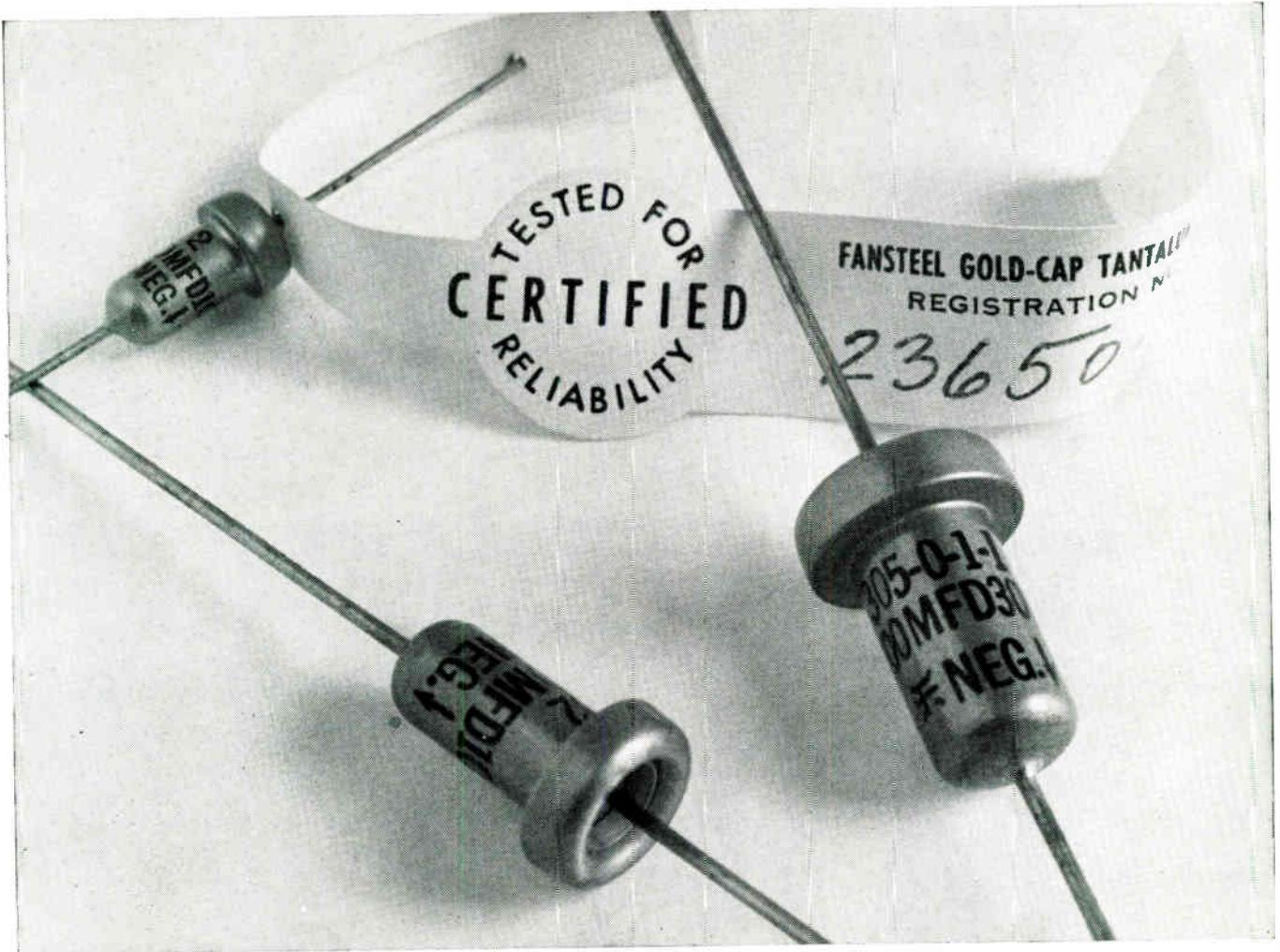
The 1N3729 has 600v breakdown with recovery of 0.5 μ sec to 80k Ω .



Designed for high-voltage, high-freq. miniaturized power supplies, the device is available in "stick" subassemblies of up to 30,000v. Max. ratings at 25°C include: working voltage of 500v; peak rectified current of 320ma; current pulse of 1000ma at 2 μ sec.; 1% duty cycle; and a power dissipation of 250mw. Other specs.: forward voltage drop of 1v at 5ma; reverse current of 0.1 μ a at 25°C and 5.0 μ a at 100°C; and a capacitance of 3.0pf. Raytheon Co., Semiconductor Div., 900 Chelmsford St., Lowell, Mass.

Circle 302 on Inquiry Card

You may not need capacitors as good as these



Fansteel GOLD-CAP® tantalum capacitors satisfy a very particular need for extremely high reliability. Your design may not justify their extra cost. If so, Fansteel makes and stocks twelve other types of tantalum capacitors that will surely fill the bill. Gold-Caps are produced under Fansteel Spec. No. 6CA-101 which exceeds the requirements of any Mil. Spec. The stability of each and every unit is tested at temperature extremes for Capacitance, D-C Leakage, E S R, and Impedance. Altogether, 7,891 readings, calculations, examinations, and comparisons are made for every 100 units by Fansteel's tough Reliability Center with the aid of modern computers. When a capacitor is given a GOLD-CAP tag, individually serialized, and provided with certified test results, it has *earned* it. No, we can't be positive that these are the best tantalum capacitors in the world, but

we have no reason to think that they aren't. Send for GOLD-CAP Spec. No. 6CA-101 and see what we mean. Rectifier-Capacitor Division, Fansteel Metallurgical Corporation, North Chicago, Ill.

This is what you get—certified test data, such as illustrated, is furnished with each and every GOLD-CAP capacitor. Further inspecting or testing is unnecessary.

CAPACITOR NO.	TEST NO.	TEMP. °C	C	DF %	DC LKG.	% INITIAL C
23650-0012	1	+25	54.0	4.8	.80	
23650-0012	2	-55	47.0	18.6	.20	87.0
23650-0012	3	+25	54.0	4.8	.80	100.0
23650-0012	4	+125	56.0	4.6	2.40	108.7
23650-0012	5	+25	53.3	4.8	.80	98.7

NEW PRODUCTS

...for the Electronic Industries

RFI MEASURING EQUIPMENT

The Model NM-22A operates from 150kc to 32mc.

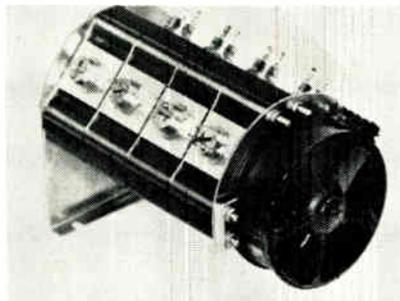


It has built-in capability for data and spectrum signature recording. Both a superheterodyne receiver and a calibrated freq. selective microvoltmeter, the NM-22A features constant gain over the freq. range; 2 selectable 6db bandwidths (3 and 10kc) and analog voltage outputs for freq. vs. amplitude recording. Sensitivity is rated up to $0.1\mu\text{v}$ and measurement range is 140db. Stoddard Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif.

Circle 303 on Inquiry Card

MODULAR PACKAGED COOLER

This Semiconductor Cooler is available with up to 32 stations.

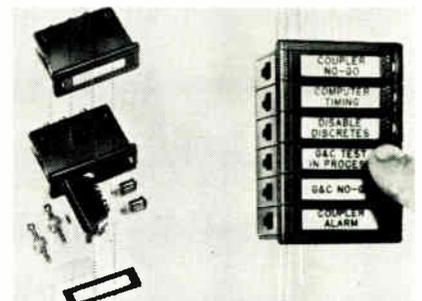


Modular packaged unit with up to 32 stations, also comes with a 400cps or dc Mil spec. blower. Packages can be made for prompt delivery to include various individual coolers with thermal resistances ranging between 0.3 and 1.0 C/W/semiconductor. Full use of air flow is obtained. Electrically isolated quadrants allow wide design latitude. Available for both shelf and stud mounted semiconductors. Wakefield Engineering, Inc., Wakefield, Mass.

Circle 305 on Inquiry Card

INDICATOR LIGHT

Missilite 400 Series provides individual self-contained units.



The modular lights screw together, facilitating servicing, replacement and re-arrangement in the field. The design eliminates the necessity of replacing a complete group of lights where only 1 light is to be changed. The Missilite 400 Series conforms to the applicable environmental and operational requirements of Mil-E-5272, Mil-T-5422 and Mil-L-3661A. Units can be supplied in an r-f shielded assembly. Marco Industries Co., 2075 S. Helena St., Anaheim, Calif.

Circle 307 on Inquiry Card

RUGGEDIZED PILOT LIGHT

Available in 6, 12, 24, 28 and 48 volt types.

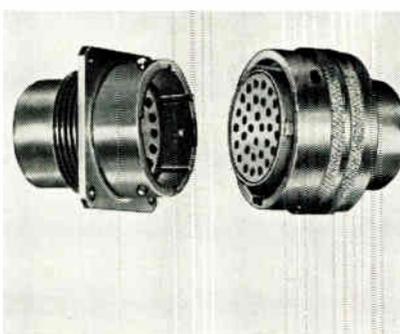


Lamps exceed Associated Testing Laboratories' specs. for aircraft, missile borne, shipboard storage and transport, and ground equipment low voltage signaling devices. The unit includes a pilot lamp housing of rugged general purpose phenolic, $\frac{1}{4}$ inch shorter than similar units, offering a saving of space. All metals used in the housing are nickel-plated to meet military specifications for dissimilar metals. Sylvania Electric Products, Inc., Lighting Products Div., Salem, Mass.

Circle 304 on Inquiry Card

CONNECTORS

Pygmy Connectors, PT-SE series, mate with a wide range of connectors.

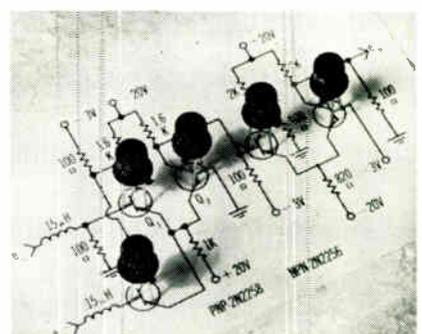


Electrical connectors providing inter-mateability with existing specification Mil-C-26482 connectors, plus military standard crimp contact geometry, are offered. They feature complete inter-mateability with PT and SP solder type, CE crimp type, and Mil-C-26482 connectors. Design features eliminate wiring diagram changes, retain solder option, and provide contacts compatible with military standardized application tooling. Scintilla Div., The Bendix Corp., Sidney, N. Y.

Circle 306 on Inquiry Card

SWITCHING TRANSISTORS

For computer logic and other pulse circuits.



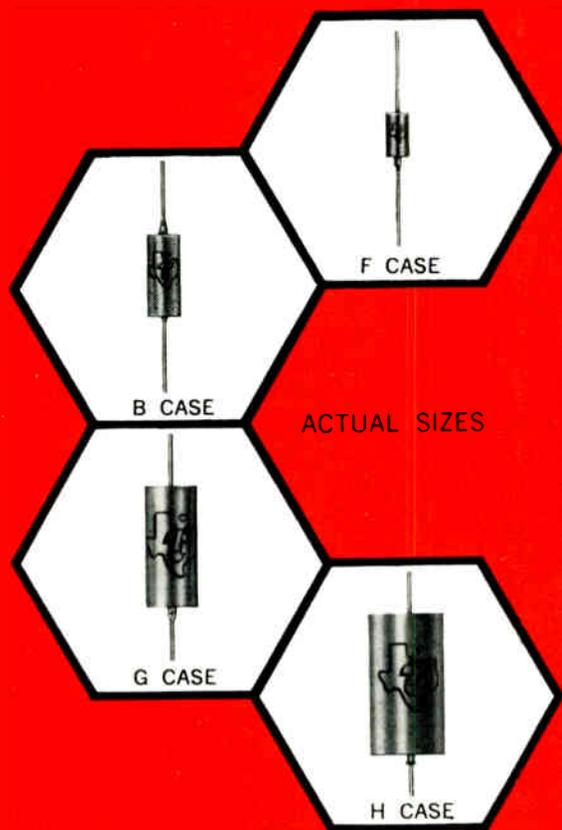
Two pairs of low-cost complementary pnp and npn mesa transistors are for high-speed current-mode switching (non-saturating) uses. Types 2N2256-2N2259, feature typical gain-bandwidth products of 320mc, with turn-on turn-off times on the order of 3 to 4nsec. Two transistors, with current gains (H_{FE} at 25ma) of 20 and 40 respectively, available in both silicon npn and germanium pnp series. Motorola Semiconductor Products Inc., Dept. CML, 5005 McDowell Rd., Phoenix 8, Ariz.

Circle 308 on Inquiry Card



tan-TI-cap[®]

MIL-C-26655A/2B



SOLID TANTALUM ELECTROLYTIC CAPACITORS

Meet or exceed the electrical and mechanical specifications of MIL-C-26655A/2B. Now available from Texas Instruments . . . all capacitance values from 0.33 μf to 330 μf , 6–35V $\pm 10\%$ and $\pm 20\%$, styles CS12 and CS13. Send for chart showing catalog numbers and ratings.

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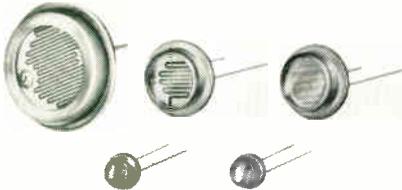
Circle 75 on Inquiry Card
World Radio History

NEW PRODUCTS

...for the Electronic Industries

CdS PHOTOCELLS

Hermetically sealed in rugged head-on metal enclosures.



Fifteen photocell types are available in 3 case styles which have body diameters of 1.1 inch, 0.5 inch, and 0.25 inch respectively. A wide range of resistance values is provided with some types having extremely low resistance at moderate light levels for transistor circuit operation. Metal cases permit high dissipation in small unit volume. National Semiconductors Ltd., 230 Authier St., Montreal 9, Quebec, Canada.

Circle 309 on Inquiry Card

FREQUENCY STANDARD

Designed for alignment of 2-way radio networks.

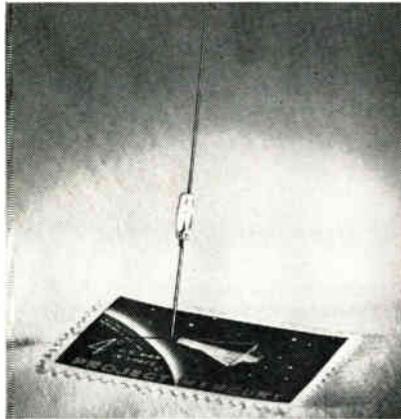


The model SC0101 Frequency Standard is a light-weight, self-powered, accurate instrument for the adjustment of transmitting and receiving equipment. The battery-powered instrument operates at any of 10 preselected frequencies from 10mc to 480mc, and at temperatures from -22° to $+104^{\circ}$ F. The model SC0101 weighs 2.6 lbs. and measures $7\frac{3}{4} \times 4 \times 4\frac{1}{2}$ in. Although primarily designed for portable use, it is also for laboratory applications. Stancor Electronics, Inc., 3501 W. Addison Ave., Chicago, Ill.

Circle 310 on Inquiry Card

LIGHT ACTUATED SWITCH

For direct switching of controlled rectifiers, relays, and solenoids.



This subminiature silicon light actuated pnpn switch may be triggered by 100 to 500 footcandles of light. The glass-packaged 4-layer unit features complete input insulation, and can be used in data processing readout systems, power control systems and teaching machines. Ratings include blocking voltages from 10 to 400v and currents from 5 to 250ma (dependent on degree of light sensitivity required). International Rectifier Corp., 233 Kansas St., El Segundo, Calif.

Circle 311 on Inquiry Card

PARAMETRIC AMPLIFIER

Model 514 has an input resistance of 20,000 megs shunted by 3pf.

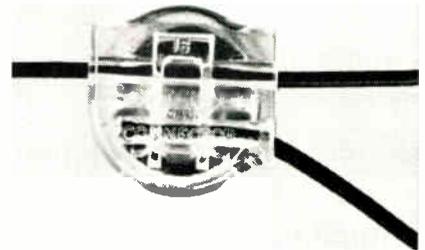


Solid state amplifier has a bandwidth of 3cps to 300kc. Broad-band noise is under $100\mu\text{v}$ with open input terminals. Model 514A has unity voltage gain. Its output impedance is $2\text{k}\Omega$; adjustable phase shift 0° to 180° ; detectable signal power is 10^{-15}w . Denro Lab., 2801 15th St., N.W., Washington 9, D. C.

Circle 312 on Inquiry Card

TAP-SPLICING CONNECTOR

Self-stripping/insulating for multi-conductor communications cable.

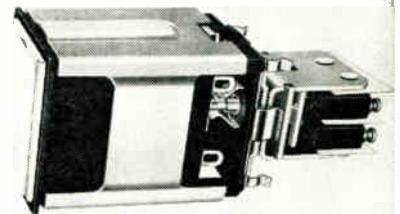


The "Scotchlok" brand electrical connector, Type UG, eliminates wire stripping, twisting and soldering when making splices. Cable conductors can be tapped without being cut, reducing cable slack needed, and eliminating the "piecing-out" procedure. The connector makes and insulates any 2 wire combination of No. 19-26 AWG solid or No. 20 to 26 AWG stranded wire. The splice is mechanically and functionally equivalent to a twist and solder joint. Dept. W2-278, Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 1, Minn.

Circle 313 on Inquiry Card

SWITHLITE

Unit is front relamping, front mounting, M-Series, switlites.



Includes: 4 independent MS flange base lamps with silicon rubber color filters; common ground lamp circuit for independent or multiple lamp lighting; and translucent white button which lights up completely or in colored quarters or vertical or horizontal halves. Mount without hardware from the front of any panel 0.020 to 0.250 thick. Snap-on switch modules in 2pdt or 4pdt have momentary, alternate or solenoid-held action. Controls Co. of America, Control Switch Div., 1420 Delmar Dr., Folcroft, Pa.

Circle 314 on Inquiry Card

THUMBWHEEL SWITCHES

TABET U.S. Patent 2,841,660

Binary & Digital. Meet MIL-S-22710



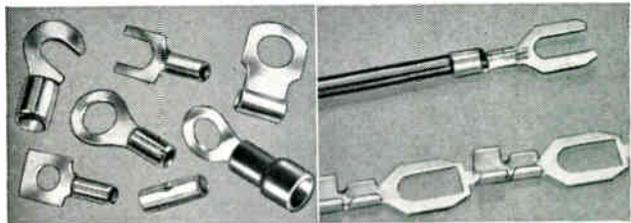
- For Critical Reliability Applications.
- Available with internal lighting MIL-L-25467A.

 <p>Permanent wafer type, Series TSD-P. Only 1/2" panel space needed per module. Also available in multi-deck series TM.</p>	 <p>Removable wafer type, Series TSD-R. For continuous operation applications where interruptions must be held to an absolute minimum.</p>
 <p>Permanent wafer type, Series TSB-P. Available in 8, 10, 12 or 16 positions, up to 36 switches per assembly.</p>	 <p>Removable wafer type, Series TSB-R. For applications where maintenance time is valuable and rapid servicing a necessity.</p>

CHICAGO DYNAMIC INDUSTRIES, Inc.
 PRECISION PRODUCTS DIVISION
 1725 Diversy Blvd., Chicago 14, Illinois
 Phone: WEllington 5-4600

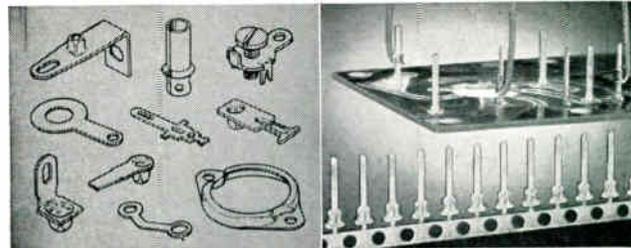
Circle 89 on Inquiry Card

Malco Widest Selection Of Electronic Hardware



Solderless Terminals

Spade and Ring Terminals



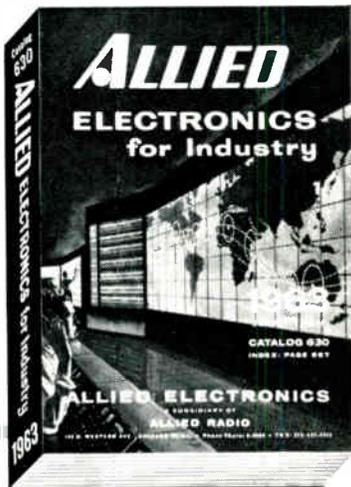
Lugs and Terminals

Wrap-a-Wire Terminals

- High-production techniques afford lowest possible cost
- Ample stocks assure fast delivery

Request Bulletin No. 612.
 Send b/p or specs. for quotation

Malco MANUFACTURING COMPANY
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Circle 90 on Inquiry Card

THIS 5 TON OBI PRESS-RITE CAN SAVE YOU BIG MONEY!



In fast production, with 50% less die wear, low operating costs.

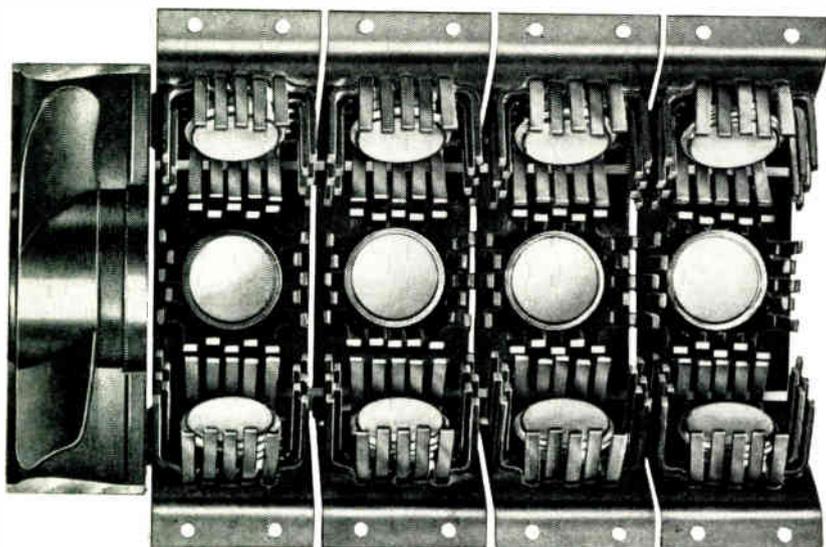
In features. Large press extras like exclusive dual spring clutch and special "C" frame design . . . at no extra cost.

For the full money-saving details write . . .

HAVIR MANUFACTURING CO.
 436 Cleveland Ave. • St. Paul, Minnesota
 Circle 92 on Inquiry Card

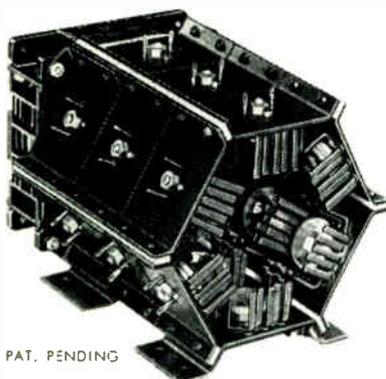


REVEALED...



NEW FORCED AIR SEMICONDUCTOR COOLER

IERC's Staggered Finger Design of the F-600 Gives These Advanced Features:



PAT. PENDING

- MORE WATTS PER POUND
- MORE EFFECTIVE USE OF FAN OUTPUT
- EFFICIENT WITH MOST AVAILABLE FAN TYPES
- MODULAR CONSTRUCTION
- ELECTRICALLY COMMON OR ISOLATED MODULES
- EASY COMPONENT ACCESSIBILITY

One of the major advancements in convector design introduced by IERC has been the staggered finger configuration. Intentionally induced air flow turbulence and increased convection rate of this design gives more effective use of fan output and greatly reduces mass requirements. As a result, the F-600 is superior in cooling efficiency, yet 50% lighter than comparable assemblies.

We invite your evaluation of the new F-600. Let us send you test results and complete technical data. Write on company letterhead to:

IERC DIVISION

transistor heat-dissipating devices

INTERNATIONAL ELECTRONIC RESEARCH CORPORATION

135 West Magnolia Boulevard, Burbank, California • Victoria 9-2481

Foreign Manufacturers: Europelec, Paris, France. Garrard Mfg. & Eng. Co., Ltd., Swindon, England

NEW PRODUCTS

TRANSISTORIZED RELAY

Highly sensitive, all transistorized unit for long rugged service.

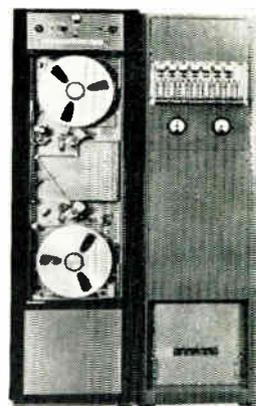


Model TL-1500 is a laboratory relay rated at 1500w at 110v. It features an external reversing switch with a positive safety lock. It measures 4 x 5 x 4 inches. Model TL-1500 is also equipped with neon indicating lights which show relay position. Lightweight lab unit has 2 outlets—one for controlled load; the other for convenience. An industrial model, TI-1500 is also offered, rated: 1500w at 110v; 6½ x 5 x 2 in. Max. operating temp. is 134°F. Delpark Electronics, Inc., 1113½ Morton Ave., Chester, Pa.

Circle 255 on Inquiry Card

RECORDER/REPRODUCER

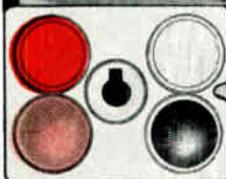
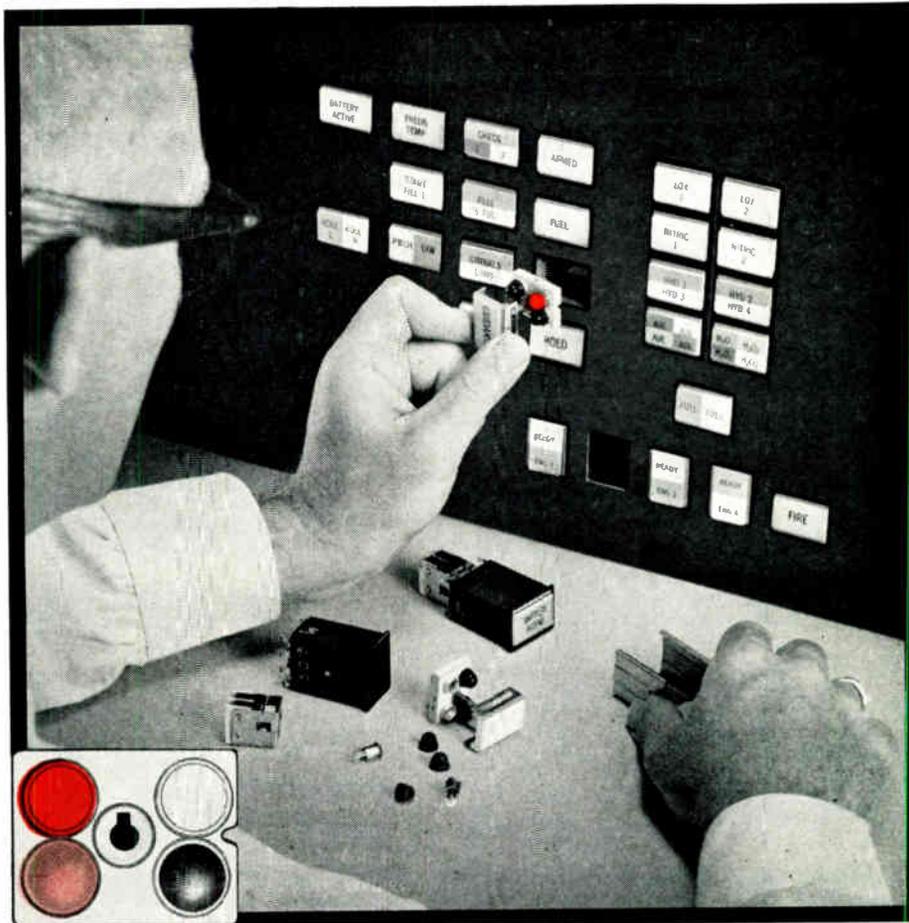
Tape instrumentation designed with time delay.



This magnetic tape recorder/reproducer, 480 Series, is housed in 2 standard 19 in. rack cabinets. It provides a fixed or continuously variable time delay between record and reproduce or between 2 reproduce operations on a pre-recorded tape. The desired delay (up to 30 sec. at 60 ips) can be set by timers located on the second cabinet or by the data itself. Model 481—100cps to 100kc Direct and 0 to 10kc FM, and Model 482—250cps to 250kc Direct and 0-20kc FM. Electronic Systems Div., Sangamo Electric Co., Springfield, Ill.

Circle 256 on Inquiry Card

New **M-series** Switchlite Displays 4 Colors at Once...

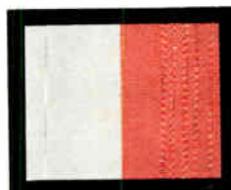


4 independent lamps...choice of 5 colors...and 8 button styles gives unlimited indication flexibility

Horizontal split, dual lamp reliability per segment



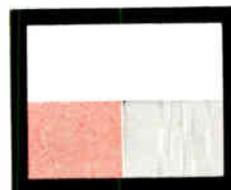
Vertical split, two-lamp brilliance per segment



4 different color indications on 1 button



"T" split, either side, horizontal or vertical



Total button illuminated—pair lamps for color change



Indicating Versatility—Just One Feature That Makes New Switchlite Unique!

M-Series Switchlite gives you any kind of display you need! 4 independent lamps with common ground lamp circuit . . . buttons with 8 styles of legend area . . . choice of 5 colors give unlimited flexibility. Silicon rubber color filters replace without removing lamps.

Switching Versatility—6 different switch modules snap on without disturbing panel mounting. Pick from 2PDT or 4PDT switches with momentary alternate, or solenoid-held action. Switch module omitted for indicator light use only.

Idiot-Proof Design—so simple, you can't make a mistake . . . all parts are keyed, even legend plate and lamp module. 4-lamp Switchlites relamp and mount from front . . . fit into single horizontal or vertical cut-out. No hardware, no screws, no barriers. Individually or matrix-mounted in any pattern.

All standard M-Series models available right now from your Control Switch Division distributor. Get the full story on new Switchlite. Write for new M-Series technical catalog.

CONTROLS COMPANY OF AMERICA
CONTROL SWITCH DIVISION

1420 Delmar Drive, Folcroft, Pennsylvania
Telephone: LUdlow 6-7500 • TWX: 215-534-0241

NEW FLEXIBLE PERMANENT SEALANT



- seal metal joints, sheet work
- seal leaks
- insulate wiring and terminals
- use as adhesive for pre-fabricated silicone rubber

For a thousand jobs, just squeeze it on and it's on to stay! No pre-mixing or priming. RTV-102 silicone rubber adheres to almost anything — glass, metal, plastics, tile, wood, silicone rubber. Sets in minutes, cures in a few hours, forms a resilient rubber that never dries out, cakes or cracks. Resists moisture, grease, weathering, many chemicals, and temperatures from -75°F to 500°F .

RTV-102 won't sag on vertical surfaces, can be smoothed over large areas, "gives" with vibration and flexing. For free evaluation sample plus technical data, write on your letterhead describing your application to Section 00970, Silicone Products Department, General Electric Company, Waterford, N.Y.

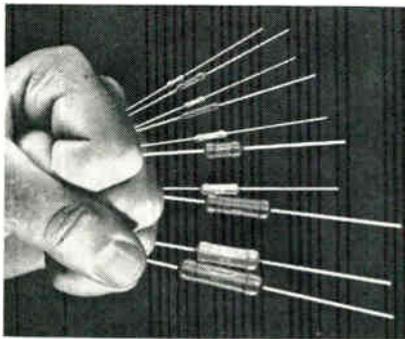
GENERAL ELECTRIC

Circle 93 on Inquiry Card

NEW PRODUCTS

MINIATURE RESISTORS

Wire wound, silicone coated units offer very high power rating/size.

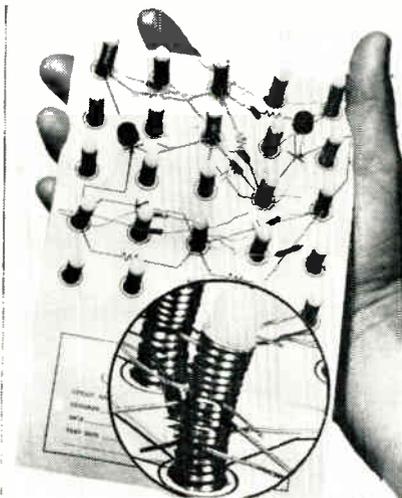


The "C" type resistors are presently available in 5 sizes: 1, 1.5, 2.25, 4 and 7w in values ranging from 10Ω to $60k\Omega$, depending on size and tolerance. Available tolerances are: 0.05%, 0.1%, 0.25%, 0.5%, 1% and 3%. The "G" series resistors (upper five) are shown above in comparison with RS resistors of comparable wattage. All "G" Type resistors are provided with gold flash copper terminations. Dale Electronics, Inc., P.O. Box 488, Columbus, Nebr.

Circle 251 on Inquiry Card

CIRCUIT BREADBOARD

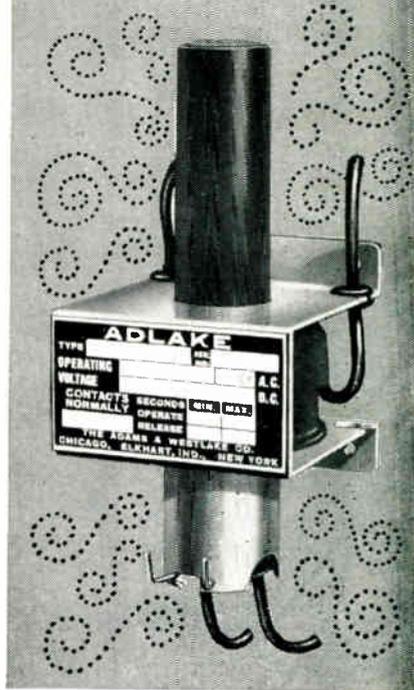
Low-cost device eliminates soldering in making trial circuits.



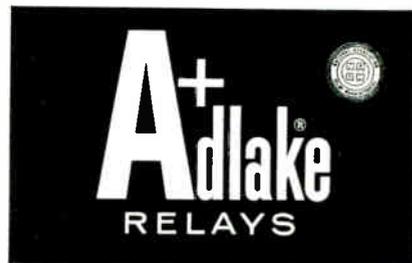
Known as the "Springboard," it provides 25 individual spring connectors, each of which can act as a common terminal for as many as 6 different components. Strong, square-wire coil springs ensure positive electrical contact, regardless of variations in gauge of component leads. Trial circuits are first laid out in pencil on circuit planner sheets furnished with each unit. These sheets are plucked to fit over the coil springs. Plastonics, Box 2053, Santa Monica, Calif.

Circle 252 on Inquiry Card

THIS RELAY OPERATES PERFECTLY SMOTHERED IN DUST!



An Adlake mercury relay functions perfectly—even when smothered in dust, dirt, or other impurities. Neither gas nor organic material can penetrate its seal. Inside, mercury-to-mercury contact takes place in a pure, non-oxidizing atmosphere. This liquid contact completely eliminates failures caused by low contact pressure, contact burning, pitting and sticking. Provides a new, clean contacting surface for each operation. No wonder Adlake mercury relays stand up in "dirty situations" where mechanical relays clog and fail. Adlake has the most complete selection of mercury displacement and mercury wetted contact relays in the industry. For complete information contact your Adlake representative, or Adlake direct.



THE ADAMS & WESTLAKE COMPANY
Dept. M-8809 Relay Division, Elkhart, Indiana
Phone 219 CONGRESS 4-1141
Circle 94 on Inquiry Card

NEW PRODUCTS

DEFLECTION AMPLIFIER

Transistorized electrostatic unit mounts around CRT neck.



This wide band, fully transistorized deflection amplifier is designed for use with dual deflection CRT's combining electromagnetic and electrostatic deflection, used as output devices for computer generated displays. Type D65701 is packaged on a 5 in. dia. printed circuit board which conserves space and keeps output lead length to a min. Push-pull output/channel is 120v peak-to-peak. Nominal input for full output is 1v across 100Ω. RMS Associates, 805 Mamaroneck Ave., Mamaroneck, N. Y.

Circle 253 on Inquiry Card

SSB RECEIVER ADAPTER

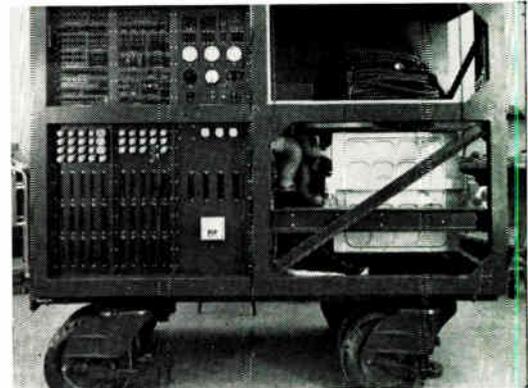
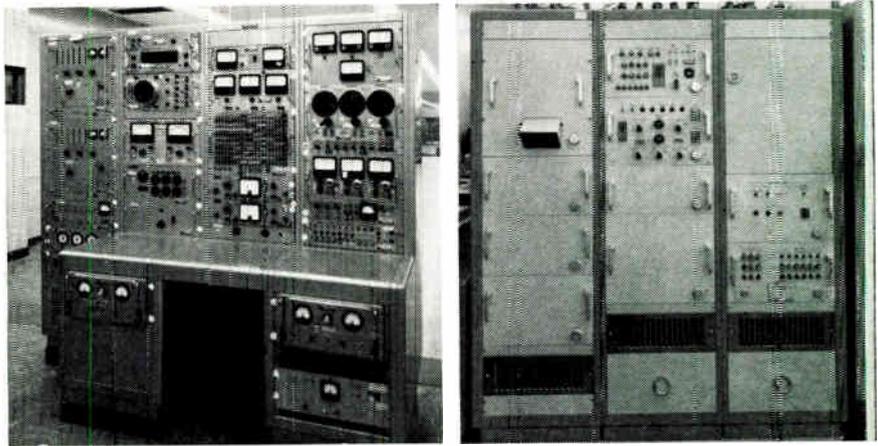
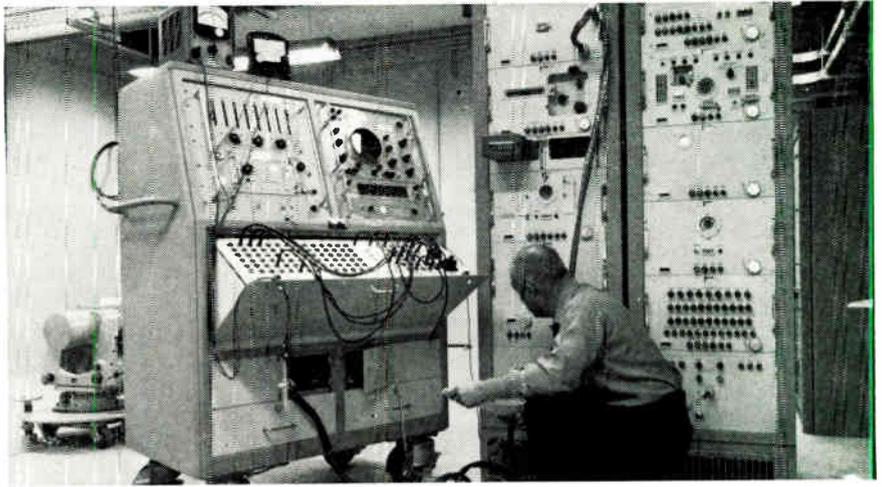
Model RSSB-62-1A, converts conventional AM receivers to SSB operation.



Completely Nuvistorized unit operates with a B+ of 60v. The adapter measures 5¼ x 13½ x 19 in. and weighs 20 lbs. Included is an all-electronic AFC with a correction speed of 50cps/sec. Received carrier is directly compared with a local carrier reference from a crystal oscillator. During severe fades of main and sub-carrier, a RC memory maintains tuning until carrier is restored. Kahn Research Laboratories, Inc., 81 S. Bergen Place, Freeport, L. I., N. Y.

Circle 254 on Inquiry Card

Now available...



ARMA'S experience in Aerospace Ground Equipment

ARMA—creator of the Atlas inertial guidance system—has engineered and produced almost \$2 billion of complex systems and components over the past four decades. This performance-proved ability is now available to aerospace contractors for the production and development of a wide range of systems and components in the areas of electronics, computers, inertial components, servomechanics and hydraulics. It includes:

Launch monitoring and control systems • Automatic checkout and test equipment • Ground handling equipment • Trainers and test simulators • Depot and factory test equipment.

Complete details on production facilities and services are contained in booklet AGE-1. Write Corporate Government Marketing, Arma Division, American Bosch Arma Corporation, Garden City, New York.

8798



ARMA DIVISION
AMERICAN BOSCH ARMA CORPORATION

If it's **SPEED**
you want in
**SILICON PLANAR
TRANSISTORS**

2N914 2N784A 2N708



**Small-Signal
Sylvania
Epitaxial types**

For logic and driver applications, Sylvania offers a choice of high-speed transistors featuring very low saturation voltage at high collector current, plus fast turn-on, turn-off and storage time.

	Collector-Base Breakdown Voltage V_{CB0}	Saturation Voltage V_{CEsat}	D.C. Current Gain h_{FE}	A.C. Current Gain h_{fe}	Turn-On Time t_{on}	Storage Time t_{stg}	Turn-Off Time t_{off}
2N914	40 volts (min) at $I_C = 1.0 \mu A$	0.7 volt (max) at $I_C = 200 \text{ mA}$ $I_B = 20 \text{ mA}$	30 (min) 120 (max) at $V_{CE} = 1.0 \text{ V}$, $I_C = 10 \text{ mA}$ 10 (min) at $V_{CE} = 5.0 \text{ V}$, $I_C = 500 \text{ mA}$	3.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 20 \text{ mA}$ $f = 100 \text{ mc}$	40 nsec (max)	20 nsec	40 nsec
2N784A	40 volts (min) at $I_C = 100 \mu A$	0.19 volt (max) at $I_C = 10 \text{ mA}$ $I_B = 1.0 \text{ mA}$	25 (min) 150 (max) at $V_{CE} = 1.0 \text{ V}$, $I_C = 10 \text{ mA}$	3.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 10 \text{ mA}$ $f = 100 \text{ mc}$	20 nsec (max)	15 nsec	40 nsec
2N708	40 volts (min) at $I_C = 1.0 \mu A$	0.40 volt (max) at $I_C = 10 \text{ mA}$ $I_B = 1.0 \text{ mA}$	15 (min) at $V_{CE} = 1.0 \text{ V}$, $I_C = 0.5 \text{ mA}$ 30 (min) 120 (max) at $V_{CE} = 1.0 \text{ V}$, $I_C = 10 \text{ mA}$	3.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 10 \text{ mA}$ $f = 100 \text{ mc}$	---	25 nsec	---

A look at the specifications will show that all of the transistors on these two pages make the most of Sylvania's advanced techniques for epitaxial growth. All have excellent AC current gain, low saturation resistance, and will operate at high case temperatures. Planar passivated construction gives Sylvania transistors their low noise and low leakage characteristics, plus uniformity of electrical performance and extended life.

Look to Sylvania when your design calls for reliable epitaxial planar transistors. Contact your Sylvania Sales Engineer or Sylvania Franchised Semiconductor Distributor for details. For technical data, write Semiconductor Division, Sylvania Electric Products Inc., Dept. 199, Woburn, Mass.

For
**SPEED plus
 HIGHER CURRENT
 & POWER-
 HANDLING**

2N1613

2N1958A 2N1959A 2N2297 2N2410

T0-5



**Large-Signal
 Sylvania
 Epitaxial types**

Particularly useful as core and lamp drivers, these medium-power transistors offer switching speeds only slightly less than their small-signal counterparts, plus increased current and power-handling ability. Popular types include the 2N1613 which, like the others, features the famous Sylvania Epitaxial process.

	Collector-Base Breakdown Voltage V_{CB0}	Saturation Voltage V_{CEsat}	D.C. Current Gain h_{FE}	A.C. Current Gain h_{fe}	Turn-On Time t_{on}	Storage Time t_{stg}	Turn-Off Time t_{off}
2N1613	75 volts (min) at $I_C = 100 \mu A$	1.5 volts (max) at: $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$	40 (min) 120 (max) at $I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ 20 (min) at: $I_C = 500 \text{ mA}$, $V_{CE} = 10 \text{ V}$	3 (min) at $I_C = 50 \text{ mA}$, $V_{CE} = 10 \text{ V}$	$t_d + t_r + t_f = 30 \text{ nsec}$		
2N1958A	60 volts (min) at $I_C = 100 \mu A$	0.45 volt (max) at: $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$	20 (min) 60 (max) at $I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ 15 (min) at: $I_C = 1000 \text{ mA}$, $V_{CE} = 10 \text{ V}$	1.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 25 \text{ mA}$, $f = 100 \text{ mc}$	60 nsec (max)	25 nsec (max)	45 nsec (max)
2N1959A	60 volts (min) at $I_C = 100 \mu A$	0.45 volt (max) at: $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$	40 (min) 120 (max) at $I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ 25 (min) at: $I_C = 1000 \text{ mA}$, $V_{CE} = 10 \text{ V}$	1.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 25 \text{ mA}$, $f = 100 \text{ mc}$	60 nsec (max)	25 nsec (max)	45 nsec (max)
2N2297	80 volts (min) at $I_C = 100 \mu A$	1.0 volt (min) at: $I_C = 1000 \text{ mA}$ $I_B = 15 \text{ mA}$	40 (min) 120 (max) at $I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ 15 (min) at: $I_C = 1000 \text{ mA}$, $V_{CE} = 10 \text{ V}$	3.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 50 \text{ mA}$, $f = 20 \text{ mc}$	---	---	---
2N2410	60 volts (min) at $I_C = 100 \mu A$	0.45 volt (max) at: $I_C = 150 \text{ mA}$ $I_B = 15 \text{ mA}$	30 (min) 120 (max) at $I_C = 150 \text{ mA}$, $V_{CE} = 10 \text{ V}$ 25 (min) 100 (max) at $I_C = 500 \text{ mA}$, $V_{CE} = 10 \text{ V}$	2.0 (min) at $V_{CE} = 10 \text{ V}$, $I_C = 50 \text{ mA}$, $f = 100 \text{ mc}$	65 nsec (max)	---	65 nsec (max)

SYLVANIA

SUBSIDIARY OF

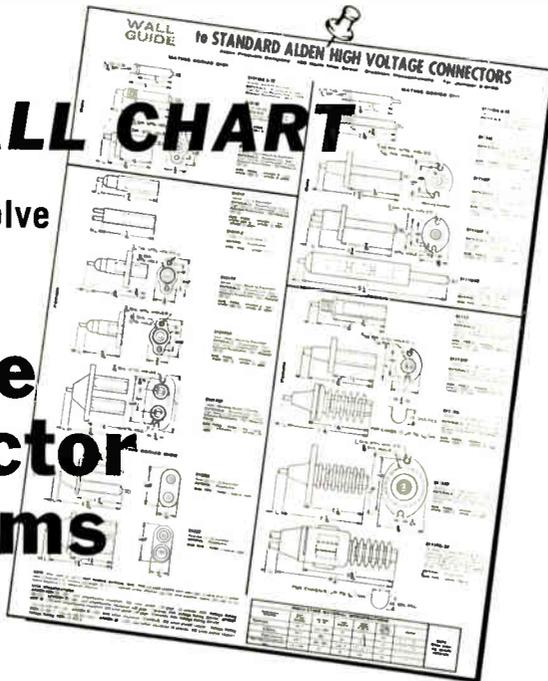
GENERAL TELEPHONE & ELECTRONICS



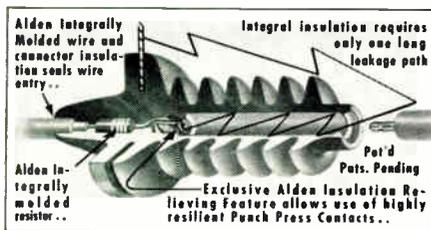
NEW WALL CHART

can help you solve

high voltage connector problems

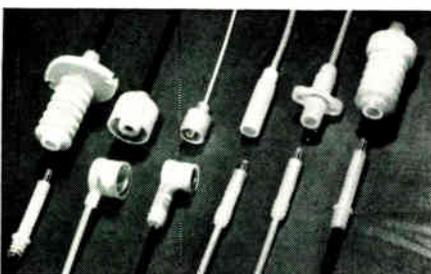


You can choose from a complete series of standard designs and specify your particular connector environmental needs.



Engineering samples can be in your hands by return mail!

The Alden High Voltage Wall Chart contains full scale engineering, drawings, connector specs, wire types, and insulating material descriptions to simplify your planning, layout and specifying.



A few of the many Alden IMI High Voltage Connectors and tube caps available for solving your problems.

Unique Alden High Voltage Connectors are more reliable, simpler and less expensive than conventional designs; will tame arc-over and corona problems at voltages up to 30 KVDC.

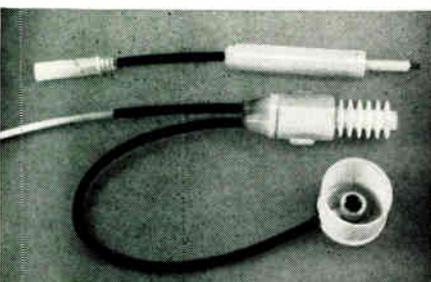
The exclusive Alden "IMI" (integrally molded insulation) makes it possible to mold insulation forming the connector body in a single hot shot directly around leads, contacts, and any special circuit components such as chokes, resistors or corona shells.

This one shot technique actually adds reliability yet saves production costs and these savings are passed on to you.

Send for the free Alden High Voltage Wall Chart — use it to determine the best standard design for your particular application then contact us for a sample connector or proposal tailored specifically to your needs. Write to:

ALDEN

PRODUCTS COMPANY
9123 N. Main St., Brockton, Mass.



Connectors with leads tailored to meet your specs — operating voltage, circuitry layout and environmental conditions, or can be molded into Unit Cables.

AC-DC POWER SUPPLIES

Regulation is $\pm 0.1\%$ line, $\pm 0.2\%$ load; ripple is 1% max.

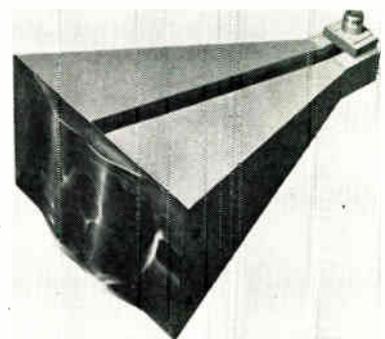


The RVA Series voltage regulated transistorized power supplies are designed to deliver voltage regulated dc power from 105-125vac sources. Input freq. range is 50-400cps. The RVA series is manufactured in 4 constant duty power ratings—15, 30, 60, and 100w. Models from 5vdc to 300vdc are available. The RVA-300-30 (shown) has: input, 105-125 vac; output, 300vdc, 30w; and measures $4\frac{1}{2} \times 3\frac{3}{8} \times 6$ in. Kupfrian Manufacturing, 160 Prospect Ave., Binghamton, N. Y.

Circle 257 on Inquiry Card

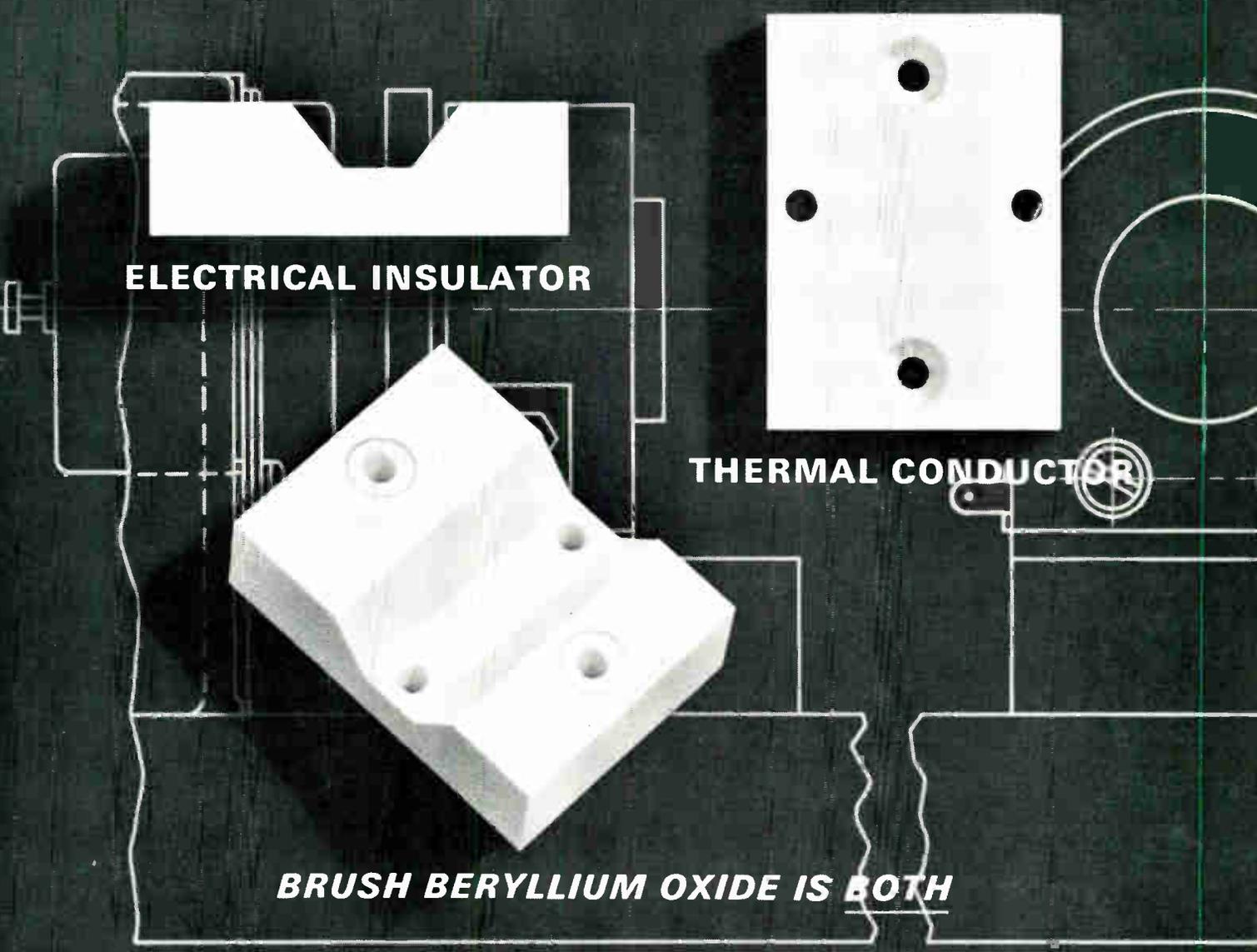
BROADBAND HORN ANTENNA

High, nearly constant operating efficiency over a 10:1 range.



Model AN-10 is designed to accomplish the same function as a combination of conventional horn antennas. The high performance is made possible by using a solid dielectric phase-correcting lens located in a double-ridged horn. Calibration is within ± 0.3 db. The Model AN-10 horn antenna weighs 4 lbs. and measures 11 in. long with an aperture of 5×7 in. It has a gain of 5 to 20db. Sylvania Electronics Systems—West, Sylvania Electric Products, Inc., P.O. Box 188, Mountain View, Calif.

Circle 258 on Inquiry Card



ELECTRICAL INSULATOR

THERMAL CONDUCTOR

BRUSH BERYLLIUM OXIDE IS BOTH

Diagrammatic courtesy of Avco Corporation

The ceramic that conducts heat like a metal

It's a unique paradox of properties: beryllium oxide stops electric current, but lets heat come through.

That's why one part, made of BeO, can do two jobs better than two parts made of other materials. That's how many products are being made smaller and more reliable, at less total cost, to keep competitive.

If you need a component which will conduct or absorb heat—while it insulates electrically—discover beryllium oxide. It combines these properties better than any known material.

We fabricate beryllia in virtually unlimited sizes and configurations, and it can be metalized and precision ground.

Brush beryllium oxide ceramics will improve your product, your process, and save you money.



**BERYLLIUM OXIDE PARTS,
FABRICATED AND SUPPLIED BY BRUSH**

To serve you better, Brush offers immediate delivery of improved quality and new, low priced standard beryllium oxide semiconductor bases and heat sinks. A variety of sizes and types is available—typical examples are shown here. Send us your requirements. Full information and specs furnished promptly.

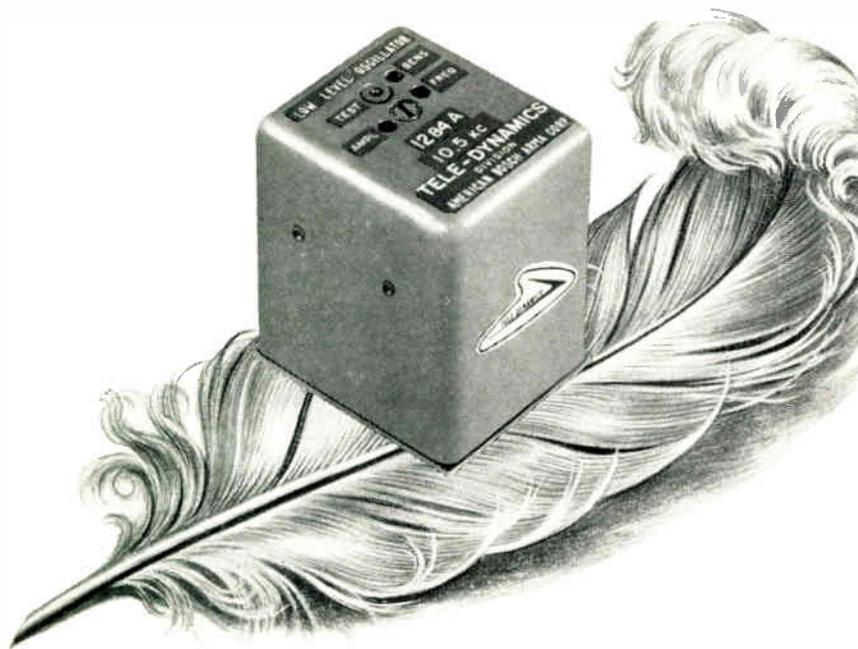


THE BRUSH BERYLLIUM COMPANY
5209 Euclid Avenue • Cleveland 3, Ohio

Circle 101 on Inquiry Card

World Radio History

TELEMETRY BY TELE-DYNAMICS



A featherweight that does a heavyweight's job

Tele-Dynamics Type 1284A Low Level Subcarrier Oscillator weighs only $3\frac{1}{4}$ ounces and occupies only $4\frac{1}{2}$ cubic inches.

Produced for the new generation of space vehicles, this unit is designed to operate with differential signals as low as ± 5 millivolts full scale. It provides meticulously engineered high linearity and thermal stability together with exceptionally rugged mechanical construction.

The Type 1284A oscillator provides—

- Low level operation with high level performance
- High input impedance
- High common mode rejection
- Optional deviation limiting
- Band pass filters for all IRIG channels

For the operating, environmental and physical characteristics of this unit—or for details about Tele-Dynamics complete line of transistorized telemetry components, write to

TELE-DYNAMICS
DIVISION
AMERICAN BOSCH ARMA CORPORATION
5000 Parkside Avenue, Philadelphia 31, Pa.

NEW PRODUCTS

PISTON CAPACITORS

Sealed construction; for airborne, sea-borne and missile applications.



Super Max-C Trimmer Piston Capacitors have an extended range because the electrode band is embedded within the glass cylinder. Long life anti-backlash adjustment mechanism has a minimum adjustment life of 500 cycles. Available in 1-14, 1-28, 1-42, 1-60 and 1-90pf for panel mounting. For printed circuits, ranges are: 1-14, 1-28, 1-42, 1-60 and 1-90pf. Features include: dc working voltage of 1000vdc; dielectric strength of 2000vdc; Q factor of 500 at 1mc; and insulation resistance 10^6 megohms. There is no derating from -55° to $+125^\circ\text{C}$. JFD Electronics Corp., 6101 Sixteenth Ave., Brooklyn 4, N. Y.

Circle 259 on Inquiry Card

CODE GENERATOR

This subminiature generator is keyboard operated.



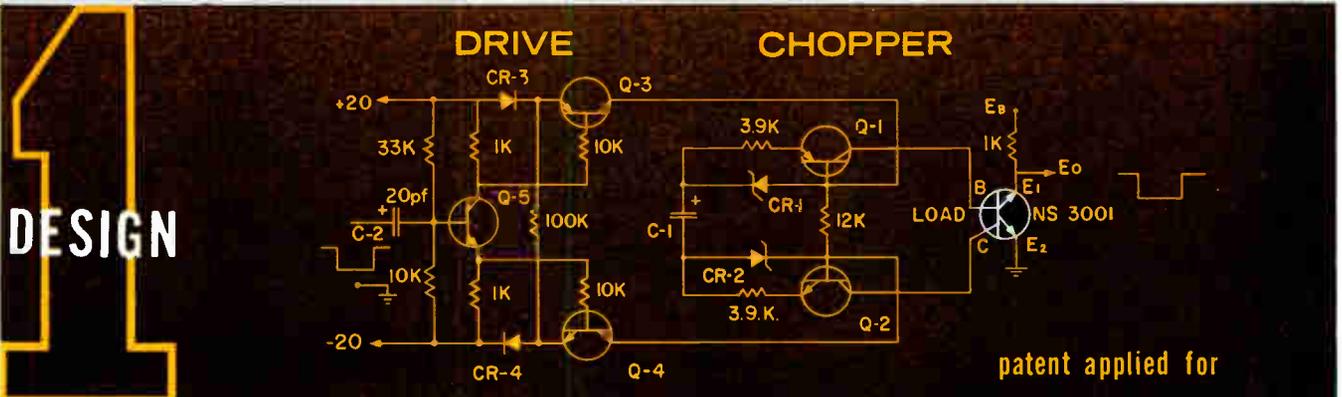
Producing either International Morse or Baudot codes, Codamite Model 201 provides both a relay contact and a side-tone output in either code selected by the operator. For military uses requiring a small, portable, battery-operated unit, it operates from any voltage between 12 and 24vdc at a constant drain of 0.8a. Weighs less than 3 lbs., and is approx. 5 x 7 x 2 in. The unit is all solid-state, and uses a 10-bit magnetic-core shift register as the memory element for one-character memory. Dept. JA, Codamite Corp., P.O. Box 2914, Anaheim, Calif.

Circle 260 on Inquiry Card

NATIONAL SEMICONDUCTOR

A TRANSFORMERLESS DRIVE FOR THE INCH*

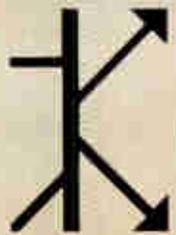
(INTEGRATED CHOPPER)



DESIGN

NS 3050 PARAMETERS

$BV_{E_1 E_2 O}$	10 V min
V_O	$\pm 100 \mu V$ max
$I_{E_1 E_2 O}$	5 nA max
R_d	50 Ω max
$R_o \left(\frac{\Delta V_O}{\Delta I_B} \right)$	25m Ω



FEATURES

- Circuit operates from common power supplies.
- High speed switching maintained from < 10 CPS to over 100kc
- Turn on time < 1 μsec
- Turn off time < 1 μsec
- Maximum on time determined by C_1 typically 50 $\mu sec/uf$
- Spiking minimized.

FOR COMPLETE TECHNICAL DESCRIPTION OF CIRCUIT SHOWN WRITE FOR "TRANSFORMERLESS CHOPPER DRIVE CIRCUIT" GEM #8 AND DATA SHEETS TO PRODUCT MARKETING DEPT., NATIONAL SEMICONDUCTOR CORP., BOX 443, DANBURY, CONN.

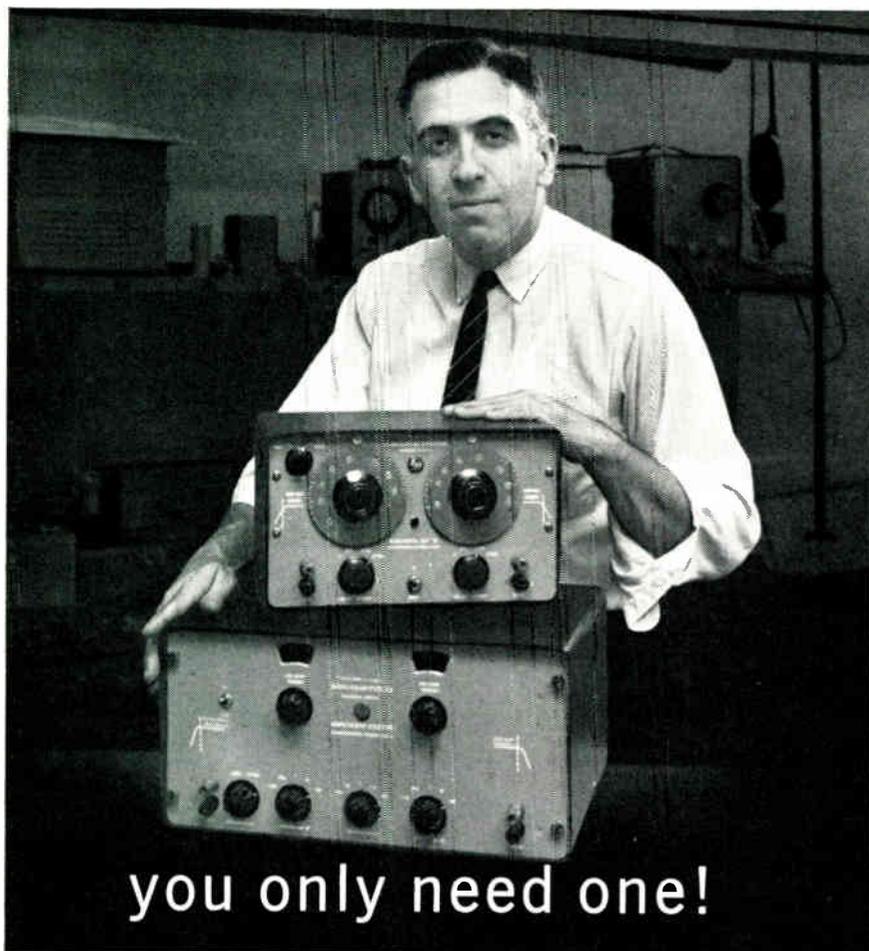
*trademark



NATIONAL SEMICONDUCTOR

CORPORATION

DANBURY, CONN. • TEL. Pioneer 3-7624 • TWX DANB 452-U



you only need one!

choose the Krohn-Hite multi-function filter that suits your applications!

Why invest in multiple filters, when Krohn-Hite offers you a line of multi-function filters to meet your every day filtering requirements!

There's the new Krohn-Hite Model 315-A, for example — a Band-Pass, Band-Rejection or High-Pass variable electronic filter. Perfect for those unpredictable filtering applications in the audio and ultrasonic range. Covering a frequency range of 20 cps to 200 kc, the Model 315-A is controlled through all its modes by a single switch on the front panel.

For ultra-low frequency and audio range filtering, choose the convenient Model 335 — the Krohn-Hite Band-Pass, Band-Rejection, High-Pass or Low-Pass variable electronic filter. The 335 offers 5% frequency accuracy from 0.02 cps to 20 kc. Its high-pass response extends to 100 kc. The low-pass response extends right to dc, with stabilization of the output dc level.

Both of these versatile filters offer completely variable independent high and low cut-off settings. Dials are direct-reading. Their high input impedance of these filters allows bridging across sensitive circuits without loading. Their output impedance is low, and the output doesn't require terminating in a specific load.

So if your filtering requirements change from day to day, consider your budget and investigate these Krohn-Hite multi-function filters! Write for full specifications.



KROHN-HITE CORPORATION

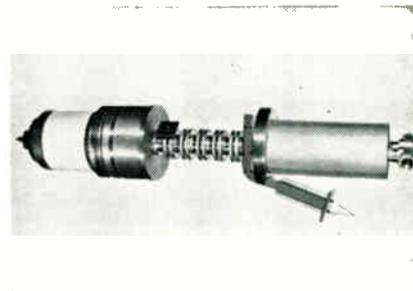
580 Massachusetts Avenue • Cambridge 39, Mass.

Pioneering in Quality Electronic Instruments

NEW PRODUCTS

KLYSTRON AMPLIFIER

Features a peak power output of 1.25 megawatts at X band.

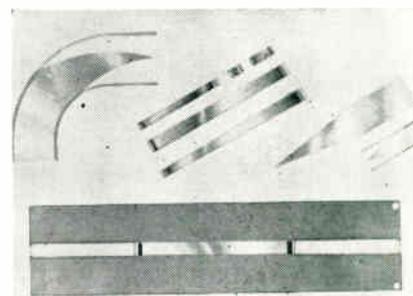


The tube, the SAX-191, delivers a min. 1 megawatt of power output over a 370 mc bandwidth. Although it operates in the 8.83 to 9.2gc range, the flexibility of its 7-cavity design makes it adaptable for use in any area of X band. With its 50db gain figure, the tube delivers full output power from an input of only 12.5w. The result is a simplified chain; only one driver is required between the oscillator and the SAX-191. The tube is 37 in. long. Sperry Electronic Tube Div., Sperry Rand Corp., Great Neck, N. Y.

Circle 261 on Inquiry Card

STRIPLINE RESISTORS

This "two dimensional" strip resistors fit into the stripline circuit.



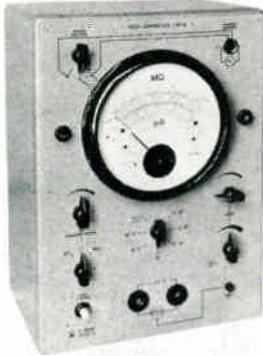
Microstrip Stripline Resistors have a base of thin film natural mica. The resistance film is an alloy of pure metals, approximately 50 millionths of an inch thick and sealed with a coating of Quartz. Fired silver terminations can be supplied for dc connection to the copper center conductor of Microstrip or Stripline circuits. Can be supplied as matched loads, fixed pads, variable attenuator elements or terminations. Available in resistances ranging from a few ohms to several hundred ohms. Come in straight rectangular or square sections, tapered rectangular sections for electrical match, or curved. Filmohm Corp., 48 W. 25th St., New York 10, N. Y.

Circle 262 on Inquiry Card

NEW PRODUCTS

HIGH RESISTANCE OHMMETER

The Tera-ohmmeter, using no batteries, is fully line-operated.



It is for measurement of extremely high insulation resistance in accordance with the specs. of Mil, IEC and VDE. The Type N has fixed test voltages of 10 and 100v, a total range of 0.1 megs to 50TΩ and is completely line operated with highly stabilized power supplies. It is for testing insulation of components, capacitors, transformers, cables, wires and the like. It also tests insulating materials such as plastics, etc. Rohde & Schwarz, 111 Lexington Ave., Passaic, N. J.

Circle 406 on Inquiry Card

GRAPHIC RECORDER

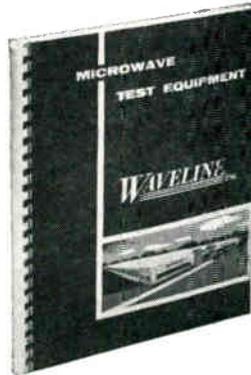
Provides dynamic 1/2% accuracy, high sensitivity to 1/4% of span.



This dual-speed graphic recorder has a 5mv to 50v span. Used in recording dc voltage or current variations vs. time, the Model 5000 provides step selection of ranges from 5mv to 50v by means of a front panel attenuator. It uses a null-balance, servo-type, potentiometric, chopper-stabilized system to eliminate zero-drift problems. Available chart speeds range from 1 in./hr. to 16 in./min. Measures 12½ x 11¾ x 9 in. Dallons Laboratories, Inc., 120 Kansas St., El Segundo, Calif.

Circle 407 on Inquiry Card

New Catalog



Microwave Test Equipment 2.6 to 90.0 Gc

Over 1000 standard precision waveguide instruments and components are described in Waveline's new 114 page illustrated catalog. This new easy to read catalog contains complete specifications and prices for the following standard items —

attenuators • noise tube mounts • crystal and bolometer mounts • waveguide switches • series, shunt, and hybrid tees • fixed and adjustable terminations • slotted lines and probes • standard gain horns • elbows, twists, and straight sections • flange fasteners and waveguide stands • variable shorts • double stub, slide screw, and E/H tuners • band pass filters • directional couplers • adapters and transitions • frequency meters • pressure and bulk-head units • phase shifters

Write today for this new catalog:

WAVELINE INC.

P.O. Box 718, W. Caldwell, N. J. • Capital 6-9100

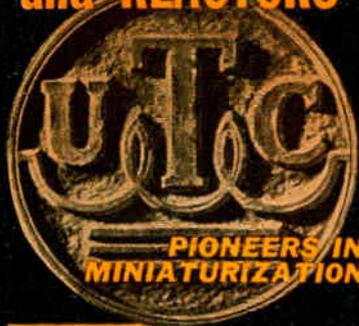
WAVELINE INC.

CALDWELL, NEW JERSEY

Phone: Capital 6-9100

TWX Caldwell, N. J. 703

ULTRA-MINIATURE TRANSISTOR TRANSFORMERS and REACTORS



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Sealed to
MIL-T-27A

**IMMEDIATE
DELIVERY**
From Stock

There is no transformer even twice the size of the DO-T and DI-T series which has as much as 1/10th the power handling ability... which can equal the efficiency... or equal the response range. And none to approach the reliability of the DO-T and DI-T units (proved to, but exceeding MIL-T-27A grade 4).

Rugged

... COMPLETELY METAL CASED

High Power Rating

... up to 10 times greater

Excellent Response

... twice as good at low end

Low Distortion

... reduced 80%

High Efficiency

up to 30% better, compare DCR

Moisture Proof

hermetically sealed to MIL-T-27A

Anchored Leads

will withstand 10 pound pull test

Printed Circuit Use

... nylon insulated leads

Suited to Clip Mounting

... use Augat #6009-8A clip

UNITED TRANSFORMER CORPORATION

150 Varick Street, New York 13, N.Y.

PACIFIC MFG. DIVISION

3630 Eastham Drive, Culver City, Calif.

EXPORT DIVISION

13 East 40th Street, New York 16, N. Y.

WRITE FOR LATEST CATALOG

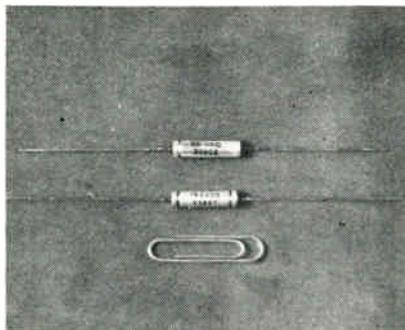
Circle 107 on Inquiry Card

NEW PRODUCTS

...for the Electronic Industries

TANTALUM CAPACITORS

Solid slug line features a unit rated at 75v, 85°C max.

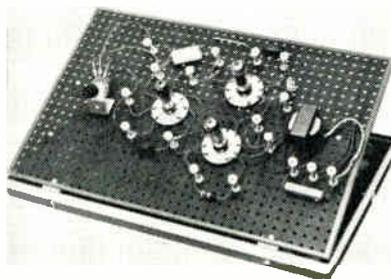
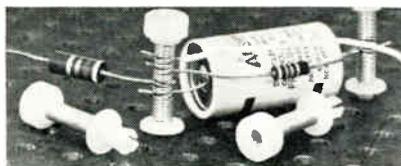


A line of miniature foil tantalum and solid slug tantalum capacitors are available. Foil tantalum lines features a 400% increase in ratings for Mil specification can sizes, a 50% decrease in leakage current limits, and a 50% reduction in capacitance tolerance for etched foil units. Carolina Components Inc., 721 Rosewood Dr., Columbia, S. C.

Circle 263 on Inquiry Card

BREADBOARDING SYSTEM

Connectors are of helical spring design.



The system components are the Koil-Klips and a perforated circuit board. The Koil-Klip may be inserted anywhere on the 1/2 in. grid board. Once inserted the Klip may be pulled upward and component leads and wires threaded thru the coils. The Koil-Klip will accommodate leads of the foil-type as well as leads having diameters up to 0.050 inches. A complete series of economical kits for laboratory and classroom is available. Elec-Traid, P.O. Box 53, Cambridge 41, Mass.

Circle 264 on Inquiry Card

MICROWAVE TOWER

For microwave and heavy duty communication and broadcast uses.



This tower is constructed in an equilateral triangular pattern of 3 1/2 ft. with the tower legs varying in tubular steel from 2 to 4 in. to meet the requirements of the installation. Tower is completely hot dipped galvanized and available for installations up to 800 ft. when using the proper size and weight of the tubular steel components. Can be tailored and engineered to meet exact needs of the antenna to be installed. Rohm Mfg. Co., Box 2000, Peoria, Ill.

Circle 265 on Inquiry Card

SOUND LEVEL METER

Gives high performance under rugged environmental conditions.



Model 2203, 6 lbs., features a stable accuracy of ±1db from 20cps to 15kc over the range of 31db to 134db. This is obtained through a built-in precision condenser microphone, a case specifically shaped to minimize acoustic reflections, and an RMS detector circuit. Field calibration to 0.2db accuracy is readily performed through use of a Model 4220 Pistonphone Accessory. B & K Instruments, Inc., 3044 W. 106th, Cleveland 11, Ohio.

Circle 266 on Inquiry Card

DC-AC INVERTER

Delivers 117vac at 2.5a and 400cps from a 12v battery source.

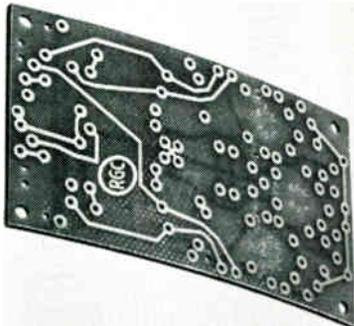


Heat radiation fins on opposite sides of the chassis permit the transistors to operate cooler for reliability under severe amb. temp. conditions. The inverter, Model S/A814, is normally furnished with 4 transistors. If voltage regulation to tight tolerances is required, a regulator pack can be provided. The input voltage range is from 6 to 32vdc; amb. temp. range from -35° to $+55^{\circ}$ C. Max. voltage output is 300v-a with a mean efficiency of 87%. SunAir Electronics, Inc., 3101 S.W. Third Ave., Ft. Lauderdale, Fla.

Circle 267 on Inquiry Card

PRINTED CIRCUIT BOARD

For curved applications, keeps shape even after reheating.



For use in tracking systems, satellites, missiles and other applications requiring curved P.C. boards. Made of laminated, flame resistant epoxy glass in colors of tan, black or green, these boards have plated through holes and gold plated or solder plated circuitry. Curved printed circuit boards have been formed on a radius of 7 in.; smaller radii are possible, with boards printed on only one side. R G Circuits Co., 15261 Mansel Ave., Lawndale, Calif.

Circle 268 on Inquiry Card

BREAKTHROUGH IN COST REDUCTION!!

Senate Bills to Curb Price Boosts Offered

Revaluations Raise Taxes

School Bonds and Tax Hike on June Ballot

Cost of Living Up .2% in March to Set Record

Steel Price Boost Stalls Ford Carding

Shareholders' Meeting to Set Record

Wage-Price Spiral Seen by Industry

House's New Estimate of 1962 State Production is 1.6% Higher

Steel Users in L.A. Eye Import Prices

Mike Spurs Inquiries

Post Office Chief Calls Rate Boost Imperative

Kuchel Warns Against Postal Rate Increases

MICRO-RADIONICS, INC. ANNOUNCES NEW, LOW FERRITE ISOLATOR PRICES!



In the face of industry-wide rising prices, M-R-I now dramatically reduces ferrite isolator prices for all popular band widths.

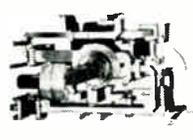
Advanced state-of-the-art techniques and long experience, combined with a cost conscious, value analysis team and vastly improved production methods have brought manufacturing costs to the lowest point in many years.

M-R-I is passing these new, lower costs on to the microwave industry.

Contact your M-R-I representative or write, wire or phone direct for the new low prices on ferrite isolators.



MICROWAVE SUBSYSTEMS



MONOPULSE RF SUBSYSTEMS



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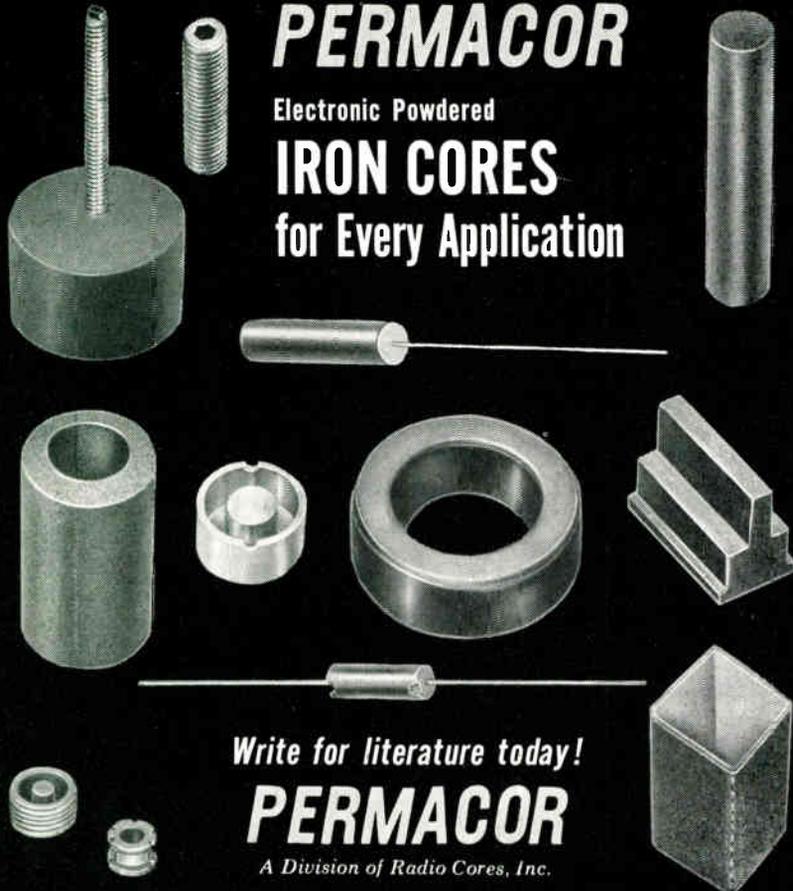


"L" BAND ATC AND DME TRANSPONDER TEST SETS

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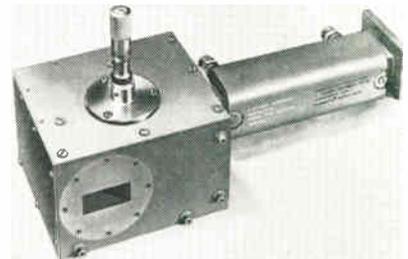
9540 Tully Ave., Oak Lawn, Ill. • Phone: GArden 2-3353

Circle 109 on Inquiry Card

NEW PRODUCTS

SOLID STATE LIMITER

This high power, passive, C-band unit is designed to replace TR tubes.

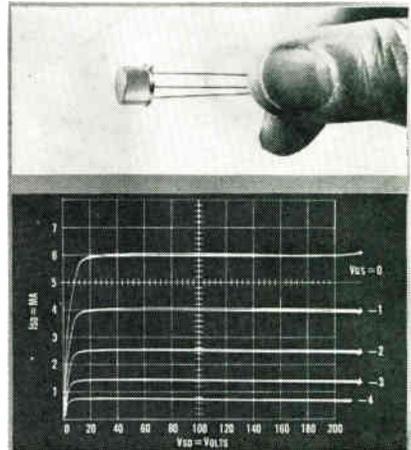


The limiter operates from 5.4 to 5.7gc at power levels up to 300kw peak and 450w average. Insertion loss, including a pressure window, is 1.2db max. Flat power leakage is 75mw and spike leakage is 0.15erg. Peak power in the spike is approx. 1/2w. Exhibits preselection characteristics and has a 3db bandwidth, nominally 35mc. Center of the bandpass can be adjusted to any freq. within the band by a single micrometer setting. Sperry Microwave Electronics Co., P.O. Box 1828, Clearwater, Fla.

Circle 269 on Inquiry Card

FIELD EFFECT TRANSISTOR

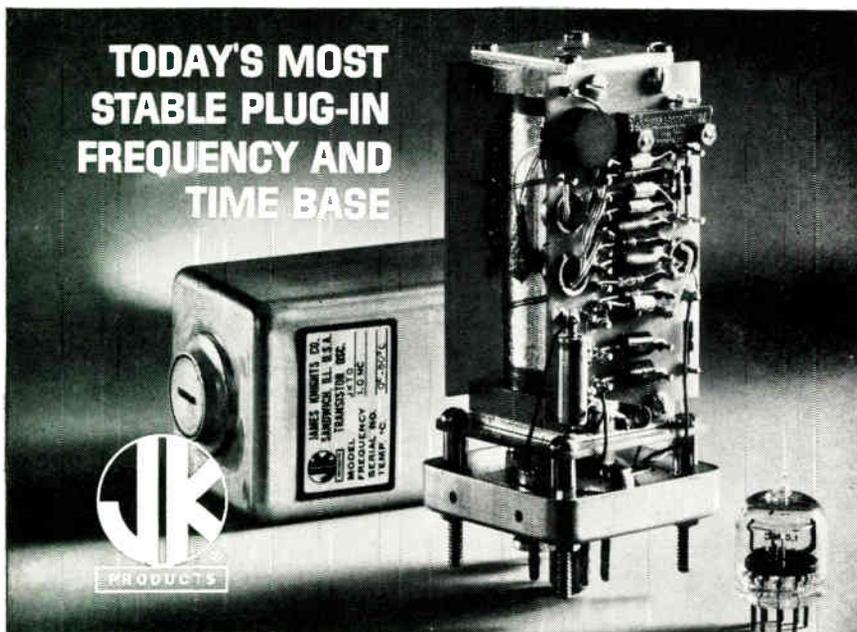
Designed to directly replace vacuum tube pentodes.



N-channel diffused silicon field effect (uni-polar) transistors are high input impedance, small signal amplifiers, in TO-5 packages. Features include: Source-to-gate and drain-to-gate voltage breakdowns are high; devices having breakdowns of 50(FG34), 100(FG35), 150(FG36), and 200(FG37) are available; min. gm (transconductance) on the devices above is 1000; and min. input impedance is 50megs. Amelco, Inc., Electron Devices Div., 341 Moffett Blvd., Mountain View, Calif.

Circle 270 on Inquiry Card

**TODAY'S MOST
STABLE PLUG-IN
FREQUENCY AND
TIME BASE**



SPECIFICATIONS

Stability: 5×10^{-9} /Day. **Frequency:** 1 mc to 5 mc normal range; 31.25 kc to 50 mc extended range. **Oven:** DC type proportional control. **Power:** 28 volt input. **Output:** 1.25 volts into 5 K ohm load. **Dimensions:** 2" x 2" x 4.5" seated height. Write for data sheet, James Knights Company, Sandwich, Ill.

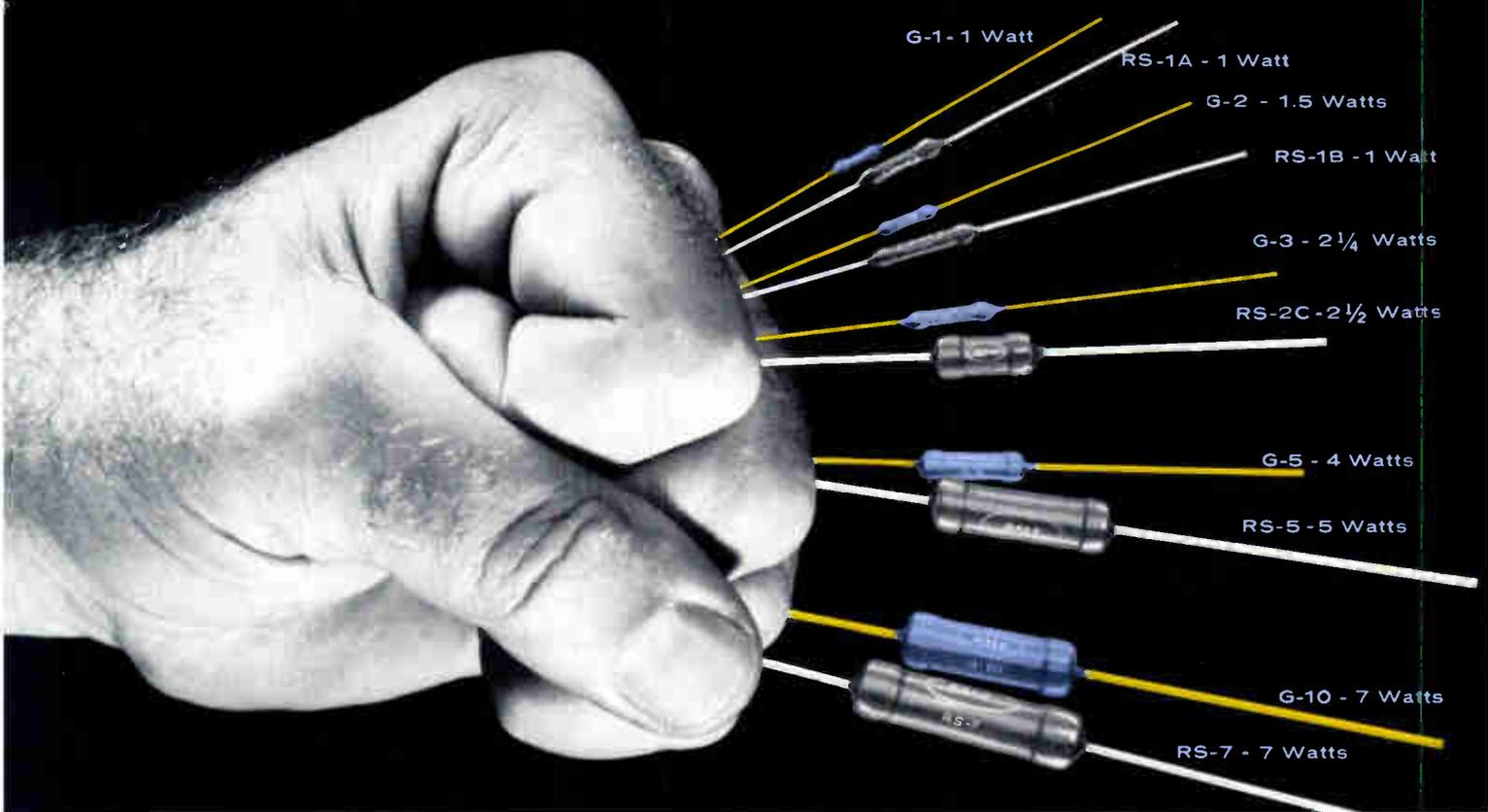
JKTO-43 Transistorized FREQUENCY STANDARD

Designed for both
laboratory and field service

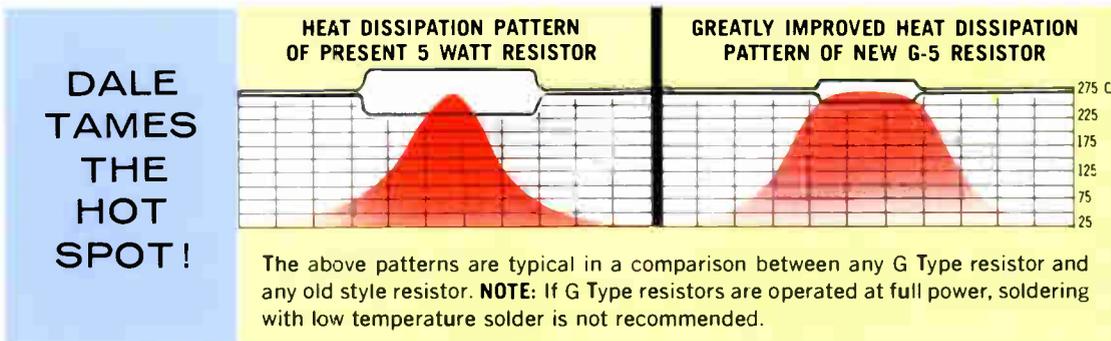
Circle 110 on Inquiry Card

DALE ACHIEVES MAJOR POWER BREAKTHROUGH

in relation to size with **NEW "G" SERIES**



As precious jewels are mounted in gold to complement their value, DALE G Type and HG Type resistors are provided with gold flash copper terminations. This characterizes the craftsmanship and precision that makes this achievement possible. G Type Resistors presently available in five sizes: 1, 1.5, 2.25, 4 and 7 watts in values ranging from 10 ohms to 60K ohms, depending on size and tolerance. Available tolerances are .05%, 0.1%, 0.25%, 0.5%, 1% and 3%.



DALE ELECTRONICS, INC.

Columbus, Nebraska

A Subsidiary of THE LIONEL CORPORATION

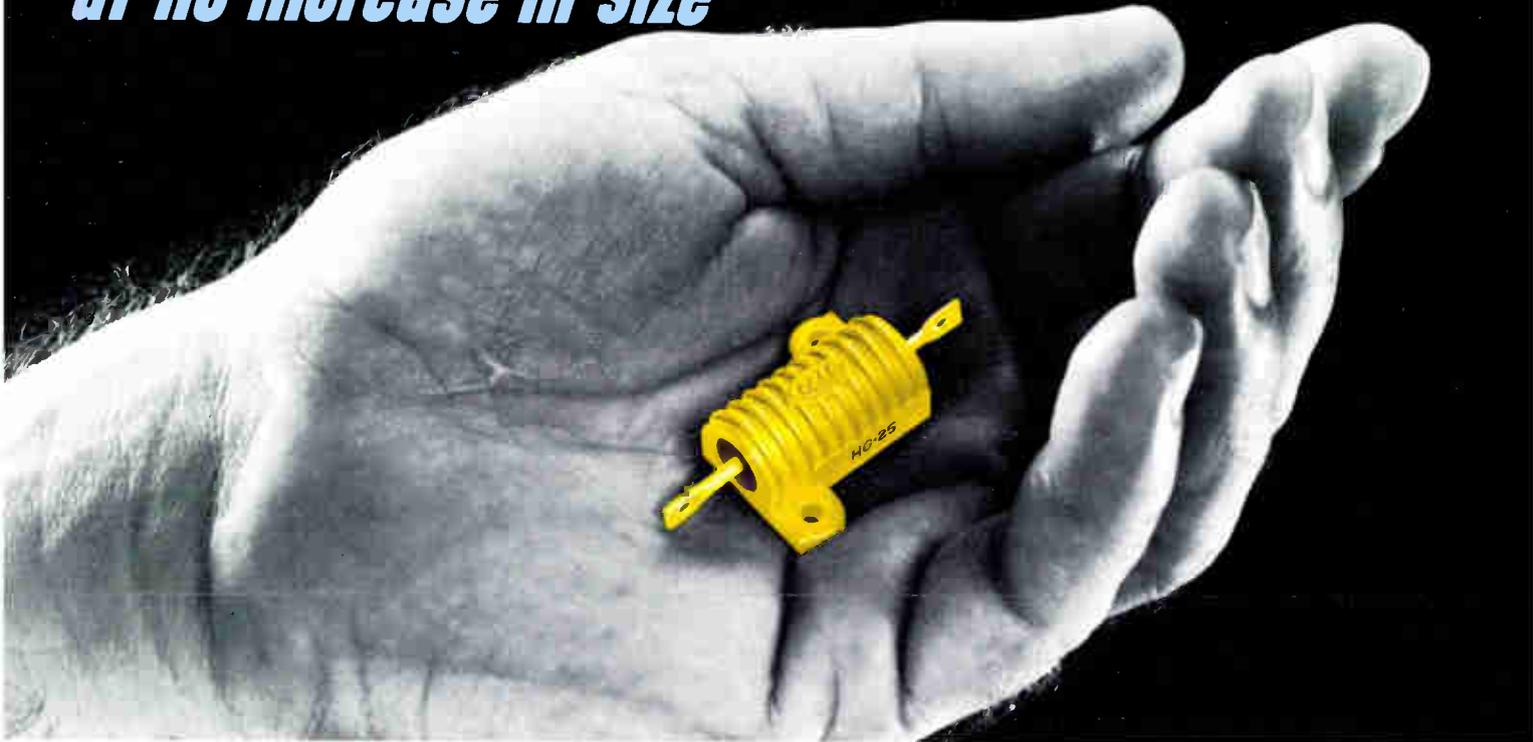
World Radio History



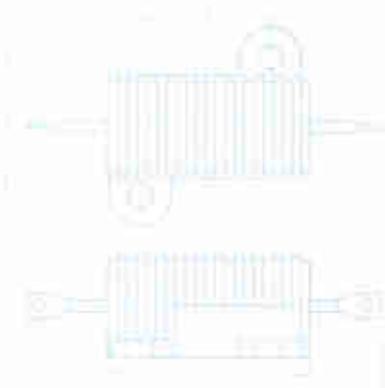
NEW DALE HG RESISTOR

MORE THAN DOUBLES MIL SPEC POWER REQUIREMENTS

at no increase in size



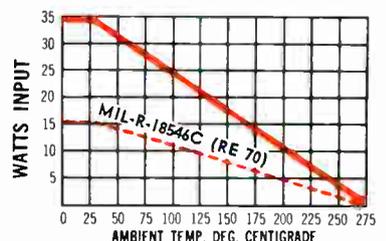
The DALE HG-25 resistor meets all functional and environmental requirements of MIL-R-18546C (RE-70) plus power dissipation of more than double the Mil Spec requirement. If derated to MIL rating, the HG will give unprecedented stability (test reports available on request). Molded into a gold anodized die cast aluminum housing, an exclusive Dale process, HG-25 is available in resistances ranging from .1 ohm to 60K ohms, depending on tolerance. Tolerances are 0.5%, 1% and 3%. Terminals are gold plated copper. (Also available with 6-32 studs and gold flash dumet terminals.) If operated at rated power, soldering with soft solder is not recommended.



TYPE HG-25

- A 719
±.005
- B .781
±.005
- C 1 1/16
± 1/32
- D 1 15/16
± 1/16

Based on 275° C. internal hot spot temperature and resistors mounted on standard .040 aluminum 5" x 7" x 2" chassis. Applicable only to resistors with .001" min. wire size. 1% maximum deviation after 1000 hours load life.



DALE ELECTRONICS, INC.

Columbus, Nebraska

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- Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- Wholesaler, mfg. representative, service firm.
- University (educational) Public Library.
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FOR OUR STATISTICAL RECORDS PLEASE CHECK THE ONE APPROPRIATE CATEGORY THAT BEST DESCRIBES YOUR COMPANY OR DEPARTMENT. Failure to do so will delay your address change.

- Mfr. of non-military electronic receiving and transmitting equipment.
- Mfr. of non-military electronic instruments, measuring, control and test equipment.
- Mfr. of non-military electronic computers, data processing, analysers, business machine.
- Mfr. of Guided Missiles and Accessories; Aircraft and Accessories, All Type of Military Products and Equipment.
- Mfr. of electronic components, parts, tubes and like products.
- Mfg. Co. (non electronic) using any of the above equip. in mfr., research or development work.
- Broadcasting or telecasting station.
- Commercial communication user (Tel & Tel, Police, Airports, Recording Studio, Etc.).
- Independent research, test, design laboratories and independent consultants—not part of a mfg. Co.
- Gov't Bureaus, Gov't laboratories, Gov't research center, military installation.
- Wholesaler, mfg. representative, service firm.
- University (educational) Public Library.
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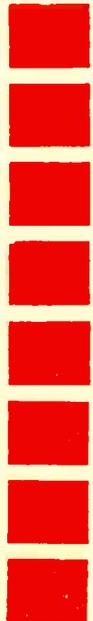
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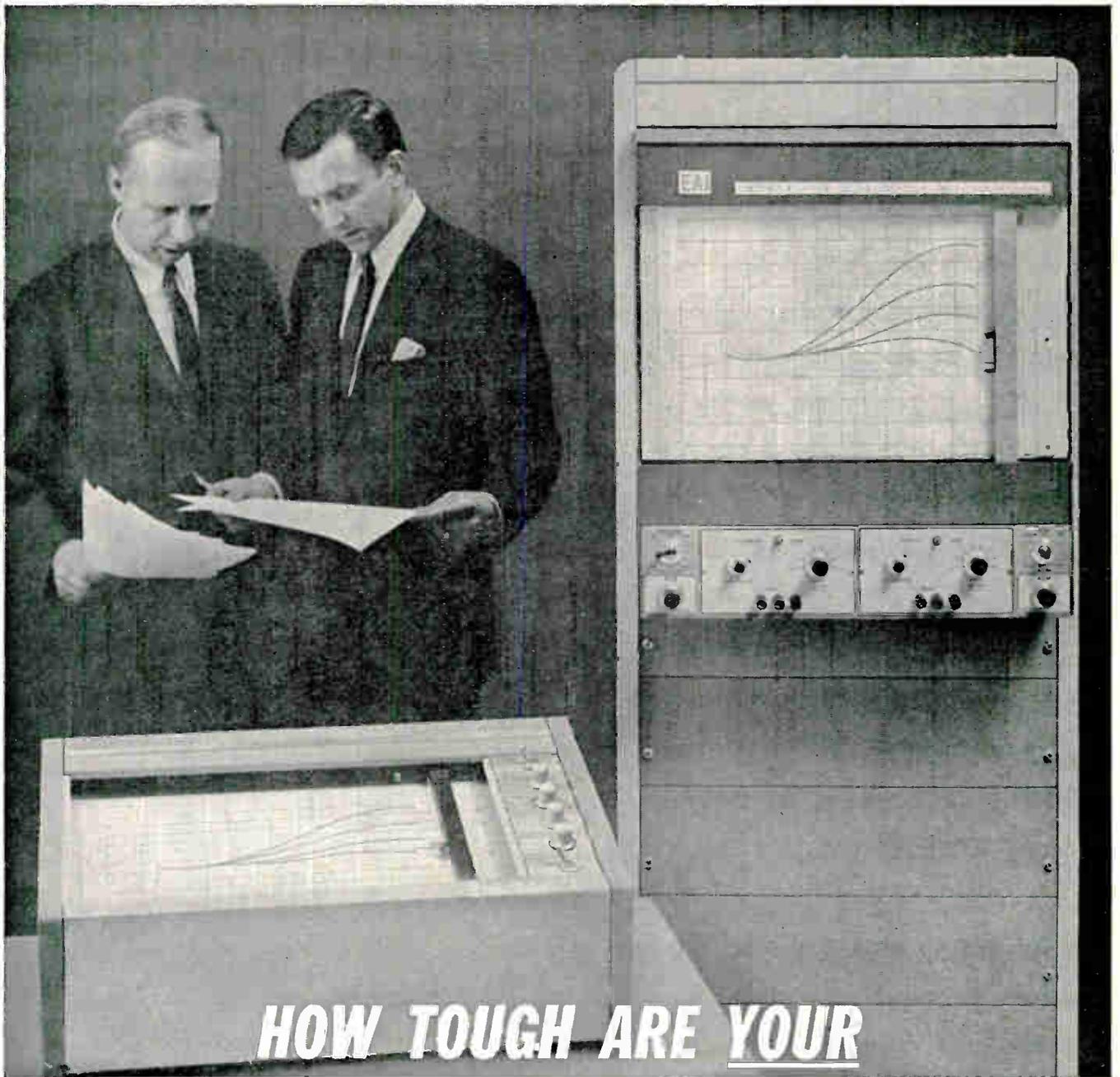
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AC VTVM & AMPLIFIER #250

Kit \$49.95, Wired \$79.95

VTVM: 12 ranges from 1mv to 300v rms; response absolutely flat from 10 cps to 600 kc; input impedance 10M Ω shunted by 15 μ f; accuracy \pm 3% of full scale.

Note: Average responding meter calibrated in rms. Linear 0-1, 0-3 scales. Decibel scales based on 0db=1mw in 600 Ω with 10db interval between ranges.

AMPLIFIER: 60db gain on 1mv range; response +0, -3db from 8cps to 800kc; output to 5V rms undistorted, variable down to zero by attenuator control at output; input impedance 10M Ω , output impedance 5K Ω ; hum & noise -40db for signal inputs above 2mv.

DESIGN QUALITY: All frame-grid tubes; 60db frequency-compensated input attenuator ahead of cathode follower with 10db/step attenuator following; two-stage R-C coupled amplifier and full-bridge meter circuit in one overall feedback loop; no response adjustment required in amplifier circuit; single sensitivity adjustment; voltage-regulated power supply. 50/60 cycle operation.

EICO MODEL 255 AC VTVM
Identical to Model 250 described above, but less amplifier facility. 50/60 cycle operation.
Kit \$44.95 Wired \$72.95

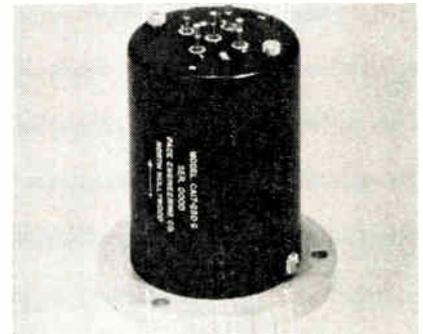
Add 5% in the West.

Circle 112 on Inquiry Card

NEW PRODUCTS

DC OUTPUT ACCELEROMETER

Designed for voltage controlled telemetering and other dc systems.



Weighing only 7 oz., Model CA17 includes in a single package a variable reluctance linear accelerometer and a dc energized, transistorized carrier-demodulator. It delivers 0-5 or $\pm 2\frac{1}{2}$ vdc and is energized with unregulated 25-30vdc, 25ma power. Available in ranges from $\pm 1g$ to $\pm 500g$. Operates over an ambient temp. range of -65° to +185°F. Damping is 0.6 critical or as spec'd. at room temp. PACE Engineering Co., 13035 Saticoy St., N. Hollywood, Calif.
Circle 271 on Inquiry Card

MIDGET IN SIZE GIANT IN POWER TYPE LK rectangular high voltage CAPACITORS

"The little one" with the tremendous power! 4 times the life of MIL-C 25A in case sizes reduced up to 80%! And you also get: superior resistance, better power factor, withstands greater overloads, may be operated to 125°C and voltage ratings from 600 to 500,000 volts.

Write today for Bulletin LK

Also ask for FREE pocket size "Comparator" and "Conversion" chart

Plastic Capacitors, Inc.
2620 N. Clybourn · Chicago 14, Illinois
DI 8-3735

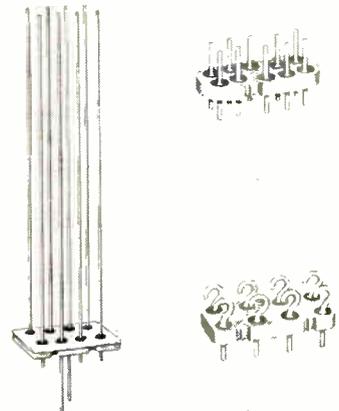


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MINIATURE RELAY HEADERS

Glass-to-metal hermetic terminals or headers for miniature relays.



Made with specially formulated "TR" glass in several colors, with 52% nickel alloy pins, and with a mild steel body, the terminals are available with both grid and S-type (oval) pin layouts. Each layout configuration consists of up to 10 pins. Three electrode styles can be selected: hook, plug-in, and extended lead. The terminals can withstand heat shock up to 1000°F, in 20 sec. as well as bending and twisting. The Fusite Corp., 6000 Fernview Ave., Cincinnati, Ohio.
Circle 272 on Inquiry Card

RELIABLE products from RAYTHEON

better tube performance looks like this



The directional distribution of getter material on the glass envelope is a sure sign of reliable performance of Raytheon tubes. Effective initial tube degassing, directional flash and greater subsequent gas absorption by the efficient Raytheon pressed-pellet getter reduce contamination of tube components for longer, more reliable operation.

The Raytheon pressed-pellet getter is impervious to moisture prior to its use

and is therefore more effective at the time of firing and throughout the life of the tube. Compared to conventional getters, the Raytheon pressed-pellet open cup getter design eliminates spurious metal particles which endanger tube life and performance. *For complete details on Raytheon's line of quality industrial tubes, please write to Raytheon, Industrial Components Division, 55 Chapel Street, Newton 58, Massachusetts.*

For small order and prototype requirements of reliable Raytheon tubes contact your franchised Raytheon distributor

RAYTHEON COMPANY

INDUSTRIAL COMPONENTS DIVISION

RAYTHEON

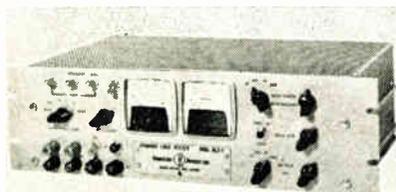
Circle 114 on Inquiry Card
World Radio History

NEW PRODUCTS

...for the Electronic Industries

POWER SUPPLY TESTER

Dynaload Model DLT-1 features range of 0 to 5a, 0 to 50v.

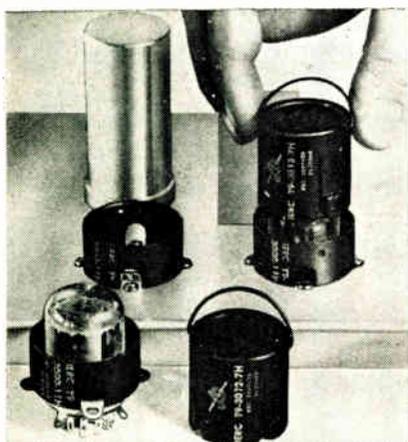


Resistive loads selected in 7 separate values with provision for external loads to extend test range. Capacitive loads from 0.001-1.0 μ fd available, to measure stability of supply under adverse load conditions. Pulse loads available from 0-3a with a pulse width from 10-10,000 μ sec at repetition rates from 10 to 10,000pps and a rise time of 1a/ μ sec. Short circuit conditions may also be simulated. Rack & panel unit is 19 x 5 $\frac{1}{4}$ x 12 in. Transistor Devices, Inc., 40 Factory St., Cedar Grove, N. J.

Circle 408 on Inquiry Card

TUBE SHIELDS

Heat-dissipating units designed for compactron tubes.

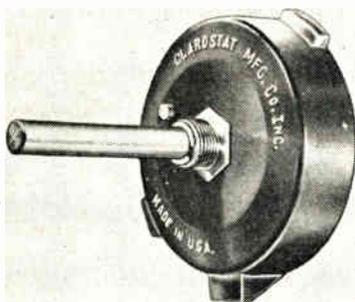


These 14 types have been developed to fit all compactron tube types. The shields will accommodate T9 diameter compactron tubes in lengths from 1 to 3 in. and T12 dia. tubes in lengths from 1 $\frac{1}{4}$ to 4 in. Full length thermal contact is made with the tube bulb by the beryllium copper spring finger liner. Heat is transferred from the tube bulb to the shell and then dissipated by radiation, convection and conduction. IERC Div., International Electronic Research Corp., 135 W. Magnolia Blvd., Burbank, Calif.

Circle 409 on Inquiry Card

POTENTIOMETERS

These 4000vdc units designed for use in radar and TV.

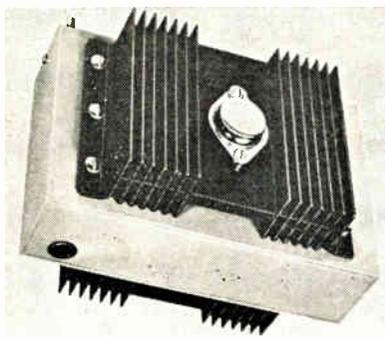


The Series 51 is a carbon potentiometer rated at 1w @ 40°C and gives a dielectric strength at working level of 4000vdc across the end terminals. The Series 51 Potentiometers are available in a resistance range of from 5000 Ω to 50megs, with linear taper. Resistance tolerance up to 100k Ω is \pm 20%, and 30% above 100k Ω . Actual voltage breakdown between terminals and ground is 10kvdc for 1 minute. The unit measures 1 31/32 in. in diameter. Clarostat Mfg. Co., Inc., Dover, N. H.

Circle 410 on Inquiry Card

OVEN TEMP. REGULATOR

For use in connection with crystal ovens.

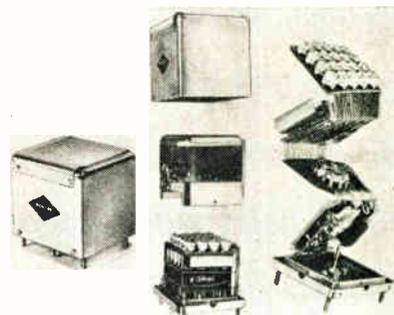


This transistorized, non-oscillating, temperature regulator, model V1250, regulates through proportional-control dc circuitry. Regulation is effective through 25w without cooling. The V1250 bans heater-circuit transient noise from the output and eliminates the danger of an overshoot in oven temp. with consequent damage to equipment. Power supply is 28vdc. Regulator is approximately 3 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 4 in. and weighs 1 $\frac{1}{2}$ lbs. Reeves-Hoffman Div., Dynamics Corp. of America, Cherry and North Sts., Carlisle, Pa.

Circle 411 on Inquiry Card

CRYSTAL OSCILLATOR

Temp. controlled Crystal Oscillator provides 20 channels.

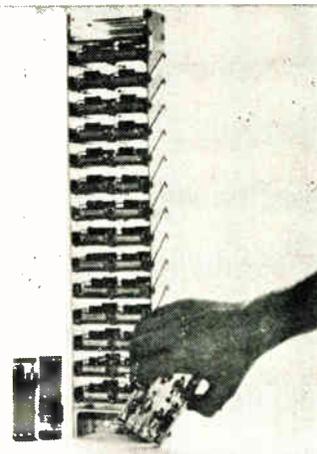


The unit uses flexible circuitry with all components including capacitors, crystals, switch wafers, and oscillator mounted directly on the circuitry. The flexible circuitry folds into less than 15 cu. in. Twenty separate externally adjustable channels have a freq. stability of 1 part in 10⁶ from -50° to +95°C. Monitor Products Co., Inc., 815 Fremont, So. Pasadena, Calif.

Circle 273 on Inquiry Card

RECTIFIER STACK

For high freq. power supplies and radar modulator circuits.

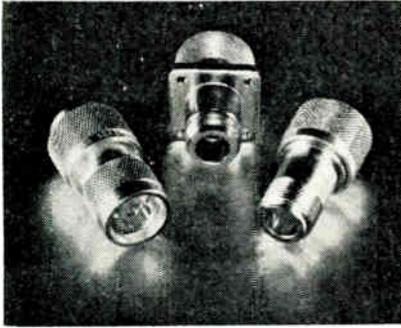


The custom stack useable to 100kc and above. Designed with "Golden Line" rectifiers and rated 35a with prv to 50kv. Applications include high freq. power supplies and radar modulator circuits such as charging diodes, holdoff diodes and backswing clippers. Contain large heat fins and open frame construction for cooling, and can be cooled by natural convection, forced air or liquid. Also available in encapsulated assemblies. Semiconductor Div., Hughes Aircraft Co., Newport Beach, Calif.

Circle 274 on Inquiry Card

COAX CONNECTORS

For use with TWTs, microwave amplifiers, and backward wave oscillators.

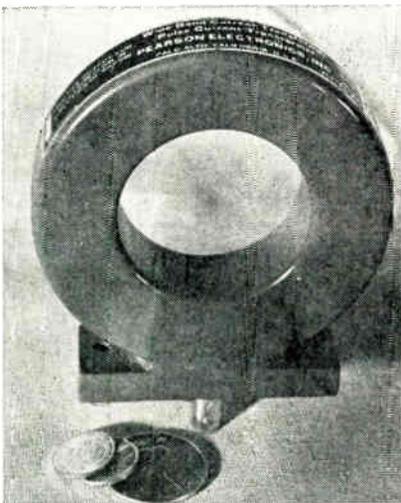


This series of modified series N precision coaxial connectors, known as the TWT series, feature a low vswr. They are available for X-band and S-band applications and for either RG-55/U flexible cable or 0.140 in. dia., 50Ω rigid cable. Greomar Manufacturing Co., Inc., 7 North Ave., Wakefield, Mass.

Circle 275 on Inquiry Card

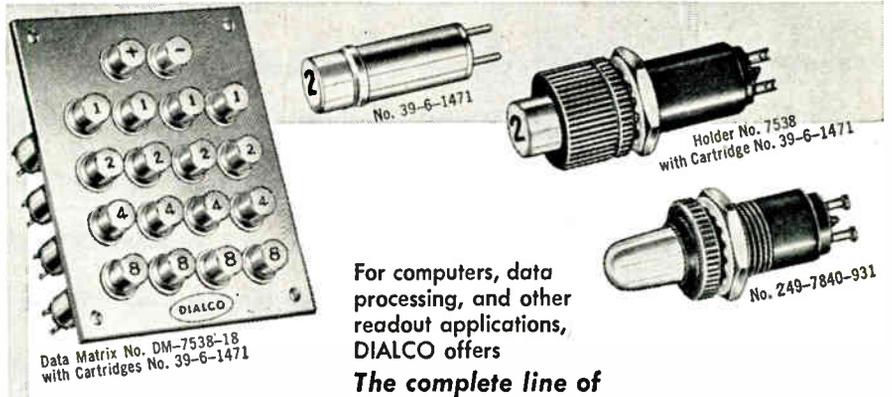
CURRENT TRANSFORMER

Wide-band unit has freq. response of 1cps to 35Mc.



Model WBCT-110 is for precision measurement of audio, video, r-f and pulse currents in conductors at low or very high voltages or in a beam of charged particles. It has 0.1 (+1%, -0%) v/a output, 20nsec. risetime, 0.0005% droop/μsec, and is rated at 30kv flashover in air and hundreds of kv in oil. The dimensions are 4 in. O.D. and 2 in. I.D. The unit is plugged into an oscilloscope using 52Ω cable. Pearson Electronics, Inc., 707 Urban Lane, Palo Alto, Calif.

Circle 276 on Inquiry Card



Data Matrix No. DM-7538-18 with Cartridges No. 39-6-1471

For computers, data processing, and other readout applications, DIALCO offers

The complete line of

DATALITES®

Ultra-miniature DATALITES are available in several basic styles: CARTRIDGE HOLDERS that accommodate DIALCO's own replaceable Neon or Incandescent LAMP CARTRIDGES. Unit mounts in 3/8" clearance hole...For multi-indication, LAMP CARTRIDGES are mounted on a DATA STRIP or DATA MATRIX in any required configuration...DATALITES with permanent (not replaceable) Neon Lamps may be had with or without built-in resistors...The "DATA CAP" series features a rotatable read-out lens cap; accommodates a clear (colorless) cartridge. LEGENDS may be hot-stamped on cylindrical lenses...Styles shown here are only typical. Send for information on the complete line.



"Data Cap" No. 250-7538-1471

Write for 8-page Datalite Brochure L-160C.



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Wassco® GLO-MELT

... for Fast-Efficient Accurate-Permanent connections.

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POWER UNITS • HANDPIECES • ACCESSORIES for all jobs from Micro-Miniature to Heavy-Current connectors

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Powertron

AC POWER SUPPLIES

A complete line of single phase, two phase and three phase electronic power supplies with output power ranging from 3 watts to 9 KVA.

Featuring:

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- Regulated output voltage.
- Low distortion.
- Many standard optional features to suit your requirements.

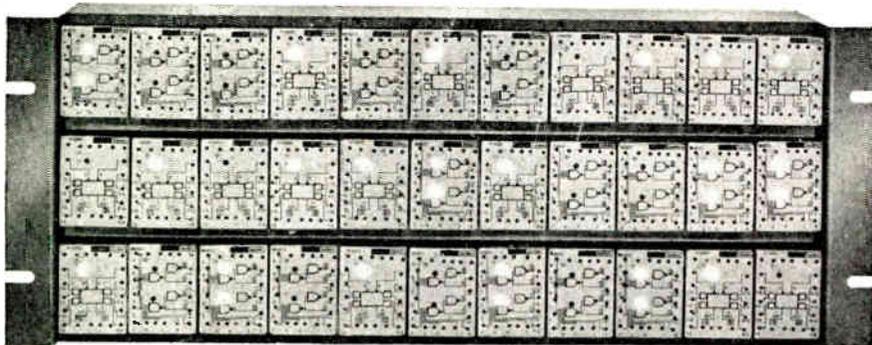
WRITE FOR OUR NEW POWERTRON SPECIFICATION CATALOG

INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th STREET • NEW YORK 3, N. Y.

VISIT Booth #709-NEC Show, Oct. 8, 9, 10, International Amphitheatre, Chicago

Circle 118 on Inquiry Card

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New Facilogic® for Digital Systems Breadboarding

FACILOGIC BY HARMAN-KARDON PROVIDES THE ONE PRACTICAL system for digital breadboarding, special test equipment, personnel training . . . easily, simply, economically. 14 exclusive features, including built-in logical indicators; front and back connections; no maze wiring; MIL spec symbols; simplified loading rules. Breadboard your system with FACILOGIC®—convert readily, for final construction, to HARMAN-KARDON logic modules and exclusive FLEXI-CARDS.

Write now for your FREE Guide to Boolean Algebra and complete FACILOGIC® purchase and exclusive "lease-loan" information. Request an in-plant demonstration, on your own problem with no obligation.

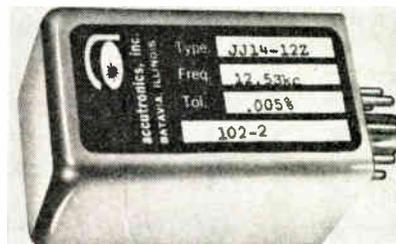
HK-79

Data Systems Division. **harman kardon** Incorporated, Plainview, New York

NEW PRODUCTS

L-F OSCILLATOR

JJ10 tuning fork oscillator series has a freq. accuracy of $\pm 0.002\%$.

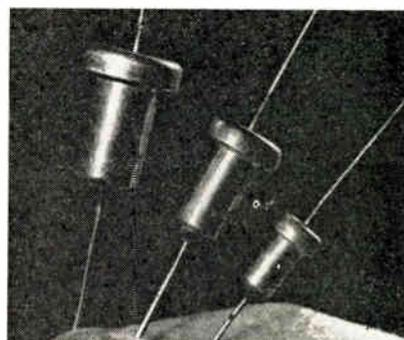


This silicon transistorized oscillator operates at any specified frequency from 50cps to 20kc. The JJ10 series gives a sine wave with greater than 3v RMS with less than 5% total harmonic distortion or a square wave with greater than 15v peak-to-peak with less than 5 μ sec. rise time. Freq. tolerance is $\pm 0.005\%$ from 0° to +60°C. Operates at any specified voltage from 6 to 60vdc. The unit measures 1½ x 1½ x 2½ to 4½ in. depending on freq. Accutronics, inc., 12 S. Island, Batavia, Ill.

Circle 277 on Inquiry Card

TANTALUM CAPACITORS

Type CL44 and CL45 tantalum capacitors meet Mil-C-3965.

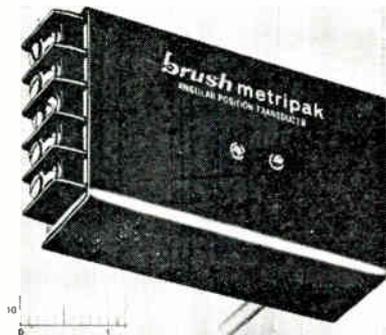


Types CL44 and CL45 tantalum capacitors conform to Characteristic C of Mil. Spec. Mil-C-3965 and are available in ratings of 1.7 to 560 μ f, 6 to 85v with a temp. range of -55° to 125°C. These capacitors are designed for military missiles and spacecraft. The patented leak-proof, crimped seal used in these capacitors will withstand the low atmospheric pressure of space environments. Rectifier-Capacitor Div., Fansteel Metallurgical Corp., N. Chicago, Ill.

Circle 278 on Inquiry Card

MOTION TRANSDUCER

Compact angular motion unit gives high dc output voltage.

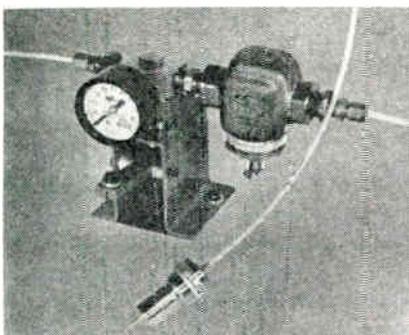


Metripak model 33 01 is offered as a basic building block for use in control, weighing, and instrumentation systems. It operates on 115v RMS, 60cps, and produces a min. output of 0.6vdc/degree of shaft rotation from 0 to 18°. Specs: Stepless resolution, 0.01% repeatability; linearity 0.10% at 10° shaft position into a 100kΩ load; temp. stability is 1% over a 100°F range and 2% from -40° to +160°F. Measures 3.9 x 2.3 x 1.0 in. Brush Instruments, 37th & Perkins, Cleveland 14, Ohio.

Circle 279 on Inquiry Card

EPOXY APPLICATOR

For application of epoxies, potting and brazing compounds.



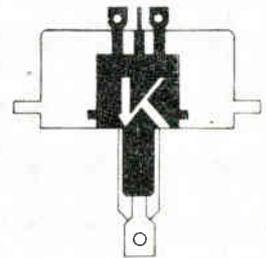
A full range of adhesive jobs from minute droplets to the potting of complete assemblies are possible. The Otto Injector consists of 3 elements: a nozzle-reservoir; a bench mounted air operated metering control; and a treddle operator. Highly viscous or very thin epoxies and long fiber types are handled equally well. The standard 1/2 in. size nozzle Injector is for precise jobs. The 1 1/4 in. size is for long run and large assembly jobs. Otto Controls, 8511 Lincoln Ave., Morton Grove, Ill.

Circle 280 on Inquiry Card

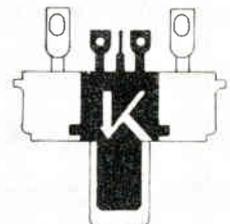
KEARFOTT

KEARFOTT power transistors average 30% lighter, 50% smaller and occupy 50% less mounting surface. **NEW** modified TO-10 hermetically sealed case and improved internal construction provide miniaturized **GERMANIUM PNP POWER** devices with ratings up to **120V @ 15 AMPS** (our #KPG2000). We are also a **DEPENDABLE SOURCE** for the following devices with ratings up to **200V@ 3AMPS**: 2N538 through 2N540A, 2N1202, 2N1203, 2N1326, 2N1438, 2N1466, 2N1501, 2N1502, 2N1504/10. Also available in TO-13 cases: 2N143/13, 2N156, 2N158, 2N158A, 2N1437, 2N1465.

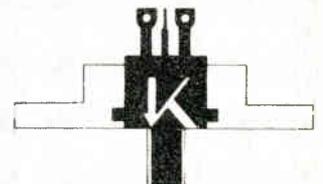
The following **DISTRIBUTORS** stock these devices: Carter Assoc. Inc., Scottsdale, Arizona; Cramer Electronics, Inc., Newton, Mass.; Hollywood Radio & Electronics, Hollywood, California; Solid State Specialist, Mountain View, California; Terminal-Hudson Electronics, New York City; Valley Electronics, Inc., Towson, Maryland. Write Kearfott Division, General Precision, Inc., Little Falls, New Jersey or 437 Cherry Street, West Newton, Massachusetts. These devices are designed, manufactured and life tested by **KEARFOTT SEMICONDUCTOR CORP.**, West Newton, Mass.



TO-36



MT-7



TO-3



TO-10



RO-28-1

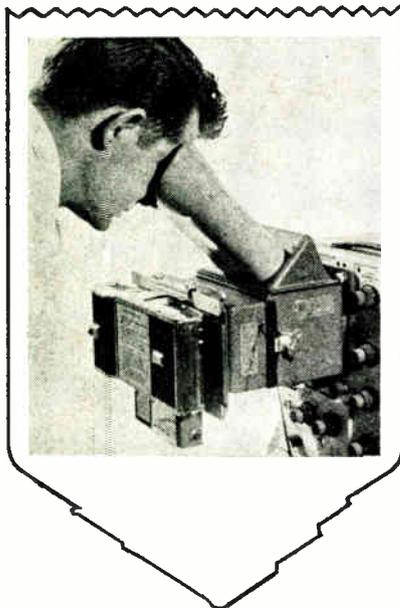
Note how little volume and space are required by Kearfott's Transistors



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NEW LOW PRICED

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POLAROID® PRINTS IN 10 SECONDS

It's new! It's efficient! It's versatile! It's the Beattie-Coleman K5 Oscilloscope Camera.

- Direct view while recording.
- Single traces at 1:0.9 ratio or 13 traces at 1:0.7 on one frame of Polaroid Land film.
- Choice of Polaroid roll film back or 4x5 back for Polaroid or regular cut film holders.
- Uses Polaroid Land 10,000 speed film.
- f/1.9 Oscillo-Raptar lens.

\$395 complete

ACCESSORIES:

- Electric shutter actuator.
- Data recording chamber.

Circle number on card for info. on full Oscillotron line.

"Polaroid"® by Polaroid Corp.

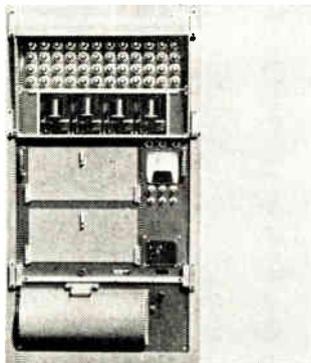


1000 N. Olive St., Anaheim, Calif. • PR 4-4503
Circle 121 on Inquiry Card

NEW PRODUCTS

FAULT-RECORDING SYSTEM

Records faults and abnormal conditions on electric power system.

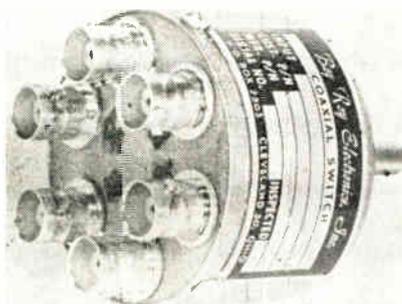


Designated as Type OS-10, the equipment is a grouping of modules which can be assembled into a complete system for fault recording to meet specific requirements. Two recording modules available. One, a strip-chart recorder with fast-starting features, capable of starting and accelerating to full chart speed in 4msec. when a fault occurs. The other is a drum recorder for very fast and short transients. An Automatic processor module is available for use with the continuous-drive recorder. Western Electrodynamics, P. O. Box 98, Colorado Springs, Colo.

Circle 281 on Inquiry Card

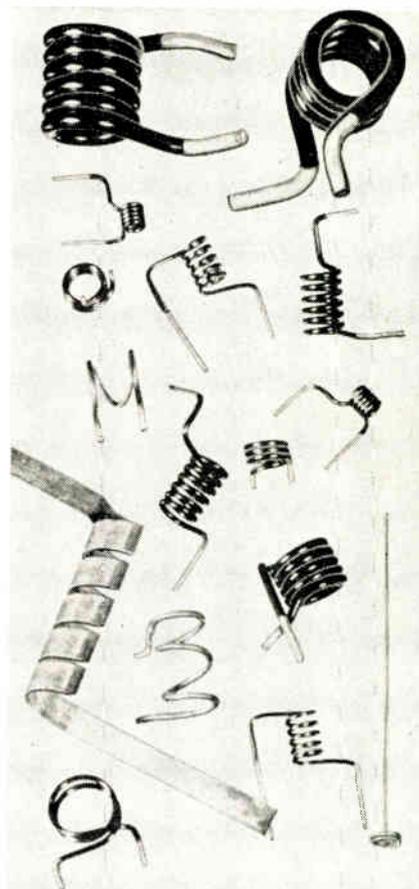
MINIATURE COAXIAL SWITCH

High r-f performance characteristics up to 3,000mc.



Miniature 2P2T unit is manually operated and equipped with BNC connectors. Can be supplied with electrical actuators and a variety of r-f connectors. Specs.: freq., 0—3,000mc; vswr, less than 1.15:1 to 900mc, 1.20:1 to 2000mc, 1.40:1 to 3000mc; isolation, greater than 55db to 900mc, 45db to 3000mc, between poles 60db to 900mc; insertion loss, less than 0.15 to 900mc, 0.20 to 3000mc; and handles 100w. Bay Roy Electronics, Inc., 16608 Madison Ave., Cleveland 7, Ohio.

Circle 282 on Inquiry Card



**High production
AIR WOUND
CUSTOM COILS
at "stock" prices!**

Stop paying "custom" prices for special application air wound coils. ROWLEY can produce air wound RF or choke coils of your design within 10 days, at "stock" prices! . . . magnet-wire coils with ends stripped and tinned, ready for assembly, in the following range: .010 to .187 inch diameter wire — 50 turns maximum. Send us your specifications for quotation . . . no obligation, of course.



Circle 122 on Inquiry Card

NEW PRODUCTS

DIGITAL MILLIVOLTMETER

The V60A is designed for low level dc voltage measurements.



Low-cost, full 4-digit millivoltmeter has a data printer connection and built-in automatic print control. It has a precision and sensitivity of $\pm 10\mu\text{v}$ without preamplifier. Can be used to read outputs of strain gages, thermocouples and other transducers; calibrate other millivolt measuring, recording, plotting or control devices; and test semiconductors. Absolute accuracy is $\pm 0.1\%$ of reading or $\pm 10\mu\text{v}$, whichever is greater. Its range is $\pm 99.99\text{mv}$ full scale. Non-Linear Systems, Inc., Del Mar, Calif.

Circle 283 on Inquiry Card

UNIVERSAL SCAN CONVERTER

Converts video information from any scanning format to another.

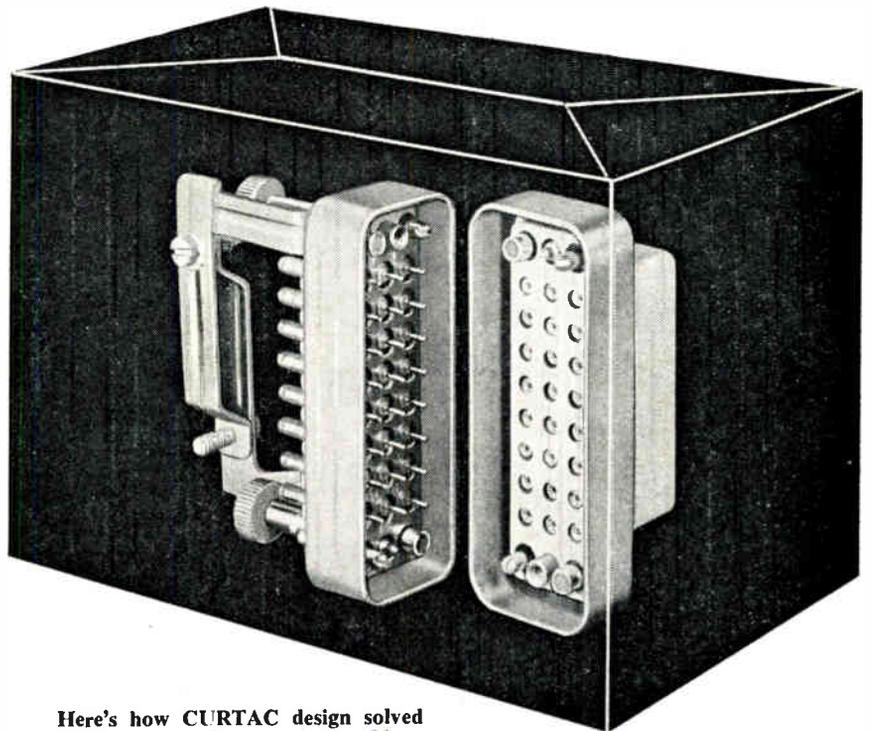


The GEC 6021 Universal Transistorized Scan Converter is designed around a dual gun storage tube and is capable of converting radar PPI data to a bright TV display on an ordinary TV monitor which can be viewed under high ambient light conditions. It is also capable of converting from one TV scan format to another. The entire unit can be rack mounted in less than 37 in. of panel space; weighs 106 lbs. Consumes 175w of power. General Electrodynamics Corp., 4430 Forest Lane, Garland, Tex.

Circle 284 on Inquiry Card

PACKAGED SOLUTIONS

...to unusual
connector problems



Here's how CURTAC design solved another unusual connector problem: In this 24-contact special purpose unit, the male connector has a "removable" type coaxial contact; the female has a "removable" CURTAC contact. The male contacts are housed in an aluminum body for common grounding; the female contact is in a body made of plastic Diallyl Phthalate.

CURTAC®

For simple . . . complex . . . or special connector requirements — CURTAC design principles give you consistent and reliable connector performance.

For Coaxial Connectors, Regular Connectors or in any combination of coaxial and regular contacts, CURTAC design gives you these features and advantages:

- New and patented closed entry construction.
- Multi-wire linear contacts — smooth mating and elastic wrapping action of each contact wire, under tension.
- Consistent and reliable electrical performance — dependable contact pressure, low voltage drop and high current rating.
- Withstand 50g shock, 20g vibration and temperatures from 125°C. to -65°C. without damage or contact chatter.
- Function to specification after 100,000 insertion and withdrawal cycles.
- Meet or exceed all applicable Mil. Specs.

Electronic Fittings Corporation can supply you with a variety of standard CURTAC Rack and Panel and Coaxial connectors, or will design, engineer and produce CURTAC Connectors to meet your specific requirements. Write today, for complete information and literature.

efc ELECTRONIC FITTINGS CORPORATION 

Route #7 • Danbury, Connecticut

A subsidiary of

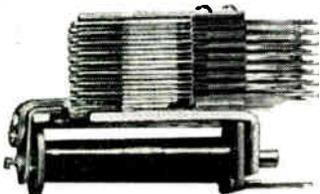
CURTISS-WRIGHT CORPORATION

Circle 123 on Inquiry Card

Stromberg-Carlson® TELEPHONE-TYPE COMPONENTS

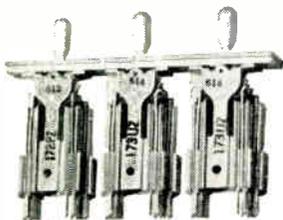
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wide range, for many electromechanical switching applications. Send for Bulletin T-5000R3.

KEYS



many designs available in pushbutton, cam and twist types. Send for Bulletin T-5002R2.

TELEPHONE HANDSETS



lightweight high-efficiency models. Standard or with switch assemblies. Send for Bulletin T-5017R.

Plus all other telephone switchboard components. For bulletins and more information, contact our nearest Sales Office. Atlanta: 750 Ponce de Leon Place N.E.; Chicago: 564 W. Adams Street; Kansas City (Mo.): 2017 Grand Avenue; Rochester: 1040 University Avenue; San Francisco: 1805 Rollins Road.

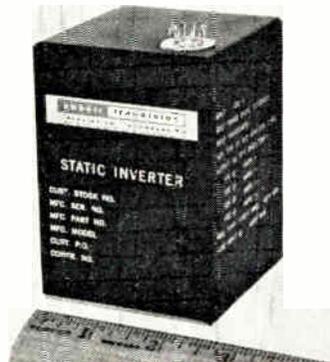
GENERAL DYNAMICS TELECOMMUNICATION

Circle 124 on Inquiry Card

NEW PRODUCTS

DC-DC STATIC INVERTERS

Designed for use with klystrons, magnetrons and CRT tubes.

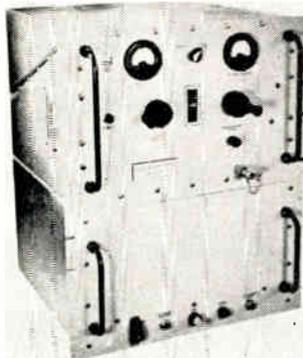


Small-size, transistorized static inverter converts 28vdc to a single output from 901 to 2000vdc. Provides close regulation for line variations, and is protected against short circuits, transient spikes and reverse polarity damage. Fully encapsulated and hermetically sealed, Model A6D1 weighs 26 oz. and measures 2 3/4 x 2 3/4 x 4 in. Units are supplied with threaded inserts and 4 matching threaded studs are included. Abbott Transistor Laboratories, Inc., 3055 Buckingham Rd., Los Angeles 16, Calif.

Circle 285 on Inquiry Card

MICROWAVE OSCILLATOR

Continuously tunable from 8500 to 9600mc; dial accuracy of 0.01%.



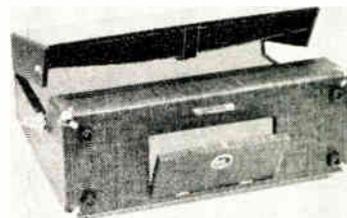
Model G120 stable microwave oscillator is for shipboard environments as a stable local oscillator and transmitter signal source for high resolution radar systems. The dial is calibrated in 1 mc increments. Short term stability is 2 parts in 10⁵ (nominal) and 5 parts in 10⁵ max. Long term stability is 1 part in 10⁵ for 8 hours. Power output is 500mw min. with stability of ±1.0db. It is also useful as a secondary standard. Frequency Engineering Laboratories, P. O. Box 504, Asbury Park, N. J.

Circle 286 on inquiry Card

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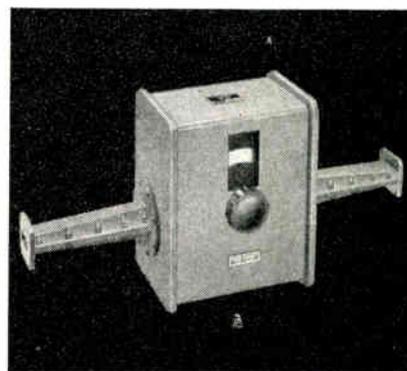
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DIRECT-READING ROTATING VANE ATTENUATOR

Model X1121A is a continuously variable, precisely calibrated, direct-reading attenuator specifically designed to provide extreme accuracy and reliability. Attenuation range is 0 to 50 DB with a calibration accuracy of 0.1 DB or ±2%, whichever is greater. Excellent time/stability is combined with an input power capacity of 10 watts average, insertion loss of 1 DB max. and a VSWR of 1.5 max. over the full band width of 8.2 to 12.4 Gc/s.

Model X1121A
Available from stock

\$247.50



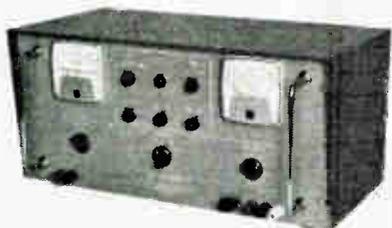
BUDD-STANLEY CO.
175 Eileen Way, Syosset, Long Island, N. Y.
NEW 1962 CATALOG AVAILABLE UPON REQUEST

Circle 126 on Inquiry Card

NEW PRODUCTS

TRANSISTOR TEST SET

Automatically tests Alpha-Beta parameters of transistors.

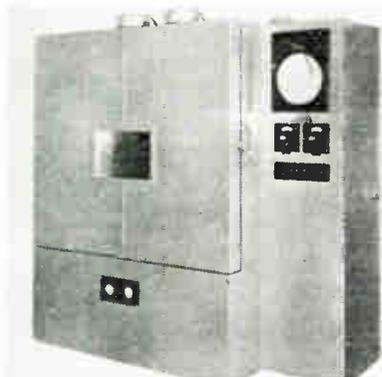


Model AB5000 measurements are made on a dynamic ac basis as a function of emitter or collector bias. In addition to checking the Alpha-Beta parameters, the unit also checks for leakage (I_{co}), and Alpha-Beta cut-off. The instrument has a regulated bias source which permits dc bias current ranges of 0-5000ma and collector bias of 0-100vdc npn or pnp. The Alpha measurement range is 0-0.999 and the Beta range is 0-600. Electronic Research Associates, Inc., 67 Factory Pl., Cedar Grove, N. J.

Circle 287 on Inquiry Card

ENVIRONMENTAL CHAMBER

Designed for shock testing at various temperatures.



Environmental chamber Model WF-64-40+300 is for shock testing of electronic components at temps. between +300° and -40°F. With an unobstructed interior of 48 x 48 x 48 in., the unit accommodates a variety of shock testing devices. Frost-free viewing window and vapor-proof interior lighting permit observation or photography during tests. Temps. are recorded on a 12 in., 24 hr. recorder. Temp. can be changed from +200° to 0° in 8 minutes. Webber Mfg. Co., Inc., P.O. Box 217, Indianapolis 6, Ind.

Circle 288 on Inquiry Card



New, economical
15/16" dia. 5-watt wirewound
variable resistors

Versatile Series AW

Available with: 1 Bushing Mounting 2 Twist Tab Mounting 3 Pull-on, Push-off Switch 4 Straight Tandems 5 Concentric Tandems. (The new Series AW wirewound controls can also be used with CTS Series 45 1/16" dia. 1/2-watt carbon control to make any combination of straight or concentric tandems desired.) Series AW can be supplied in L and T pads. Element wire can be soldered to end terminals if required.

Priced less than larger diameter lower wattage commercial wirewound variable resistors. Unique high temperature heat resistant winding core and liner permit a 5-watt rating at 25°C, or a 4-watt rating at 55°C derated to no load at 105°C. Resistance range is one ohm through 25,000 ohms, linear taper. The unit is completely enclosed for full protection.

Write for Catalog 2100. (West Coast Inquiries to Chicago Telephone of California, Inc., 1010 Sycamore Ave., So. Pasadena, Calif.)

CTS OF ASHEVILLE, INC.
SKYLAND, NORTH CAROLINA



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ELGEET ZOOM NAVITAR



Elgeet offers Vidicon television cameras and 16mm cameras the first Zoom Navitar, a manually-controlled 4:1 zoom with a 20mm to 80mm range— $f:1.8!$ This new lens achievement is optically compensated to hold focus through the entire zoom action. Fourteen elements—covers Vidicon format—resolves 600 lines—linear zoom action by ring—list price: \$400. For information, write for Catalog 2080-CZ18.

Elgeet OPTICAL COMPANY, INC.
303 Child St., Rochester 11, N. Y.

EL-98

Circle 128 on Inquiry Card

NEW PRODUCTS

LOG-VOLTMETER-CONVERTER

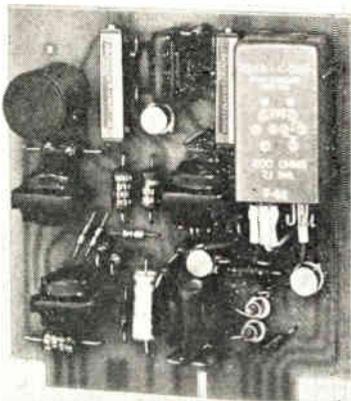
Covers 3,160:1 or 70db range on one continuous scale.



Model HLVC-150 Log Voltmeter-Converter has mirror-backed scale giving continuous ranges of 0.001 to 3.16v, 0.01 to 31.6v and 0.1 to 316v. Lower linear db scale moveable over ± 75 db to permit decibels to be read relative to any selected reference level. Output for log recording is 1mv/db with 0.2db absolute accuracy over 70db range. Operates within specs. with dc or ac inputs from 10cps to 50kc. Power required: 100w, 125vac 50/60cps. Houston Instrument Corp., P.O. Box 22234, Houston 27, Tex. Circle 289 on Inquiry Card

VOLTAGE LIMIT DETECTOR

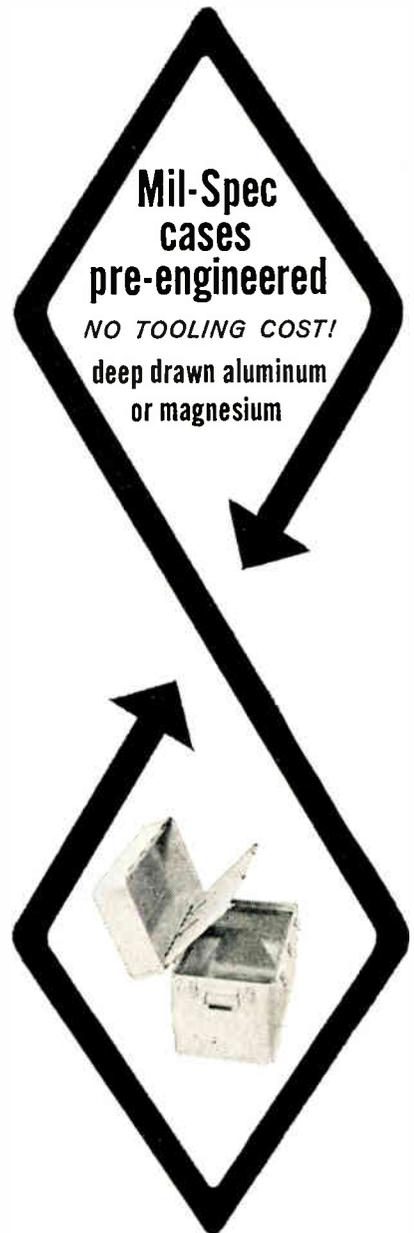
Indicates out-of-tolerance condition by means of relay closure.



The Model LD654, used in conjunction with multiplier resistors, determines whether a monitored voltage is within predetermined limits. For dc signal voltages from 1v and ac signal voltages from 5v to any max. required, the LD654 has a "GO" range adjustable from 15% to 40% of the nominal value of the signal voltage. Dimensions: 1.2 x 4.0 x 4.0 in. Specs: Input impedance, 1000 Ω /v; output, SPDT relay contacts rated 2a resistive at 28vdc; response time, 25msec. max. Verco Inc., 1430 130th N.E., Bellevue, Wash. Circle 299 on Inquiry Card

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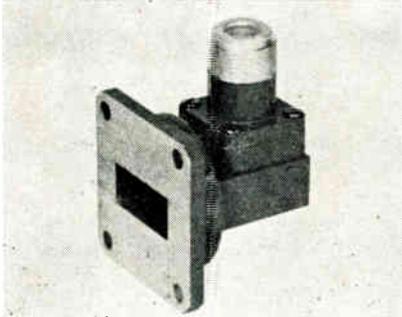
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Telephone Victoria 9-5521 area code 213
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Circle 127 on Inquiry Card

NEW PRODUCTS

COAXIAL ADAPTERS

Matched waveguide to Type-N coaxial adapters cover 2.60 to 12.4cc.

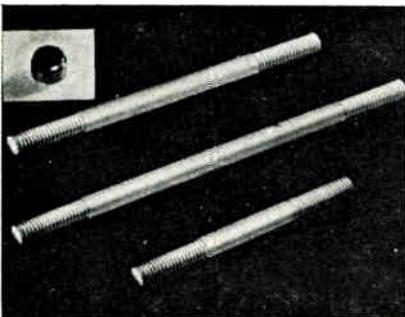


The units consist of a section of rectangular waveguide which contains a transition upon which is mounted a short section of coaxial line. The center conductor of this line is introduced into the broad wall of the waveguide section acting as a probe. The adapters transmit power in either direction and they have been especially designed to provide an improved vswr characteristic of 1.25 max. over the waveguide freq. range. Waveline Inc., Caldwell, N.J.

Circle 412 on Inquiry Card

THREADED NYLON STUDS

Now available with 4-40 threads at each end.



Solid nylon rods with 3/4 in. of American Standard 4-40 threads at each end can be supplied in 2 1/4, 3 1/2 and 4 1/2 in. lengths. Black nylon cap nuts also available in the 4-40 size. Useful as insulated adjusting knobs; decorative panel fasteners; making longer screws when used with the threaded nylon studs; and capping stud or screw end. The nylon cap/nut threaded stud combination also finds use as non-conducting spacers and random lengths screws. Weckesser Co., Inc., Dept. ES-2, 5701 Northwest Hwy., Chicago 46, Ill.

Circle 413 on Inquiry Card

IDEAS, too, grow Tall in Washington ↑ State



...and IDEAS are the stock in trade of the Electronics Industry

Trees, mountains and buildings soar to the skies in Washington, but not alone. For here the minds of creative men find pleasant stimulation. Your scientists, researchers and engineers will enjoy a happy, agreeable atmosphere, with opportunity for cultural, educational and recreational activity. Too, you'll find an undreamed-of wealth of natural resources to help make your business prosper. If you're relocating, or expanding, won't you consider surprising Washington State?

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REGULARLY REVIEWED

CIRCUITS

A D.C. Inverter With CR Timing, J. R. Nowicki. "Elec. Eng." July 1962. 5 pp. A square-wave inverter is described in which timing is controlled by the decrease of base current, using a CR timing circuit. (England)

Trigger Circuits, R. Duchamp. "El. et. Auto." June 1962. 5 pp. Diodes are generally used in steering circuits because of the resulting economy. Transistors may also be used, either for steering or amplifying the trigger pulse. (France)

Avalanches in a Free-Running Multivibrator, A. C. Bull, J. E. Houldin. "Elec. Eng." July 1962. 3 pp. A free-running multivibrator circuit using two triode valves produces a waveform in which there are abrupt changes in grid and anode voltages, referred to as avalanches. It is shown that the initiation of an avalanche may be assumed to be at a point where the high-frequency gain of the system considered as a two-stage RC-coupled amplifier just becomes unity. (England)

An Active RC Filter Using Cathode-Followers, P. J. W. McVey. "Elec. Eng." July 1962. 6 pp. Two active RC networks are described, each using a single cathode-follower as its active element. The transmission loss of one varies with frequency in a manner resembling the insertion loss of an m-derived LC filter, the other performs a function similar to that of an LC prototype. (England)

Advantages of a Current-Derived Wien Bridge Oscillator, Maurice Price. "Canadian Electronics Engineering." July 1962. 2 pp. The current-driven Wien network offers significant advantages over the conventional voltage-driven type. Advantages are simpler circuitry and less dependence on transistor parameters. It appears to be easier to achieve these desirable qualities with the current-derived network. (Canada)

Crystal-Filter Design for Multi-Channel Application, A. S. Chester. "El. Tech." April 1962. 8 pp. A crystal filter design technique is described which, by virtue of the circuit simplicity, has been found to be especially suitable for multi-channel applications. (England)

Negative Conductance in Parametric Amplifiers, G. Schilling. "Freq." May 1962. 6 pp. Parametric amplifiers may present input admittances with negative real components. Such negative conductances find applications for reducing the damping of tuned circuits. They depend very strongly on frequency. This frequency response of the negative input conductance was studied in detail by reference to the example of a parametric amplifier with parallel-resonant circuits. (Germany)

COMMUNICATIONS

A Method for Optimum Loss Distribution in Communication Networks, H. Kremer. "Freq." May 1962. 3 pp. With a linear dependence between circuit costs (without basic costs) and line losses, the optimum loss allocation in communications networks can be derived with the aid of simple calculating rules according to a "nodal-point theorem" derived in an earlier paper. (Germany)

Double Spot AFC for Radio Teleprinter Reception, K. Grabe. "Nach Z." June 1962. 7 pp. AFC at the receiving end of radio teleprinter links (F_1 or F_2) is a special problem in as far as the signal to be considered to be a control signal varying at liberty between two or four values. A proposal is made for employing a double spot control which is extended by an inoperative interval affecting only one direction of transmission. (Germany)

COMPUTERS

A Novel Computer Output Printer, A. W. Walens. "Brit. C & E." July 1962. 6 pp. Principles of a printer capable of 100 characters/sec. using a five-by-five matrix of hydraulically-operated styli was demonstrated by Creed and Co. some time ago. The device has now reached a production stage and is described in this article. (England)

Magnetic films for Storage of Information, R. C. Kell. "Brit. C & E." July 1962. 4 pp. An outline is given of the methods of preparing and testing the films. (England)

Bridge Electronic Digital-To-Analog Functional Converter, N. A. Smirnov, V. B. Smolov, V. S. Fomichev. "Avto. i Tel." Vol. 23, No. 6. 16 pp. Bridge digital-to-analog computers are considered which realize the functional treatment of the digital information according to correlations. $N_2 = F(N_x)$, $N_2 = \Phi(N_x, N_y)$. The described circuits have in the bridge arms the conductance controlled by the digital code. The data of the experimental investigation of the controlled conductances of the bridge arms realized on transistors are proposed. (U.S.S.R.)

Characteristics Of Magnetic Devices With Multi-Aperture Cores, G. D. Kozlov. "Avto. i Tel." Vol. 23, No. 6. 9 pp. Analysis of magnetization processes in multiaperture core devices is described, the two-aperture transfluxor being taken as a model. The way of determining an operation zone and characteristic of transfluxor control is proposed. (U.S.S.R.)

CONTROLS

Conditions of Autonomous Control For Continuous Action Chemical Reactor, V. A. Dozorov. "Avto. i Tel." Vol. 23, No. 6. 5 pp. A continuous action reactor, in which an arbitrary chemical reaction goes on is considered as an object of automatic control. (U.S.S.R.)

Semi-Graphical Method of Determination of Transfer Function of Automatic Control System with the Help of Known Transient Function, L. N. Darovskikh. "Avto. i Tel." Vol. 23, No. 6. 3 pp. A semi-graphical method of determining the transfer function coefficients of the linear automatic control system with the help of the known transient function is described. The example of the determination of the coefficients is proposed. (U.S.S.R.)

Electronic Automatization of Elevators, J. P. M. Seurot. "El. et. Auto." June 1962. 8 pp. Automatic control of elevators constitutes a typical logic problem. Electronics can provide industrial solutions unmatched for flexibility, elegance and economy. Use of semiconductors adds to the reliability and durability of installations. Design of a four-floor equipment using memory and a coincidence matrix logic is presented. (France)

GENERAL

Correlation Functions and Spectral Densities of Difference of Two Random Functions With Time Quantization, G. S. Sazonov. "Avto. i Tel." Vol. 23, No. 6. 3 pp. Correlation functions and spectral densities of the difference between a random function and its quantized values as well as the difference of quantized random functions with a displaced argument are determined. (U.S.S.R.)

Prewired Printed Circuits, P. Lemeunier. "El. et Auto." May 1962. 3 pp. Design of printed circuit prototypes is simplified by the use of spe-

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
El. Tech. Electronic Technology
GEC J. General Electric Co. Journal
J. BIRE. Journal of the British Institution of Radio Engineers
Proc. BIEE. Proceedings of Institution of Electrical Engineers
Tech. Comm. Technical Communications

FRANCE

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
El. et Auto. Electronique et Automatisme
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. Elektronische Rundschau
Freq. Frequenz
Hochfreq. Hochfrequenz-technik und Elektroakustik
Nach. Z. Nachrichtentechnische Zeitschrift
Rt. Regelungstechnik
Rundfunk. Rundfunktechnische Mitteilungen
Vak. Tech. Vakuum-Technik

POLAND

Prace ITR. Prace Instytutu Tele- i Radiotechnicznego
Roz. Elek. Rozprawy Elektrotechniczne

USSR

Avto. i Tel. Avtomatika i Telemekhanika
Radio. Radio
Radiotek. Radiotekhnika i Elektronika
Rad i Elek. Radiotekhnika i Elektronika
Iz. Acad. Bulletin of Academy of Sciences, USSR

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cial cards. These cards are perforated at the standard spacing and carry parallel inter-connection bands of copper. (France)

On Plotting Equipment Complex Amplification Coefficient of Non-Linear Pulse Element, M. Korshunov. "Avto. i Tel." Vol. 23, No. 5. 12 pp. Determination of an equivalent complex amplification coefficient of a non-linear pulse element is considered. Investigation is based on the analysis of a pulse frequency response of a system linear part. (U.S.S.R.)

Elements of Pulse-Time Telemetering Systems, A. A. Abdullaev, I. A. Nabiev. "Avto. i Tel." Mar. 1962. 9 pp. Pulse-time telemetering system transmitters of several kinds are described. Indicating, recording and number-typing secondary devices are considered which fix measuring pulses sent by the transmitters. (U.S.S.R.)

Certain Aspects of Current Density Distribution on the Surface of a Strip and an Elliptical Cylinder in the Process of Cylindrical Electromagnetic Wave Diffraction, V. P. Mandrazhi. "Radiotek" 17, No. 5, 1962. 13 pp. A rigid solution of the problem of cylindrical wave diffraction of an elliptical cylinder is presented. The derived series-type solutions are changed into a form convenient for summation in computers. (U.S.S.R.)

Concerning Self-Oscillations in Discrete Extremal Systems, A. V. Netushil. "Avto. i Tel." Mar. 1962. 10 pp. Graphical investigation of the dependence of the extremum search character on the object static characteristics is described. Conditions of the self-oscillations appearance are determined. Self-oscillations appearing in one-channel and two-channel optimizers with search of different types are considered. (U.S.S.R.)

Automatic Optimizer for Search of Least of Several Minima (Global Optimizer), I. N. Bocharov, A. A. Feldbaum. "Avto. i Tel." Mar. 1962. 13 pp. Possible construction principles of a global optimizer are considered. Elaborated circuit of the optimizer is described. Data of testing the experimental model of the described global optimizer are proposed. (U.S.S.R.)

A Review of the Development of Vacuum Technology, H. Schimank. "Vak. Tech." April 1962. 6 pp. Article reviews the development of vacuum technology which is thought to have proceeded in 3 stages. (Germany)

Synthesis of a Multistage Filter With the Use of a Recirculator, I. S. Gonorovskiy. "Radiotek" 17, No. 5, 1962. 11 pp. A synthesis principle is described. It is based on replacing a single passage of a signal through a number of filter stages by a manifold repeated passage of a signal through the one and the same filter stage placed into a feedback loop. Application of this principle is illustrated on an optimal filtration of a radio pulse with frequency modulated fill-in. (U.S.S.R.)

A Model of Discrete Linear Programming, A. I. Moroz. "Avto. i Tel." Vol. 23, No. 5. 12 pp. A problem of finding an optimum program for control of transits in the transport system is described. The problem is formulated as a discrete linear programming problem. A method for its solution is proposed. (U.S.S.R.)

Low Q Band-pass Filters, R. O. Rowlands. "El. Tech." April 1962. 5 pp. The problem considered in this paper is how to modify a lossless filter design in order to preserve the relative discrimination between a wanted frequency and an unwanted band when the filter elements are lossy. This is achieved by a change in the scale of the normalized transfer function. (England)

Electronics in Satellite "Ariel," "Brit. C.&E." June 1962. 2 pp. Background information on the first British satellite, formerly designated S51, describes equipment in the satellite and experiments to be carried out in conjunction with three university colleges. (England)

Modern Private Teletypewriter Systems, J. V. Evans & D. C. E. Hanney. "Brit. C.&E." April 1962. 5 pp. In this article, various types of system are mentioned with particular reference to a system recently installed in Britain by Creed & Co. for the Aluminum Ltd. of Canada group of companies. (England)

Spectral Analysis of a Packet of Pulses, M. I. Finkelstein. "Radiotek" 17, No. 4, 1962. 5 pp. The spectrum of a packet of pulses with a symmetrical envelope is determined and a method is given for the evaluation of the degree of concentration of the spectrum near the main regions of the envelope. (U.S.S.R.)

Tuning a Selective RC Amplifier with Amplified Selective Negative Feedback, A. I. Belitchenko. "Radiotek" 17, No. 4, 1962. 8 pp. Criteria for tuning a high-Q R-C amplifier with amplified selective negative feedback are analyzed. Phase relationships are determined in various sections

of the amplifier. It is shown that, at or near the resonant frequency, positive feedback must be eliminated by correcting the phase shift caused by the input impedance of the twin-T network. (U.S.S.R.)

A Strip Line for the Investigation of Steep Pulses, D. Seitzer. "Freq." April 1962. 6 pp. A coplanar strip line results as a line type with which the influence of inhomogeneities on the pulse shape can be investigated. Its characteristic impedance is defined independently of the environment and it can be varied by simple means within wide limits. (Germany)

Variable Bandpass and Dividing Networks for Centimeter Waves, F. Kunemund & G. Enslin. "Freq." April 1962. 7 pp. Microwave systems often call for filters and dividing networks whose mid-band frequency can be varied within relatively wide ranges, while their bandwidth is to remain at least approximately stable. It is shown that a solution which presents economy with respect to compact layout and high tuning accuracy can be attained with band-pass filters consisting of waveguide resonators with coaxial connecting lines and capacitive pin coupling, tuning being effected with dielectric pins. (Germany)

Synthesis of Discrete Corrective Devices Based on Criterion of Finite Control Time, M. D. Potapov. "Avto. i Tel." April 1962. 8 pp. The synthesis of discrete corrective devices is considered when the number of the transient process intervals in the sampled-data system is more than minimum. Limitations applied to realized forms of the transient functions of the closed systems are shown. (U.S.S.R.)

Analytical Design of Optimum Controllers With Constant Disturbances, M. E. Salukvadze. "Avto. i Tel." Vol. 23, No. 6. 11 pp. A problem of the synthesis of an optimum linear system with constant disturbances is solved. An integral square error which is stored by the system, during the whole transient process is taken as an optimality criterion. Sufficient conditions of optimality of the obtained solution are proved. (U.S.S.R.)

Fades Characteristics Of Normal Noise, V. I. Tikhonov. "Avto. i Tel." Vol. 23, No. 6. 8 pp. For the normal stationary low-frequency noise with different spectral densities there are experimentally determined static fades characteristics. There are: average number of fades and distribution in finite duration realization, distribution of duration of fades, distribution of the largest values, distribution of distances between minimum and the next maximum and distribution of the time of the first crossing of the definite level. Some of the experimental results are compared to the theoretical ones. (U.S.S.R.)

Device Finding and Memorizing Sign of First Half-Period Of Sign-Variable Process, V. V. Shut. "Avto. i Tel." Vol. 23, No. 6. 3 pp. A device is suggested which finds and memorizes the first half-period sign in the sign-variable process. (U.S.S.R.)

Dynamic Range of a Magnetic Recording Channel, M. V. Gilitz. "Radiotek" 17, No. 4, 1962. 11 pp. The influence of uneven release of ferromagnetic carriers and detuning of the tape mechanism on the dynamic range of the track is analyzed for the case of direct magnetic recording of signals and use of AM, FM and pulse modulation. (U.S.S.R.)

Concerning Stabilization of Speed of Motor Rotation by Means of Relaxation Generators, M. I. Londer. "Avto. i Tel." April 1962. 6 pp. A block-scheme, an operation and a theoretical ground of the system of the accurate stabilization of the rotation speed of motors with pulse control and with a standard relaxation generator are considered. Stability of the system for control of the dc low-power motor speed is analyzed. (U.S.S.R.)

Concerning Sensitivity of Hydraulic Amplifier with Nozzle and Flapper, I. M. Krassov, et al. "Avto. i Tel." April 1962. 3 pp. Sensitivity of a hydraulic amplifier of the nozzle-flapper type under various conditions of its operation is analyzed. (U.S.S.R.)

Median Value Diagrams of Networks and the Traffic Distribution in Telephone Networks, F. Wittig. "Nach. Z." April 1962. 6 pp. Investigations during the years 1950 and 1955 have been continued with a median value network diagram for 1960. Changes in a subscriber trunk dialling network during the last decade can be derived from this with a great accuracy. (Germany)

Investigations Relating to the Efficiency of the Traffic in Subscriber Trunk Dialling Systems, K. P. Kustermann & F. Wittig. "Nach. Z." April 1962. 9 pp. Paper reports on the significance of traffic efficiency, its determination, and the results of traffic investigations. Causes of faults in S.T.D. systems and the failure rate in ex-

changes are investigated in detail. Type of faults and their location along the circuit are subjects of the report. (Germany)

INDUSTRIAL ELECTRONICS

Experiments on Training Machine to Distinguish Visual Shapes, E. M. Braverman. "Avto. i Tel." Mar. 1962. 16 pp. An algorithm for training a machine to distinguish visual shapes is described. Algorithm is not based on any concrete properties of the shapes which the machine learns at the moment. As a main principle of the algorithm there is taken only the hypothesis of compactness of shapes which, as the author supposes, is applicable to the shapes of the wide class. Experimental results of the suggested algorithm test are given. (U.S.S.R.)

About Definition and Specific Properties of Automatic Inspection, V. Yu. Kneller. "Avto. i Tel." April 1962. 10 pp. Modern opinions on the automatic inspection are analyzed. A new viewpoint is described which explains the automatic inspection process as a process of the automatic detection of events which determine control actions. (U.S.S.R.)

A Tape Controlled Rotary Table, J. H. Phillips. "Elec. Eng." June 1962. 5 pp. Equipment described was developed for the automatic and accurate positioning of the rotary table of a jig borer. A rotary version of the "Inductosyn" is employed and an accuracy of the order of ± 2 sec. of arc is attained. (England)

Industrial Applications of Radioactive Isotopes, F. Juster. "El. et Auto." Jan. 1962. 4 pp. Radioisotopes have found numerous industrial applications in the fields of measurement and control. Two representative designs are described. (France)

MATERIALS

Metallurgy and Electronics, A. Danzin & N. Thien-Chi. "Onde." Feb. 1962. 27 pp. This article examines the various items which electronics has brought to metallurgy in various ways: telecommunication, television, computers, process control, measurement, high frequency energy and scientific instruments. These electronic functions are only possible by the use of special metals whose degree of purity and the nature of whose manufacture are owed in great part to the metallurgy of special metals. There is a corresponding review of the problems posed in this way to metallurgy by electronics. (France)

Ferrite Materials for High Temperatures, Y. Lescroel. "Onde." Feb. 1962. 7 pp. After having examined the performance with the temperature of the various groups of ferrites, an account is given of the properties of new ferrites developed to work up to temperatures of the order of 250°C as well as the various examples of transformers and inductances made out of these materials. (France)

MEASURE & TESTING

Microwave Position-Fixing System Uses Digital Display, K. Aykawa, R. I. Matt. "Canadian Electronics Engineering," July 1962. 6 pp. This angular measurement system uses microwave and digital techniques. It is primarily designed as a control for inshore hydrographic surveying, but has application wherever a position may be found by measuring the included angles between three known points. (Canada)

Measurements of the Admittance-Frequency Response of Paralleled Spacecharge Diodes Operating in the Range of Drift Tube Effects, F. Seifert. "Nach. Z." June 1962. 4 pp. Measurement of the electronic admittance of plane-parallel spacecharge diodes with a large electrode spacing is carried out in the frequency range 300 to 600 MC by means of a resonance method. (Germany)

Determination of Distribution Function of Random Process by Experimental Data, V. M. Baburin, et al. "Avto. i Tel." Vol. 23, No. 5. 10 pp. Some problems connected with the determination of a distribution function of a stationary random process, obtained experimentally, as a realization are considered. Error for the obtained distribution function is estimated. (U.S.S.R.)

(Continued on page 200)

SOURCES

Two Practical-Class Waveform Generators, H. V. Beck. "Elec. Eng." June 1962. 6 pp. An outline is given of the use of commercially available electronic equipment in practical classes and the circumstances in which apparatus must be designed specifically for the classroom. Two waveform generators, both feeding up to fifteen sets of apparatus in parallel, are described in detail. (England)

Crystal Locked Blocking Oscillators for a Time-Mark Generator, P. P. Petry & C. S. Muller. "Elec. Eng." June 1962. 4 pp. A simple and accurate time-mark generator is described in which the main oscillator stage is a blocking grid oscillator locked by a quartz crystal. (England)

A New Ionization Manometer with Linear and Logarithmic Scale and its Potentialities. "El. Tech." June 1962. 5 pp. An ionization manometer is described which in addition to the conventional linear scale shows also a logarithmic scale which comprises the whole pressure range of 10^{-2} - 10^{-10} Torr. (Germany)

Characteristics of Magnetic Amplifier with AC Amplification, N. M. Tishchenko. "Avto. i Tel." April 1962. 5 pp. Results of the experimental analysis of simultaneous magnetization characteristics and static characteristics of the reactor magnetic amplifier with the amplification of the ac signal are described. (U.S.S.R.)

Color-TV Transmission Tests on an International Long Distance TV-Link between Darmstadt, Berne and Rome, K. Bernath, et al. "Nach. Z." April 1962. 6 pp. Color-TV transmission tests carried out during the last 2 years between Darmstadt, Berne and Rome have shown that in principle it is possible to transmit N.T.S.C. color-TV signals over international radio links of modern design covering distances in the order of those given from the reference circuit. (Germany)

Measurements of Electric and Magnetic Interference Fields in the Vicinity of Telecommunication Equipment, H. D. Luke. "Nach. Z." May 1962. 6 pp. Electric and magnetic field measuring devices for investigations of distribution

and amplitudes of varying interference fields in the vicinity of telecommunication equipment are described, and results obtained from measurements on a telephone set and on a time searching clock are reported. (Germany)

Interferometry in Length Measurement. I. Electronic Counting of Interference Fringes, J. L. Goldberg & R. H. Brockman. "El. Tech." April 1962. 5 pp. A study has been made of the photoelectric detection process applied to a steadily moving two-beam interference fringe pattern. Aim of this work has been to determine the practicability of using electronic counting techniques in conjunction with two-beam interferometry to make precise measurements of length. (England)

Interferometry in Length Measurement, J. L. Goldberg. "El. Tech." June 1962. 6 pp. Although a relatively poor ratio of signal-to-noise has often to be accepted, fringe counting has to proceed at the fastest possible rate in order to keep the measuring time at a minimum. This part of the paper deals with the design of a suitable type of trigger circuit which produces a counting waveform directly from a noisy fringe signal. (England)

Portable Transistorized Oscilloscope, H. Mativie. "El. et Auto." March-April 1962. 6 pp. Because of their advanced characteristics, recent transistors easily lend themselves to the design of battery-fed portable oscilloscopes of excellent performance. The Tektronix 321 oscilloscope is described. (France)

AC Millivoltmeter-Voltmeter, B. Fondat. "El. et Auto." March-April 1962. 2 pp. A fully transistorized measuring instrument, battery-fed by internal mercury cells providing an autonomy of 400 hours, is described. (France)

Detection and Analysis of Gases, R. Morris, et al. "El. et Auto." Jan. 1962. 5 pp. A method and instrument have been developed for detecting minute concentrations of gases and vapors in air or process streams. The constituent to be detected is allowed to react with another gas to form particles (smoke or mist) within an ion chamber and the concentration determined by measuring the resulting change in chamber conductivity. Continuous ionization of the gas sample is provided by a radioactive source located within the chamber. Instrument design and the ion current reduction mechanism are discussed. (France)

Tests on Passive Repeaters Used in Microwave Radio-Links, C. Colavito, G. D'Auria & B. Peroni. "Alta Freq." May 1962. 14 pp. Behaviour of passive repeaters used in microwave radio-links has been characterized by means of simplifying assumptions. Then, the departure from these hypotheses, in the real problem, has been investigated; an efficiency η is defined which takes into account all these departures. (Italy)

The Origin of Parasitic Currents in High-Frequency Mass Spectrometers and Methods of Suppression, Von J. Ruf. "Vak Tech." May 1962. 8 pp. By means of suitable experiments the main causes are explained which are responsible for the occurrence of parasitic currents in a high frequency mass spectrometer in which ions are produced via electron impact. (Germany)

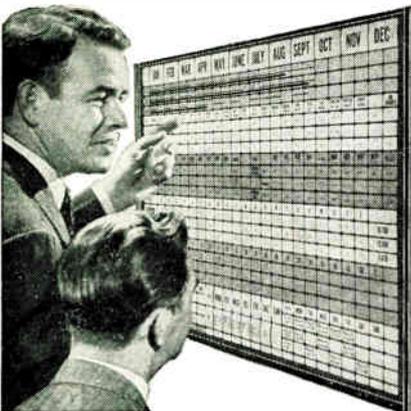
The Planning of an Electronic Telephone Switching Center with Special Consideration of Possible Interference. Part 3. Mathematical Treatment of the Multi-testing Problems, Winfried Becker. "Freq." May 1962. 7 pp. If a multitude of subscribers has access to a group of switching elements, multi-testing of one organ by a number of subscribers may occur. An approach for calculating the probability of multi-testing in two different systems of switching elements which differ with respect to the order of precedence in the attainability of these elements for an incoming seizure is shown. (Germany)

SEMICONDUCTORS

Parallel Feedback Relay Semiconductor Amplifier, R. A. Lipman. "Avto. i Tel." Mar. 1962. 12 pp. Parallel feedback relay semiconductor power amplifiers (non-symmetric triggers) are considered. Circuit operation is analyzed. Main calculation correlations and experimental results are proposed. (U.S.S.R.)

Two New Transistorized Variable Frequency Systems—A Reason for Comparing AM and FM Modulation, W. Kaiser, R. Rabe & W. Stuber. "Freq." May 1962. 11 pp. Two fully transistorized VF carrier telegraph systems are presented of which one operates with amplitude modulation and 120 cps channel spacing, the other with frequency modulation and 240 cps channel spacing. (Germany)
(Continued on page 202)

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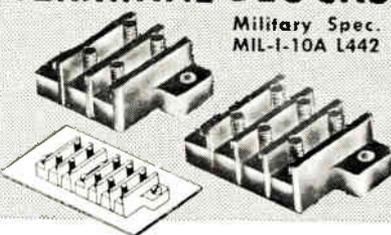
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SOURCES

Differential Amplifier, M. Pivier. "El. et Auto." June 1962. 2 pp. A design which ensures a low drift rate without extreme selection of transistors is presented. (France)

Problems Concerning Transformerless Transistor Power Amplifiers, G. B. Debiasi. "Alta Freq." May 1962. 7 pp. Some problems concerning the design of transformerless transistor power amplifiers are discussed. The possibility of linearizing the transfer characteristics with large signals is considered, and a graphical method for checking thermal stability is studied. Experimental results obtained with a 20 W amplifier are finally reported. (Italy)

A Wide Band Transistor Logarithmic Amplifier at 45 MC, R. N. Alcock. "Elec. Eng." July 1962. 6 pp. A wide band transistor logarithmic amplifier working on the successive detection principle is described. Article considers in particular the difficulties incurred in the use of transistors and broad-band stages and the design of broad-band interstage coupling for transistor amplifiers. (England)

A Transistor Voltage-to-Frequency Converter, O. DeSa. "Elec. Eng." July 1962. 2 pp. A simple circuit using four silicon transistors converts voltage into frequency with good linearity provided that f_{max} is less than about 2KC. (England)

Precision Gaussmeter, L. Voreille. "El. et Auto." June 1962. 4 pp. Semiconductors have brought into practical usefulness the Hall effect, which creates an electric voltage proportional to magnetic field intensity. Thanks to the high sensitivity obtained with indium arsenide, a precision gaussmeter has been designed. It is destined to measure magnetic field or its gradient, and ensures an incremental resolution of 10^{-4} . (France)

Radiation Damage on Diodes and Transistors, Part 1, Mario Bertolotti. "Alta Freq." Feb. 1962. 12 pp. The notion of radiation damage in semiconductor electronic devices is given and the more important nuclear radiations used in irradiation studies are briefly reviewed. Effects of these radiations on devices are then dealt with for the 2 types of devices. This first part is devoted to generalities and diodes. (Italy in English)

Temperature Stabilization of a Transistor Amplifier Stage, T. M. Agokhayan. "Radiotek" 17, No. 4, 1962. 6 pp. This article treats some of the less frequently considered aspects of transistor temperature compensation. Influence of changes in the thermal current of the collector and of the transmission coefficient of the base current on the instability of the operation of the transistor stage are investigated for a range of temperatures. Several typical circuits are used as examples. (U.S.S.R.)

Current-Tuned RC Oscillator Design and Performance, U. S. Ganguly. "El. Tech." May 1962. 7 pp. Article deals with the design of a resistance-capacitance oscillator in which forward-biased silicon junction diodes are used as current-variable resistive elements in the frequency determining network. (England)

Frequency-To-Direct Current Converter, Yu. M. Tsodkov. "Avto. i Tel." April 1962. 4 pp. A semiconductor high-stability frequency-to-direct current converter and its operation principles are analyzed. Results of the experimental investigation of the converter are proposed. (U.S.S.R.)

Transistorized Electronic Clock, R. Le Chevalier & R. Soyer. "El. et Auto." Jan. 1962. 7 pp. Excellent stability of the 50 cps frequency of the power line can be put to good use as time reference in the design of precise electronic clocks. Such a design is described. (France)

Transistor Contactless Pulse-Frequency Telemetering Device, S. G. Sukhotin, et al. Mar. 1962. 4 pp. Operation and circuit of a new contactless pulse-frequency telemetering device are described. (U.S.S.R.)

Frequency Multipliers with Tunnel Diodes, H. Graf. "Nach. Z." May 1962. 7 pp. Tunnel diode characteristic is replaced by a simple mathematical approximation. This permits non-linear cases to be treated. Frequency doubling circuits with tunnel diodes are discussed in more detail. (Germany)

Transistor Generators, R. Motisse. "El. et Auto." March-April 1962. 5 pp. Paper describes a square wave generator based on clipping, a Wien

bridge AF generator, a 1 to 44 MC oscillator, a stroboscope, and VHF oscillators reaching 250 MC (France)

Switching Transistors: Operation in the Saturation Region, J. N. Barry. "El. Tech." June 1962. 6 pp. Types of transistor circuit available to the designer of switching systems are discussed, leading to an analysis of the important transistor parameters which must be known to enable the design of fast saturating circuits to be undertaken. (England)

Transistorized Organ Generators, Alan Douglas. "Elec. Eng." June 1962. 7 pp. The continued trend towards more economic production of semiconductors and their associated circuit elements has prompted several manufacturers to introduce music generators employing transistors. Several circuits are described but all use tubes in some capacity. (England)

Oscillating System of a Frequency Modulated Auto-Generator Using the p-n Junction Capacitance, V. F. Goroshka. "Radiotek" 17, No. 5, 1962. 9 pp. A possibility of using the p-n junction capacitance as frequency modulators in a wide band of frequencies is investigated. An equation is given for an oscillating system of a frequency modulated auto-generator. (U.S.S.R.)

TELEVISION

The Design of a Group of Plug-in Television Studio Amplifiers. "BBC Mono." April 1962. 15 pp. Basic operational requirements of some of the amplifiers which are used in large numbers in the television broadcasting studios and transmission networks are considered. Mechanical form of the amplifiers, which use a plug-in arrangement is described in detail. Electrical design of the most commonly used amplifier, the video distribution amplifier, is fully described. Details of its performance, together with that of two other amplifiers are given. (England)

Examination of a Color-TV System Wherein the Chrominance Carrier, Situated in the Frequency Band of the Luminance Signal, is Simultaneously Frequency- and Amplitude-Modulated (FAM Method), Norbert Mayer. "Rundfunk." March 1962. 20 pp. Experience gained with the American NTSC and the French SECAM systems, led to the conclusion that it is possible to devise a considerably simpler method. The proposed method involves simultaneously modulating the chrominance carrier in frequency and in amplitude by two special color signals, and for this reason, it is called the FAM method. (Germany)

On the Development of a Vidicon Camera-Tube with Enlarged Photo-Cathode (Diameter 2 in.), Walter Heimann. "Rundfunk." March 1962. 3 pp. Performance of the new tube is demonstrated by means of a TV transmission. Author draws attention to the possibilities of application of the 2 in. vidicon. (Germany)

Recording and Reproduction of Still Pictures with the Memory-Sheet Device, Heinz-Gunther Walter. "Rundfunk." March 1962. 5 pp. In the memory-sheet device, a storage element is available which, owing to its high upper-cut-off frequency and its rotation in synchronism with the raster, is suitable for recording individual TV pictures and for reproducing an uninterrupted signal with unchanging picture content. (Germany)

The Memory Sheet, an Instrument for Recording Television Signals, C. Bodenstein & R. Otto. "Rundfunk." March 1962. 4 pp. Memorizing of separate pictures for any given length of time by a still-picture recording device poses special problems with regard to the magnetic-coating support and the storage head since both must be able to operate free from wear to a considerable degree. The recording device described operates with a sheet as carrier for the coating, held at an adjustable distance facing a fixed plate. (Germany)

Echo Suppression on TV Links by Means of Low-Loss Passive Quadrupoles, R. Rasch. "Nach. Z." June 1962. 12 pp. Echo interference of low intensity on TV links can be compensated in a simple manner by the insertion of passive echo equalizers with a negligible insertion loss and mismatch. Construction and design of such echo equalizers are described and practical applications are explained by means of a few examples. (Germany)

The Assessment of Lenses for Television, W. N. Sporsion. "Rundfunk." March 1962. 5 pp. Contrast-transmission of a lens as a function of the spatial frequency (frequency response) is a most useful description of the image-forming properties of a television lens, particularly in view

of the low spatial frequencies used in television. Paper describes a large optical bench which measures this function by operating upon the spread function (response to unit impulse) to derive its Fourier transform; the spread function may also be recorded. (Germany)

THEORY

Formulas for the Calculation of the Characteristics of Friction Vacuum Gauges, Hans-Werner Drawin. "Vak. Tech." Mar. 1962. 5 pp. Two novel types of friction manometers have been developed recently; their working range stretches from 10^3 to 10^{-4} Torr and pressure indication is continuous. Theory of these instruments leads to a set of formulas which allows the calculation of the characteristics of the gauges for the whole pressure range as a function of the nature of the gas. (Germany)

Concerning Calculation of Magnetic Systems with a Constant Magnet, T. M. Vorobjeva. "Avto. i Tel." Mar. 1962. 4 pp. A problem of finding a volume relative minimum of a magnetic system with a constant magnet of the method of Lagrange multipliers is solved for a certain kind of magnetic system with constant magnets. (U.S.S.R.)

Concerning Connection Between Adjuncts of Determinant Elements and its Application in Invariance Theory, V. D. Vershinin. "Avto. i Tel." April 1962. 6 pp. Connection between the adjuncts of the determinant is shown to be in existence. Based on this connection the formula is deduced which permits calculation of the value of the determinant with the help of $n-1$ adjuncts. (U.S.S.R.)

About Choice of Calculation Cases for Analysis of Systems with Random Parameters, A. I. Averbukh. "Avto. i Tel." April 1962. 6 pp. The method proposed in (1) for the determination of the mathematical expectations and of the variance of solutions of differential equation systems with random parameters is made more precise. (U.S.S.R.)

Vacuum Drying, F. Kneule. "Vak. Tech." May 1962. 7 pp. The theory on which vacuum drying is based is discussed by considering the various modes of heat transfer and movement of moisture in the matter to be dried. Present state of art is illustrated by means of a number of typical examples. (Germany)

Skin Effect Reduction by Use of Aeolotropic Conductors, P. M. Proche. "Cob. & Trans." April 1962. 12 pp. A very general theoretical calculation of the effective resistance of "aeolotropic" cylindrical conductors used as inner conductors in coaxial circuits is presented. It is shown that, subject to certain conditions, skin effect can be significantly reduced. (France)

The Ion-baffle in Conjunction with an Air-cooled Oil-Diffusion-Pump, R. A. Hoefler. "Vak. Tech." Mar. 1962. 4 pp. Based on theoretical investigations concerning the physical mechanisms of the ion-baffle in the high vacuum pressure range, 4 different designs of the ion-baffle were investigated by means of mass spectrometer methods, with the ion-baffle mounted on top on air-cooled Oil-Diffusion-Pump. (Germany)

An Investigation of Stationary Oscillations in a Magnetic Pulse Generator, I. M. Vatim, E. F. Zaytzeff and L. A. Meerovitch. "Radiotek" 17, No. 5, 1962. 10 pp. Basic theoretical aspects of a magnetic generator are analyzed. The equation for oscillation of the generator is derived, solutions for this equation corresponding to asymmetric stationary oscillations are determined and their stability is investigated. (U.S.S.R.)

Theoretical Aspects of a Comb-Type Wave-Guide Surface, with Oblique Ridges, E. G. Solov'yev. "Radiotek" 17, No. 4, 1962. 4 pp. A method is presented for approximated calculations of the delay of the fundamental wave in a delay system in the form of slots on the wide side of a rectangular waveguide oriented at a random angle. (U.S.S.R.)

Fundamentals of Statistical Design of Radio Circuits, I. M. Einbinder. "Radiotek" 17, No. 4, 1962. 9 pp. Elements are given for the calculation of numerical characteristics of parameter deviation distribution functions in the production of electronic radio circuits. Calculation is based on probability theory methods and mathematical statistics. (U.S.S.R.)

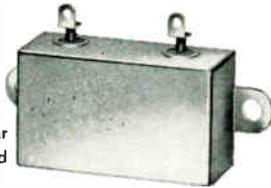
Synthesis of Information Handling Discrete Devices with Variable Program, L. N. Volgin, A. I. Folkovich. "Avto. i Tel." Vol. 23, No. 6. 7 pp. Synthesis of the variable programs for the information handling discrete devices is described. The synthesis is based on solving the polynomial equations. (U.S.S.R.)

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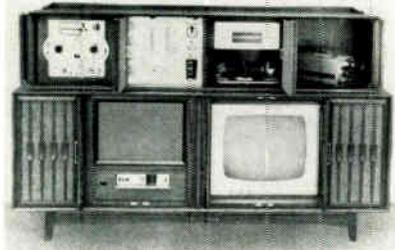
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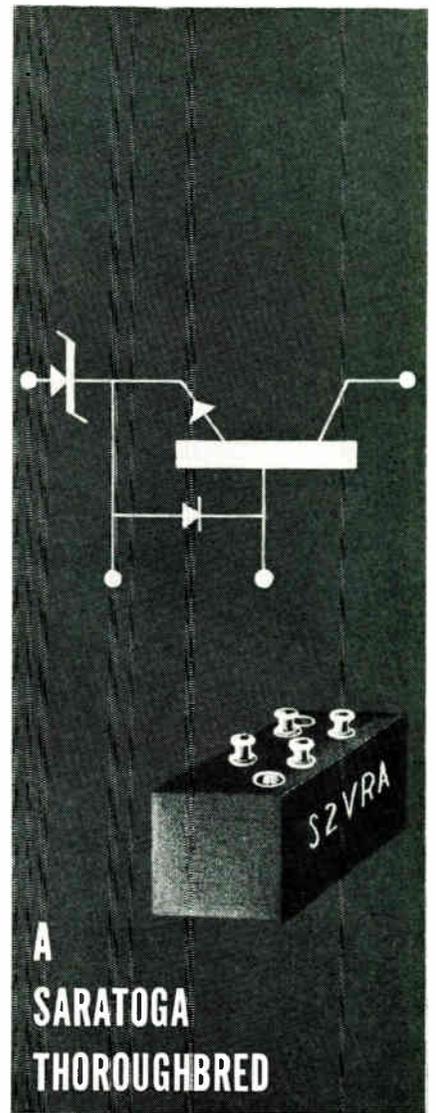
Most small firms ignore reliable business information available to them, according to a management research summary released by the Small Business Administration.

The summary, "Use of Outside Information in Small Firms," was made of a report prepared by L. J. Crampon and S. F. Schweizer, both of the Univ. of Colorado, under an SBA grant. The report was based on interviews with 162 Colorado small businessmen—123 retailers, 22 manufacturers and 17 wholesalers.

Small businessmen show too little interest in using such information sources as trade publications, public libraries, their trade associations and commercial schools, the summary points out.

It concludes that small businessmen should recognize the potential value of outside information from these sources as related to their problems—and then take advantage of it.

The summary is available upon request from all SBA offices. Copies of the full report, "A Study of the Informational Needs and Problems of Small Businessmen," may be purchased from the Bureau of Business Research, Univ. of Colorado, Boulder, Colo. The price is \$2.50.



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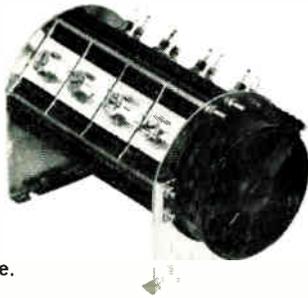
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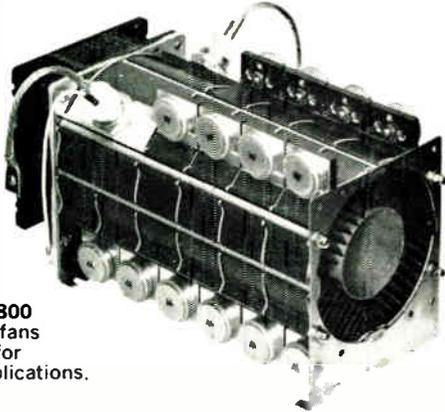
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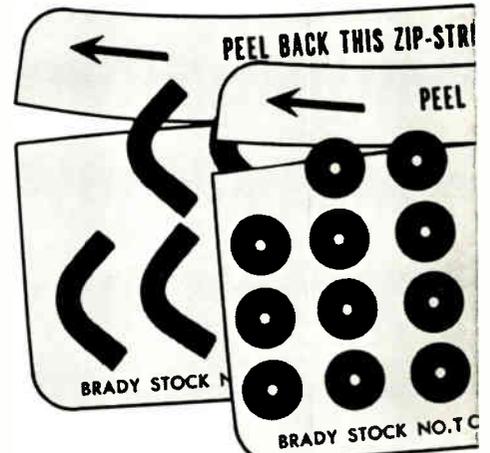
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126

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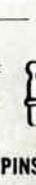
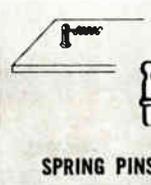
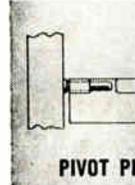
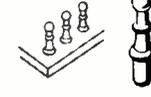
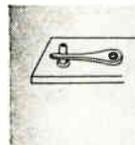
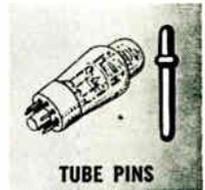
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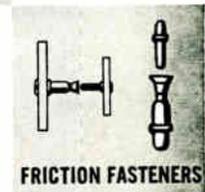


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ELECTRONIC OPERATIONS

SYSTEMS WISE

■ The FCC has warned that, until it sets standards for all channel TV receivers under the new UHF-VHF television set law, no so-called all-channel receivers can be said to meet performance characteristics which haven't yet been adopted. The FCC still has to set a date for the new rules to become effective.

SEARCHING FOR SPACE SIGNALS

This 85 ft. dia. radio telescope stands in observing position at the University of California's Radio Astronomy Lab. at Hat Creek, Calif. It, and its 33 ft. dia. companion, have already been used. The smaller one mapped a portion of the northern Milky Way. This giant weighs 200 tons, stands 110 ft., and surface error in the huge reflector has been reduced to less than one millimeter. It was designed and built by Western Development Labs. of Philco Corp., Palo Alto, Calif.



■ A new method of accurate navigation at sea by means of day or night star observations was revealed at the recent 18th annual meeting of the Institute of Navigation. GEON (Gyro-Erected Optical Navigation), essentially is a telescope mounted on a gyrocompass. The gyro provides geographic north and cancels out most of the effects of ship motion. The telescope is powerful enough to observe many stars in the daytime. With GEON, it has been possible to fix a ship's position within a mile with a single celestial sight whenever the sky is not totally obscured.

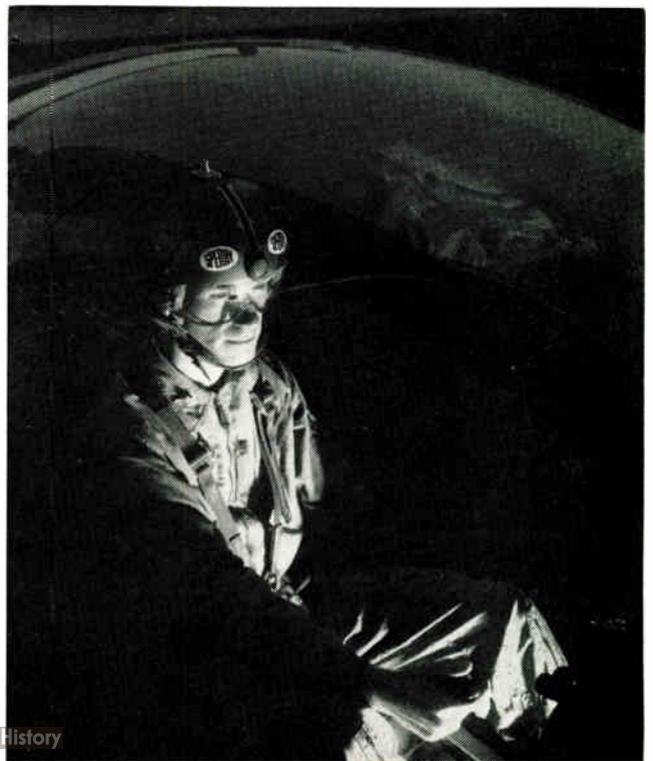
■ The operation of the supersonic transport of the future may rest in a miniaturized digital computer providing safety and economy as well as expanding available airspace for better traffic control. A Hughes Aircraft Company engineer, at the recent 18th annual session of the Institute of Navigation, said that most of the techniques and hardware needed to develop a central electronic management system (CEMS) already exist. The CEMS could take over a number of different functions including navigation, cruise control, speed and altitude scheduling, communications, automatic landing, systems test and checkout, and malfunction detection and identification, which are now performed, on subsonic aircraft, by a variety of subsystems.

■ A new "jam-resistant" communications technique, allowing pilots to talk with each other up to 100 miles apart without being overheard, is under development for the Air Force by Raytheon Co. Infrared "light" beams will be used as the two-way voice carrier to prevent jamming, spoofing, interception or detection. The system includes automatic search, acquisition and lock-on features. The beamwidth will be about 1/10th of 1 degree wide and at a distance of 50 miles its projected spot will be about 500 ft. in diameter. It is near completion at Raytheon's Missile and Space Div.'s Santa Barbara, Calif. Operations.

■ American Telephone & Telegraph Co., New York, N. Y., has invited 9 international communications common carriers to experiment with AT&T's Telstar satellite. The list includes American Cable & Radio Corp.; General Telephone & Electronics Corp.; Hawaiian Telephone Co.; Press Wireless, Inc.; Radio Corp. of Puerto Rico; RCA Communications, Inc.; South Puerto Rico Sugar Corp.; Western Union Telegraph Co.; and Tropical Radio Telegraph Co.

HELMET SIGHTING SYSTEM— PILOT LOOKS, WEAPONS AIMED

A helmet allowing a helicopter pilot to shoot what he sees, by simply looking at his target and pressing a button, has been developed by Sperry Gyroscope Co., Great Neck, N. Y. The visor is equipped with a bulls-eye sight through which the pilot lines up his target. The armament automatically wheels to face the same direction. The pilot presses his firing button; the kill is made.



UNDERSTANDING MICROWAVE SYSTEM LOADING

There is nothing mysterious about system loading. The author very simply points out the factors to be considered and shows how to calculate the load levels using simple math.

MUCH EMPHASIS is being placed on the use of Point-to-Point microwave for communications. In most cases the information transmitted is composed of a multiplicity of "Voice Channels," as well as other information such as telemetering and signaling tones.

The complex signal appearing at the wide-band modulator input of a microwave transmitter, made up of tones and speech signals, takes on the characteristics of so called "white" or Johnson noise. And, because the FM deviation of the microwave equipment is dependent on the instantaneous power applied to it, the characteristics of this complex signal must be carefully considered when determining the transmitter input level for best operation.

Complex Signal Characteristics

When a number of tones of

different frequencies are applied to multi-channel equipment, the resulting complex signal has peaking effects. These effects are important in finding the load effect of the complex signal. In two commonly used types of carrier multiplex equipment, tones are either a large portion or essentially all of the load to be handled. Single sideband suppressed carrier (SSB - SC) multiplex equipment such as the Lenkurt type 458X, which transmits out-of-band signaling tones, has one -16 db tone for each voice channel. Transmitted carrier multiplex equipment, such as Western Electric Co. type "ON" has one carrier for each two voice channels, and the carriers are of such high level, that their combined power is the controlling factor.

Another type of carrier equipment where tones become important is telegraph multiplex equipment. As many as 20 tones may be present in each voice channel, and since in a large system several voice channels may carry telegraph, the resulting load is important.

When two tones of different frequencies and sources are combined in a single circuit, the maximum voltage will be encountered

when both tones simultaneously reach their instantaneous peaks. As the number of tones increases, the maximum voltage which may occur increases, and will be the sum of the instantaneous peaks of all tones. Fortunately, the probability of all tones reaching a peak simultaneously becomes very small for a large number of tones. This is due to momentary out-of-phase conditions of the tones. It is, therefore, permissible to consider a peaking factor between the RMS power of the combined tones and the power corresponding to the peak. This is usually expressed in db, and is the ratio that is practically never exceeded.

For 20 or more tones, a "Peak Factor" of 13 db added to the RMS power of the combined tones will give a peak which is exceeded only 0.003% of the time. For fewer than 20 tones a smaller peak factor may be used, down to 6 db for two equal level tones (see Fig. 1). As used in a microwave or multiplex system, all tones are usually of equal level, or a group of tones will be of sufficiently high level, either individually or collectively, that they have control in determining the load effect. Therefore, it is not

By K. L. DUMAS

Manager,
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Philadelphia 44, Pa.

necessary to consider the possibility that all maximum levels will occur simultaneously, and a peak power based on a peaking factor of 13 db is more realistic.

Speech Characteristics

Because speech in a telephone channel is a complex signal constantly changing in level and frequency, it cannot be handled on a simple tone basis. In addition, the composite signal of many talkers, all on different frequencies, all operating simultaneously into a common unit, greatly complicates the problem. Under these conditions it is impossible to calculate the peak power at any particular moment.

Some factors which complicate the situation are:

1. Loud or soft talkers.
2. Local or long distance calls.
3. Number of talkers active.
4. Length of telephone line to switchboard.
5. Age of telephone set.
6. Level of the side tone at the telephone set.

These are just a few of the many variables which make it necessary to handle telephone speech on a "statistical basis." When all of these variables have been summed up, they essentially break down to a single value, called, "average talker level."

Several years ago Halbrook and Dixon of the Bell Telephone Labs. found in a statistical study of talker habits, that the "average talker level" was -12.1 dbm as measured at the switchboard. They found the talkers had a standard deviation from this level of 5.8 db.

Some years later (on different equipment), in Europe, Brockbank and Wass found the level to be somewhat lower, or -15.6 dbm at the same point. This figure was even more recently substantiated in the United States by

V. Subrizi of the Bell Telephone Labs.

The average talker level accepted by the CCITT, as well as many telephone equipment users in the U. S., is -15.6 db, or more commonly -16.0 dbm at the switchboard.

Multi-channel speech has been the subject of continuing investigations of groups such as the Bell Telephone Labs for many years. The talking habits of telephone users is constantly being altered by many factors, the most important of which is the improvement of transmission and equipment. Because of its random nature, speech is considered statistically. The results are given in terms of peak power relative to reference transmission level, which is exceeded only a small percentage of the time. The analysis takes into account the probability that a certain number of channels will be active simultaneously, that the volume of speech power will vary

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over a wide range, and the statistical characteristics of the ratio between RMS and peak speech power.

A peak factor similar to that used with tones, is therefore also used in connection with speech. With a large number of speech channels the peaking factor approaches the same value of 13 db as with a large number of single tones, although the peaking factor for a single talker is about 18.0 db (see Fig. 1).

Tone & Speech Combination

When considering a point-to-point microwave system which must handle a large number of talkers and tones, it is undesirable to consider that all channels have very loud talkers hitting high instantaneous peaks at the same

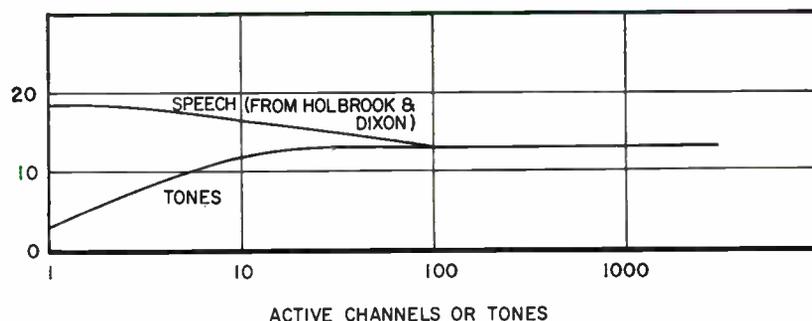
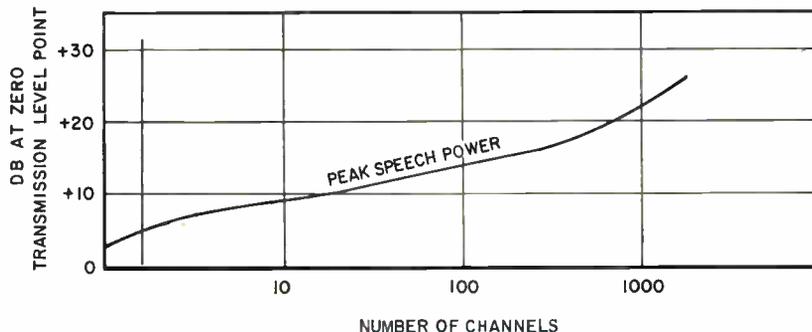


Fig. 1: Graph shows for 20 or more tones a Peak Factor of 13db is added to rms power.

Fig. 2: Necessary load capacity of a system loaded with average talkers at -16 db.



SYSTEM LOADING (Continued)

time. Since this condition occurs so rarely, it is costly to build equipment to handle this maximum loading condition. The instantaneous power which is exceeded only 1% of the busy hour is considered an optimum criterion. Most multi-channel equipment is designed to handle this power before distortion noise becomes objectionable.

To determine the combined channel load a system must handle, the level of the talkers and any tones present must be added. To this power must be added the peak factor for the needed number of tones and speech channels. This will give the absolute peak a system must handle. However, only the number of "active" channels in a system should be considered when adding the speech.

A channel is considered "active" whenever continuous speech is being introduced into it; i.e., a channel is active during the time it is actually carrying speech power, and also during the short pauses that occur between words and syllables of ordinary speech. Other than this, a channel is said to be "busy" when it is not available to the operator or switch equipment for a new call.

Fig. 2 shows the peak power (based on -16 db talkers), which must be carried by a microwave system to hold the noise, due to intermodulation, within acceptable limits.

Complex Signal Peak Power

The peak power of a given number of channels may be calculated in the following manner:

Consider a microwave system which must handle 240 channels of speech. Assume the multiplexer is a system such as Lenkurt 45 BX which has a signaling tone present for each channel of speech. The tones being present at all times have a 100% activity factor.

Taking the signal tones first, the 240 tones at -16 db will have a total RMS power of

$$10 \log 240 = +23.8 \text{ db above } -16.0 \text{ db.}$$

This is the total RMS power which results from the 240 signaling tones only.

To find the total composite power it will be necessary to add to this figure the power contribution of the talkers. To do this the number of "active" channels must be found. This information can be taken directly from the channel activity curves of Hol-

brook and Dixon shown in Fig. 3. From this curve we see that for 1% of the time a 240 channel system will have 80 "active" channels. There may be more channels busy, but only 80 can be expected to be active.

The talker contribution, therefore, is:

$$10 \log 80 = +19.0 \text{ db above the average talker level of } -16.0 \text{ db at the switchboard.}$$

To combine these two levels it is necessary to add them as power ratios, so we have a total combined power rise of:

$$240 = \text{Power ratio of signal tone levels}$$

$$80 = \text{Ratio of active channels}$$

$$320 = \text{Total power ratio which will be present 1\% of the busy hour.}$$

Converting this ratio to db:

$$10 \log 320 = 25.05 \text{ or } 25.0 \text{ db total RMS power rise above } -16 \text{ db.}$$

From Fig. 1 we see that both the speech and tones have the same peaking factor of 13 db, also that the total number of energy sources is well out in the range where a 13 db figure of peaking is considered. We can, therefore, confidently add a peaking factor of 13 db to the total power thus:

$$25.0 \text{ db} = \text{total RMS power rise above } -16.0 \text{ db}$$

$$13.0 \text{ db} = \text{peaking factor}$$

$$38.0 \text{ db} = \text{total rise above } -16.0 \text{ db.}$$

The signaling tones and the speech were 16 db below the switchboard reference level of zero dbm, so to convert our power rise to absolute power it is only necessary to algebraically add the two.

We now have an absolute power of:

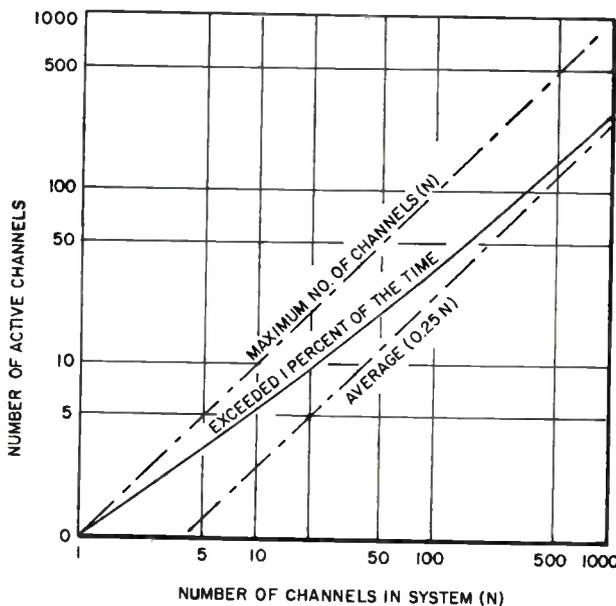


Fig. 3: This chart can be used to find the number of "active" channels in a microwave system.

+38.0
-16.0

+22.0 db above the zero dbm
reference level.

This peak power value of +22.0 dbm will be exceeded less than 1% of the busy hour.

Microwave System Loading

In any microwave system the peak modulation level and frequency are known, and it is this value which should not be exceeded. It, therefore, becomes necessary to reduce this "peak power" to a value which will not produce adverse effects.

As shown in the previous calculations, the composite signal of a 240 channel multiplex system of the type shown will have a power increase of +22.0 db above an individual test tone level at the same point. To find the per channel test tone level at the microwave input, it is only necessary to algebraically subtract the multiplex system peak power of +22.0 db from the absolute power handling capacity of the microwave system used.

For example, let us assume the microwave system produces an undistorted maximum deviation with a peak input power of -15 dbm.

To properly connect our 240 channel multiplex system it would be necessary to reduce the composite level as applied to the microwave input as follows:

-15 dbm = peak input to
microwave
+22 db = power rise of
multiplex

-37 dbm = test tone level
per channel.

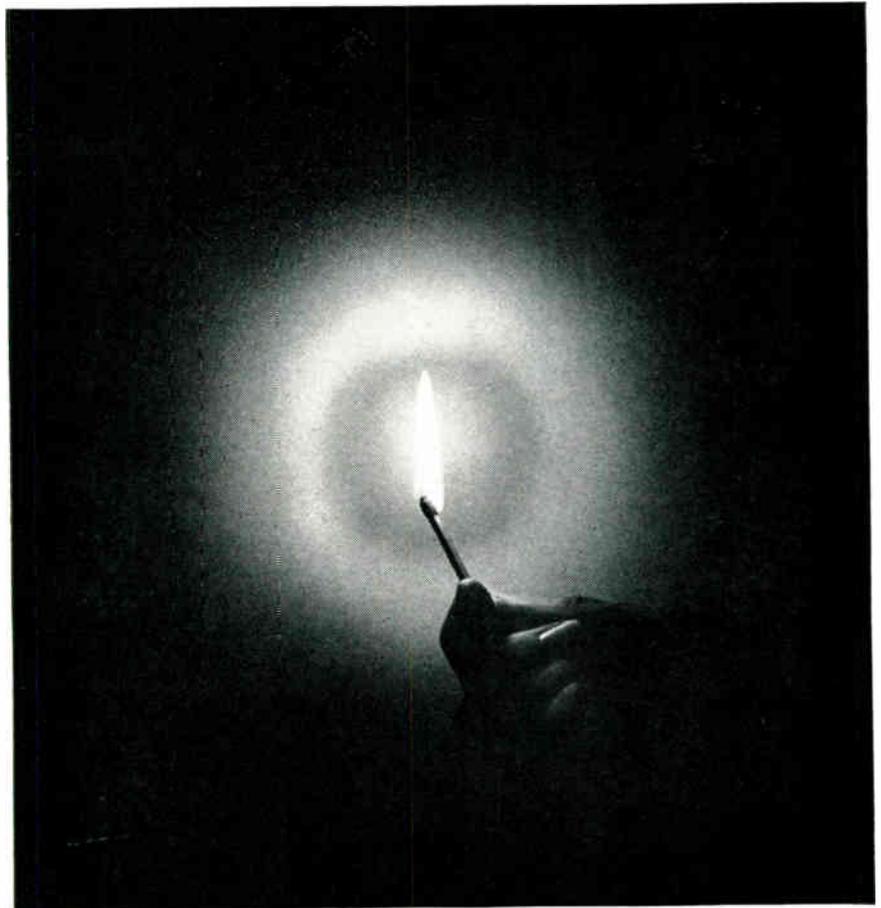
The significance of these figures indicates that with a single test tone applied to a channel at the switchboard, measured individually at the microwave input, it should read 37 db below the value applied at the switchboard.

In common parlance -37 db becomes the zero transmission level point (OTLP) for the microwave equipment. Considering only the microwave, test tones connected to the input at this value would be correct on a per channel basis.

Conclusion

These load levels represent the optimum condition, and will keep

the busy hour load below the maximum deviation of the system. When operated in this manner, circuit noise can be expected to exceed the average busy hour condition only 1% of the time. This 1% represents 36 seconds of the busy hour and will be broken up into many very short intervals so that the effect on the circuit will be negligible.



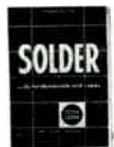
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MICROWAVE ISSUE

WASHINGTON NEWS LETTER

SPACE COMMUNICATIONS — The space communications bill which aroused so much debate in the Senate recently had many asking what it is all about. Briefly, it stacks up like this: The Administration measure, already passed by the House, provides for a private, government-regulated corporation to operate the U. S. portion of a projected global satellite communications system. Half of the corporation's stock would be sold to companies like AT&T and half to the public, with each group of stockholders electing six directors. The President would appoint three directors.

DELAY CONTINUED—A handful of liberal Democrats who normally support Administration measures continued to filibuster against the Government's plan. The Democratic leadership was joined by the Republicans in favoring the measure to complete an odd alignment of legislative forces. Two of the Democratic objectors, Sens. Wayne Morse (D., Ore.) and Joseph S. Clark (D., Pa.) said that, while they opposed the government measure, which provides for private ownership and operation, they were not committed to government operation. Morse said he was "perfectly willing to consider working out a lease or license" with AT&T, RCA or any other communications company to operate the system. Another opponent, Sen. Estes Kefauver (D., Tenn.) was for government operation of the system through an agency like the TVA. Morse and others charged that under the bill AT&T would, in effect, get a gift "of the half billion or more" the government has put into scientific research.

ADMINISTRATION'S VIEWS—Attorney General Robert F. Kennedy supported the bill before the Senate Foreign Relations Committee, where it was sent for further study after Senate action was blocked by the filibusters. He testified he felt the government's and public's best interests were "well protected" under terms of the legislation. He said the bill had undergone "tremendous study" by the Justice Department, its Anti-trust Division and other Federal agencies, including the FCC.

FCC CHAIRMAN'S VIEWS—FCC Chairman Newton M. Minow stressed that "private ownership of communications has served us very well through American history and we are hopeful as we move into space that our traditional philosophy will continue to work equally as well." Telstar's success, with other U. S. communications satellites scheduled for launching soon,

means regular global TV within three or four years, Minow prophesied. Minow stated he felt prospects of agreement on frequencies for satellite communications at the 1963 Geneva International Conference were very good. A key Bell scientific official testified that, because of Telstar's success, only one more experimental satellite may be needed. Another Telstar is scheduled to be launched in October.

TWO-FOLD IMPACT — Senate proponents of the Administration plan pointed out the delay in legislation could give Russia a chance to launch its own communications satellites. They said, Russia could then take advantage of their strengthened position to win advantages in negotiating for space communications frequency allocations. (The International Telecommunications Union meets in Geneva in 1963 to consider the problem of allocating frequencies for satellite communications.) It was pointed out that the foreign populace and some segments of the U. S. public could not understand the delay in America's space communications bill after the notable Telstar achievement. Telstar's notable intercontinental TV and telephone transmissions were hailed in Europe and other parts of the world. They were held comparable with the successful manned orbital flights by Glenn and Carpenter.

TECHNICAL SUCCESS—Bell system scientists reported that technical tests of Telstar revealed it can have a time in orbit of at least 200 years. The satellite is enduring the rigors of space travel in a remarkable fashion. The solar cells powering the satellites transmitting and receiving equipment are operating without radiation damage in accordance with earlier Bell calculations. The canister containing Telstar's electronic equipment has maintained its pressure and is not being punctured by meteorites. There is apparently no gas leakage.

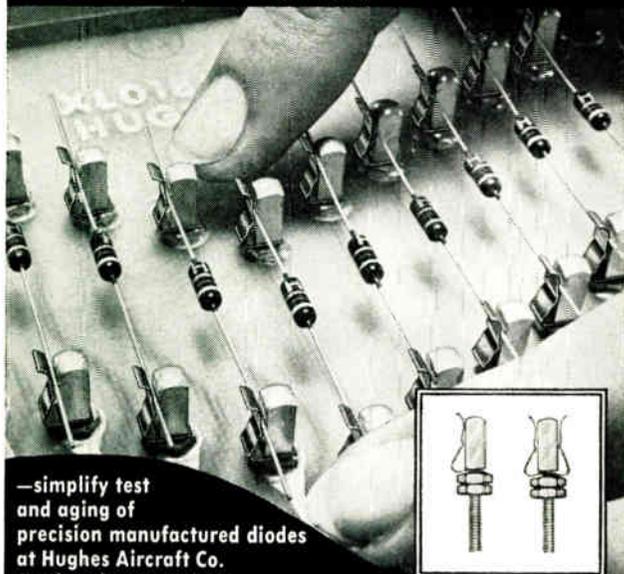
ALL-CHANNEL SET TRANSITION—The Electronic Industries Association, after surveying 21 leading TV set manufacturers on the date of their change to producing all-channel set receivers, came up with the following findings: Most manufacturers plan to shift to producing all-channel sets in the Fall of 1964. The TV manufacturers must revamp their processing lines and clear away existing VHF set inventories. Another hurdle is the design of a workable all-channel tuner.

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Washington 4*

ROLAND C. DAVIES

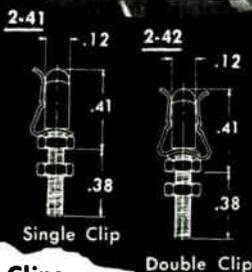
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(Pat. Pend.)



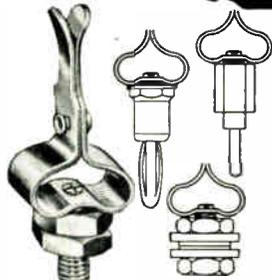
—simplify test and aging of precision manufactured diodes at Hughes Aircraft Co. Semiconductor Division

Rapid testing—always positive contact. Single unit requires only 3/16" x 1/8" panel area—double unit, 1/4" x 1/8". Nickel plated brass with nickel plated, heat treated beryllium copper spring clips. (Also available in stainless steel.) Adjustable spring tension.



Other Grayhill Test Clips

All Grayhill Test Clips offer adjustable spring tension. All metal parts are nickel plated brass (except threaded stud which is nickel plated steel). Available in stainless steel for temperatures up to 600°F., and in Inconel X for higher temperatures. Teflon insulating washers available for Series 2-4.



Series 2-0—Standard



Series 2-20—Miniature



Series 2-60 Stud-less

Write for Grayhill Engineering Catalog for full details on these and other Grayhill Electrical & Electronic Components.

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PIONEERS IN MINIATURIZATION

CUES

... for Broadcasters

Some Studio "Kinks"

HERBERT GREENBERG, Staff Eng.

WINS, New York, N. Y.

The pilot lights in the VU meters on studio equipment often have to be replaced and in some this is a difficult and time-consuming chore. Also, most manufacturers use bulbs which are much brighter than needed because the equipment is used in well lighted areas.

Either the use of lamps rated at twice the supply voltage, or wiring the two lights per meter in series will result in a pleasing and less distracting illumination. This will prolong the life of these often hard to get at components.

This procedure has been extended to the pilot lamps in the jewel indicators in rack mounted equipment with gratifying results and a reduction of reflections in the glass of control rooms and studios.

If your studio uses tape cartridges, prepare one with no audio and a "stop" every 5 or 10 seconds, as desired. This will permit on-the-air adjusting of the cue sensitivity without patching, or otherwise removing the machine from service.

A "test" cartridge with 1000 cycle tone and no stops, prepared by removing the plug from the cue head and recording, is very useful for checking and setting playback levels, testing for "wow," and by beating against the regular test oscillator at intervals to note if the speed is normal or not. Just feed two inputs and mix. A definite beat will be noted as the tones near each other, and they can be zeroed to establish an exact reading by varying the audio oscillator while the tape is moving. The percentage of difference can be easily calculated, and remedial action taken if necessary.

Tube testers will disclose most troubles caused by defective tubes, but occasionally a tube that tests normally in the tester will be the source of mysteries and hard to locate troubles.

Reducing the filament voltage by switching to the next lower filament voltage will often disclose tubes that are near the end of their useful life or causing difficulties. A good tube will not be greatly affected, but a poor one will show up with markedly lower readings. Use a new or known good tube as a reference.

If you have "clean" cueing amplifiers, why not reduce the filtering and deliberately introduce some hum which will serve to warn that an operation is not ready to go on the air? It may prevent some "goofs."

Packaged Power (Cont.)

The Hartman plant is the first production plant to use the new energy source. The energy package will use natural gas to generate all of the plant's electrical power, heat, and air conditioning.

Described as a pilot plant operation, the turbine engines will operate together or independently to drive 420 cps generators, singly or in parallel, to furnish plant lighting and power for machinery, spot welders and ovens. A 60 cps motor-generator set will supply power for office machinery and equipment. The normally wasted turbine exhaust will be fed to a waste heat boiler which generates steam or hot water for heating and absorption type air conditioning.

Choice of the 420 cps operating frequency is explained as an economy measure. Due to the product's nature, power needs are primarily in the relatively higher frequency ranges. A large welding load provides attractive operating economies at the higher frequency. Definite advantages are also realized in the plant and office lighting load. High frequency lighting offers more lumens per watt and eliminates lamp ballast entirely. Lower wiring and fixture cost plus extended tube life are cited. The natural gas fueled turbines are expected to provide an annual operating cost saving.

The turbine-generator sets provide larger facilities for testing Hartman produced 420 cps contactors and circuit breakers. A special "white room" within the new facility includes triple-filtered air, rigid temperature and humidity control, and sterile shield work stations. The building is being erected to increase such "controlled environment" production facilities for subminiature relays. The company produces equipment used in aircraft, missiles, ground support systems, submarines and hydrofoils.

Gallium Arsenide (Cont.)

One measure of the purity of the IBM gallium arsenide is the carrier concentration, which ranges between 2×10^{15} and 10^{16} per cubic centimeter.

Another measure of purity is the carrier mobility, which has previously been no higher than about $6000 \text{ cm}^2/\text{volt-sec.}$ except in a few exceptional, and unreproducible, batches of gallium arsenide. In crystals pulled from the melt contained in aluminum nitride crucibles, mobilities greater than $7000 \text{ cm}^2/\text{volt-sec.}$ are consistently obtained. In the oxygen atmosphere process, mobilities of $8000\text{-}8600 \text{ cm}^2/\text{volt-sec.}$ are obtained with careful control of the oxygen pressure.



Time after time engineers specify Johnson connectors!

Whatever the choice . . . sub-miniature nylon connectors for printed circuit use—or Johnson's patented "Six-Way" Binding Post . . . time and time again design and development engineers specify Johnson connectors!

A complete line of nylon and standard connectors are readily available to meet most military and commercial applications—nylon types include: sub-miniatures for printed circuit applications; insulated solderless tip and banana plugs; tip and banana jacks; tip jack and sleeve assemblies; metal-clad and "rapid-mount" tip jacks; dual banana plugs and a unique, "6-way" binding post. Available in 13 colors for coded applications, nylon connectors are designed to operate throughout an extremely wide temperature range and under conditions of high relative humidity—voltage breakdowns available up to 11,000 volts on some types! For detailed information on the complete Johnson connector line and other Johnson electronic components—write today for our newest components catalog!



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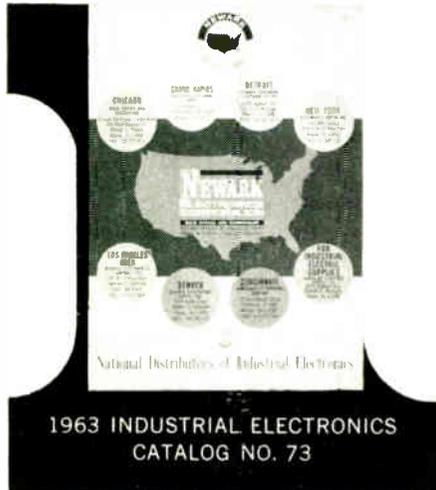


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JET ENGINE STUDY METHOD

Jet experts at United Air Lines' San Francisco Maintenance Base have developed a new way to study turbine engines. They monitor dynamic balance by charting strength and character of vibrations generated inside the engine. An electronic device developed by the airline's engineers is used.

TRANSISTOR TESTER



Linda Lee Shryock, a production employee, holds germanium epitaxial mesa transistor which was tested on the Motorola Automatic Sequential Computer Operated Transistor Testing Line at Motorola, Phoenix, Arizona. The system is capable of completely testing, selecting and sorting up to 28,000 transistors per eight-hour shift, or one unit/sec.

TINY CRASH LOCATOR

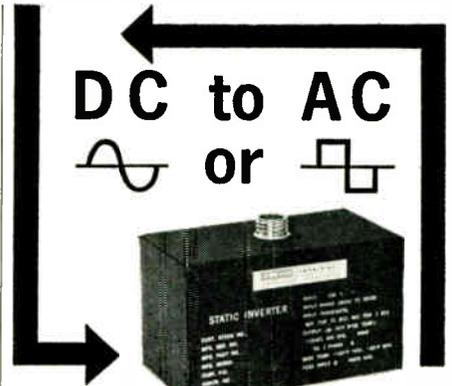
A fully-automatic crash locator beacon weighing only 4¾ lbs. has been developed by Hycon Mfg. Co. Monrovia, Calif. It is designed to replace the 50 lb. World War Two "Gibson Girls" now carried on all trans-oceanic jets.

Called HyMarker IV, it will be sold by the Air Cruisers Div. of the Garrett Corp., Bellmawr, N. J.

ERRATA FOR TUBE INTERCHANGEABILITY CHARTS

The National Bureau of Standards kindly supplied us with an interchangeability list for various types of tubes, both foreign and domestic. Because of the length of the list, we published the list in four parts. This list was published in our March, April, June, and July 1962 issues.

After publishing these lists it was noted that some errors had crept in. To overcome these errors and meet the demand for this information in one complete package, we have had reprints made. These reprints are corrected versions and are available, at no charge for single copies, by writing on company letterhead to the Editor, ELECTRONIC INDUSTRIES, 56th & Chestnut Sts., Philadelphia 39, Pa.



- Frequencies from 400 cps to 5 KC
- Output voltages from 5-500 VAC
- 50, 100, 200 VA Standard

Designed to change low voltage DC power to sine or square power, these small-size, transistorized inverters can be supplied in a wide range of output voltages and frequencies. Units feature regulation to ½% for input 24 to 30 VDC, short circuit protection, and meet the environmental requirements of MIL-E-5272C. Prices range from \$185. to \$595. Delivery of most units from stock.

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PHASE SETTERS

PRECISION

- Direct Reading in Degrees.
- Accuracy 0.05° or 1%.

Type 405 Series: 1 cps to 500 kc. Accuracy 0.25° relative, 1° absolute. No amplitude adjustment from 0.1v to 70v. Suitable for plotting phase curve.

Type 202: 20 cps to 500 mc. Accuracy 0.02° or 2%. 1° full scale sensitivity. Phase range 0-1, 0-2, 0-4, 0-12, 0-120, and 0-180 degrees.

Type 205A1-A2: 100 kc to 15 mc. Accuracy 0.05° or 1%. Sensitivity 0.04v.

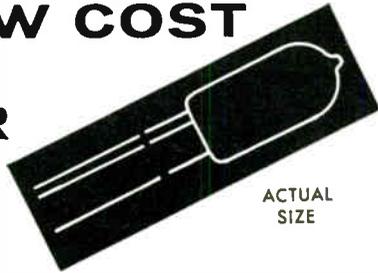
Type 205B1-B2-B3: 15 mc to 1500 mc. Accuracy 0.05° or 1%. Sensitivity 10 millivolts or better with receiver.

AD-YU
ELECTRONICS LAB., INC.
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ELECTRONIC INDUSTRIES • September 1962

New! LOW COST KRYTRON TRIGGER TUBE



ACTUAL
SIZE

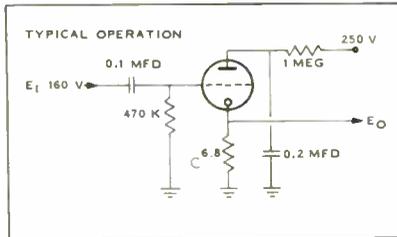
The Eii-42 is a new, cold-cathode trigger tube for use in electronic trigger, timing, pulsing and similar circuits where a short duration, high current pulse is required.

The Eii-42 requires no filament power or keep-alive current, and stands by at full sensitivity while consuming no power. The tube contains radioactive material to insure reliable operation in total darkness as well as in light.

Anode voltage 135-250 Vdc, peak current 5-100 a, trigger transfer current 0.1 uA. Typical circuit application illustrated below.

Other Krytron trigger tube types available with keep-alive current for high-speed firing, with anode voltages up to 3000 Vdc and peak currents up to 1000 a.

Eii DESIGNS AND MANUFACTURES VARIOUS TYPES OF SPECIAL PURPOSE TUBES. Call-write or wire now for full details.



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NOW POLYPROPYLENE PLASTIC CLAMPS

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NEW LOW COST

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STRONG—toughest plastic clamp made . . . high tensile strength. Tougher 'n 'ell!

MOLDED to uniform size and shape, smooth edges.

DURABLE—for outdoor or indoor use. Excellent dielectric properties. Resist solvent, grease, oil, etc.

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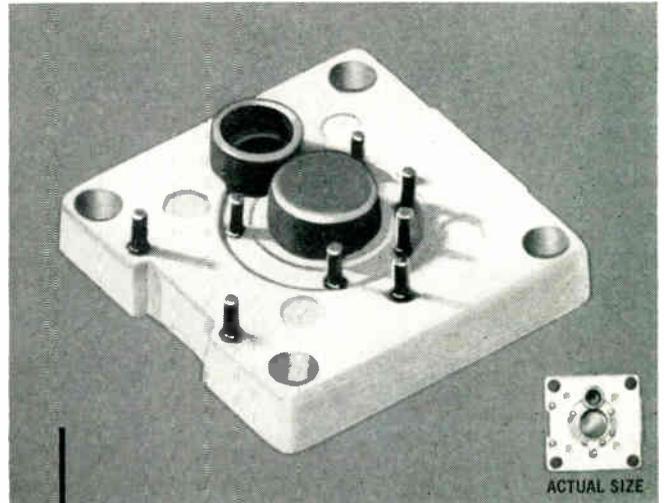


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NEW CERAMIC-TYPE MOLDING MATERIAL FOR Micro Miniaturization MODULAR PACKAGES



ACTUAL SIZE

HAVEG develops
new method for manufacturing
HERMETIC SEALS
of complicated design with
ceramic type materials

- 10 inserts hermetically sealed in the molding process. Inserts shown are .020 dia. — (.006 flat or round are possible).
- precision tolerances $\pm .001$ on center distance.
- insert material molded to exact specifications and inserts sealed — no metallizing required.
- dimensional stability and excellent electrical and arc properties between 600°F and 1000°F fill that important "temperature gap" in molded materials.

Learn more about HAVELEX and how it can help you solve some of your problems. For latest technical data, write to HAVELEX Sales Mgr., Dept. EI-29.



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SYSTEMS & CIRCUITS



JAPANESE ELECTRONIC OUTPUT reached \$1.4 billion in 1961 compared to \$1.2 billion in 1960, according to the Commerce Department's Business and Defense Services Administration. During the same period the U. S. electronics output increased from \$9.8 to \$10.2 billion.

TV RECEIVER AND TUNER manufacturers' engineering management representatives have agreed on recommendations the industry will make to the FCC with respect to minimum technical requirements for the production of all-channel TV sets. The specifications were made up at a meeting called by EIA in response to an FCC request for industry suggestions. No

recommendations developed will be made public until after they have been submitted to the FCC. The EIA made a survey of set makers and found that July, 1964, was the preferred date for the all-channel TV sets.

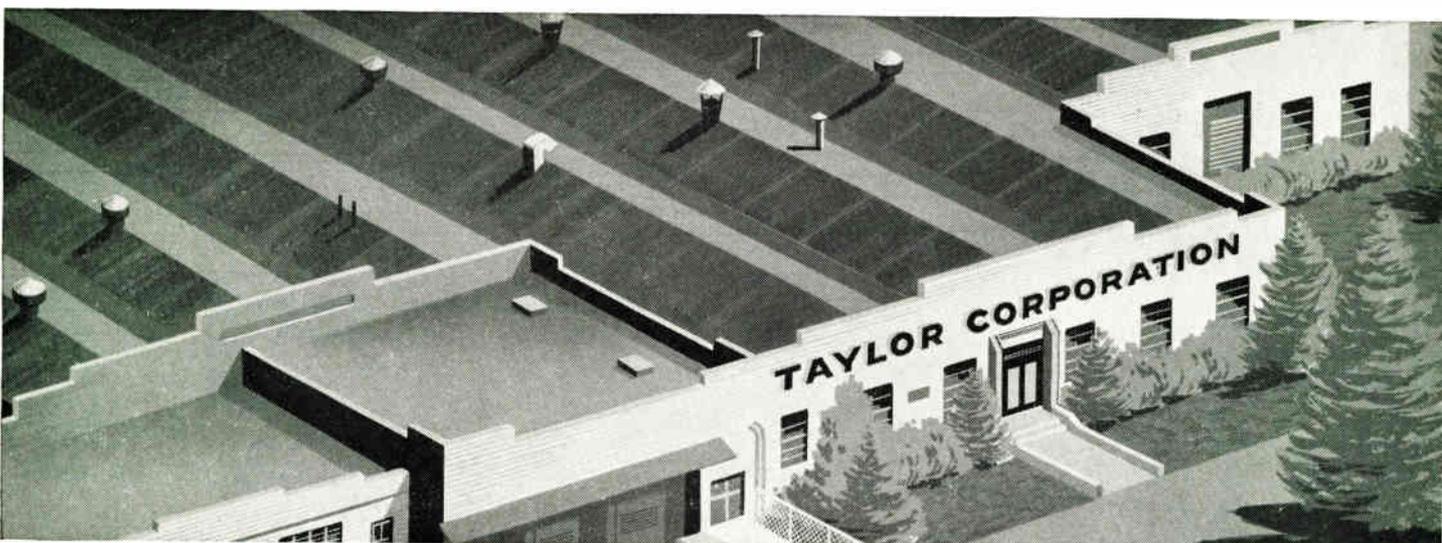
AUTOMATIC LOGGER received National Association of Broadcasters endorsement. This endorsement covers the FCC's plan to allow automatic logging devices to record technical operations of TV and radio stations. However, there is one objection to the FCC's plan to allow use of the device—it would require a daily check by a first-class operator. Stations with only one first-class operator may have to hire another one to make the daily entry.

OPTICAL MASERS/LASERS have been showing up more and more as practical hardware. Perkin-Elmer Corporation has just announced commercial production of helium-neon optical maser emitting a continuous, visible, coherent light at 6328 angstroms. Raytheon Company has developed a commercial continuous wave visible light laser. Laser is set for 90 day delivery.

A MANUAL NAVIGATION SYSTEM is being studied by Kollsman Instrument Corp., Elmhurst, N. Y. Under terms of a contract with the USAF, the company will explore the feasibility of manual space position fixing aboard orbital and space vehicles.

Manual techniques for celestially determining the position of spacecraft with sufficient accuracy to enable the space pilot to guide his vehicle to its destination, will be investigated. Among the advantages of a manual navigation system would be its high reliability and its ability to operate independently of complex power sources.

Announcing a new name for
Taylor



A DIGITAL COMPUTER TECHNIQUE which makes possible production of composite cloud photo maps over large land areas, including continents, has been developed by IBM.

The experimental technique converts satellite cloud photographs to digital form, reconstructs them in a digital computer, and then reproduces them as a Mercator projection. It promises to make available a powerful tool for the study of the earth's cloud cover, which should contribute to man's ability to understand the vagaries of weather.

Work on the project was sponsored by the Geophysics Research Directorate of the Air Force Cambridge Research Labs, Office of Aerospace Research, Bedford, Mass.

A COBOL COMPILER is being developed by Sylvania Electric Products Inc., Waltham, Mass. for the U. S. Army. The compiler is for use with the Army's MOBIDIC (mobile digital computer) systems.

COBOL (common business-oriented language) is a common "language" denominator for computers of different makes and techniques. COBOL expresses computer procedure in concise, readable English language terms. It defines a program without reference to

the hardware features of a specific computer. Once a program is written in COBOL, it requires translation into an actual machine-coded program. This is what the compiler does. It produces a running program for the computer from COBOL.

Once a computer is equipped with a COBOL compiler, it can use any program written in COBOL, even though the program was written for a computer of an entirely different make.

ULTRASONIC DRYERS are being marketed by Branson Instruments. The dryers are for use in controlled laboratory work where heat cannot be applied to a material or substance. The unit makes use of an acoustic whistle which changes compressed air or gas into sonic waves. This sonic "energy" is passed into a sonic chamber where it attacks the force of attraction between the molecules of moisture and the material. After the molecular attraction is broken the moisture is carried off by the dry air or gas.

"RELIABILITY ENGINEERS can predict, in numerical terms, the probability of success or failure of a given concept or design long before it is put into product form, thus saving industry

considerable investment of time and funds. There is a tendency to conclude that reliability effort costs money. Some studies have indicated, however, that this is not quite true. While directly assignable time and labor increases, the cost of equipment rework decreases." This was stated by Herman Wuerffel, Manager of Product Assurance, Astro-Electronic Div., RCA, during the recent Reliability Training Conference held in Princeton, N. J. Conference was co-sponsored by the IRE and ASQC.

COMPONENT PRODUCTION is often bottlenecked by the cleaning of items which require a glass-to-metal seal. It seems that drying after cleaning and rinsing in an aqueous solution in metal finishing rooms is the culprit. The use of methanol and acetone dip is expensive and inefficient. A "Spotless Dryer" made by Phillips Mfg. Co., Chicago, a firm licensed by the British concern, Imperial Chemical Industries, Ltd., does a rather efficient job. Called "Trisec," it operates on the principal that certain cationic surface-active agents dissolved in a chlorinated solvent are strongly absorbed at the surface of glass or metal objects; also, that these agents preferentially wet the objects and displace the water.

Taylor Fibre Co.—

corporation

Our former name gave the erroneous impression that we were *only* a fibre manufacturer, did not indicate how we have grown and the diversification of product lines we have achieved through expansion of research and development, engineering and production facilities. Nor, moreover, did it suggest a company that has moved far in the direction of highly engineered products that permit more effective application of specialized knowledge and skills, such

as we possess in high degree, to the solution of customers' problems.

Typical of the products we are now making and developing for specialized applications are filament windings for military and commercial use, reinforced plastic materials for missile, rocket and aerospace uses, copper-clad laminates for printed circuits, and improved laminated plastics and vulcanized fibre for general industry.

Taylor corporation
ENGINEERED PLASTICS

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INDUSTRY NEWS

Ralph L. Parr—appointed Vice President, Marketing, Dynatronics, Inc., Orlando, Fla.

Lockheed Aircraft Corp. and its subsidiary, Lockheed Missiles & Space Co., Sunnyvale, Calif., announce the following appointments: **Willis M. Hawkins**—named Vice President, Engineering and Research, Lockheed Corp.; and, all in LMSC, **Elmer P. Wheaton**—appointed Vice President and General Manager, Space Programs Div., **Dr. Roy Smelt**—named Vice President and General Manager, Nuclear Space Program Div., **R. R. Kearton**—named General Manager, Space Systems Div., and **D. J. Murphy**—appointed General Manager, Operations Div.

Texas Instruments Incorporated, Dallas, Tex., announces the following appointments: Vice President **Edward O. Vetter**—named to head the newly-formed Materials and Controls Div.; **George L. Williams**, **Philip J. Gomez**, and **John F. Wilson**—elected Vice Presidents of Metals & Controls, Inc., a corporate division.

Curt Hedman—appointed a Middle Atlantic District Manager, Mathias Klein & Sons, Inc., Chicago, Ill.

Walter E. Peek—named Vice President, Sales, for Centralab, The Electronics Div. of Globe-Union, Inc., Milwaukee, Wis.

James Evans—named Sales and Marketing Manager, Computer Diode, Corp., Lodi, N. J.

Robert G. Lynch—appointed Vice President Marketing, Electron Tube Div., Sylvania Electric Products, Inc., Emporium, Pa.



W. E. Peek



R. L. Berg



R. C. Lynch



E. L. Dashefsky

Ralph L. Berg—elected a Vice President, Controls Co. of America, Chicago, Ill.

James C. Davis, Jr., and **Frederick C. Hawkes**—elected Vice Presidents, Spectran Electronics Corp., Maynard, Mass.

Edward L. Dashefsky—appointed a Vice President, Raytheon Co.

General Electric Co., Schenectady, N. Y., announces the following appointments: **Olavi H. Halttunen**—named Marketing Manager, Capacitor Dept.; Hudson Falls, N. Y.; **G. E. Ormson**—

I believe they do have a point!

Introducing an alligator clip with a "microscopic tip"!

the Mueller **MICRO-GATOR**

Here is the alligator clip you can now use where no other clip will do! On printed circuits, in tight spots and on tiny terminals too crowded for anything but its "microscopic" tip. Fully insulated right down to the nose. It offers all the speed, free-handed ease and convenience associated with other Mueller alligator clips.

Strong new type "keyed in" hinge. Traditionally snappy Mueller spring. Clinching ears for gripping wire.

Tough, Vinyl, skin-tight insulator. Lip-action tip-slot. A ringer for the popular "Mini-gator" insulator.

INSULATORS SOLD SEPARATELY. (Standard Red and Black colors. White, Blue, Yellow and Green also available.)

FREE SAMPLE of clip and insulator, on request to factory

Mueller Electric Co.

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ONLY PERKIN GIVES YOU THIS CHOICE IN 30A DC POWER SUPPLIES



MODEL TVCR040-30



MODEL TVR040-3D

TRUE DYNAMIC REGULATION OF BOTH VOLTAGE AND CURRENT

DC OUTPUT: 0-40v, 30a. STATIC REGULATION: (Line) $E \pm 0.01\%$ or $\pm 2mv$, $I \pm 0.02\%$ or $\pm 3ma$; (Load) $E \pm 0.02\%$ or $\pm 4mv$, $I \pm 0.05\%$ or $\pm 7.5ma$; DYNAMIC REGULATION: Line $\pm 50mv$ for inst. $\pm 10v$ line change, Load $\pm 0.5v$ for FL change. RIPPLE RMS: $E 2mv$, $I 5ma$. RESPONSE: 50μ sec. \$1295.

VOLTAGE REGULATION WITH ADJUSTABLE CURRENT LIMITING

DC OUTPUT: 0-40v, 0-30a. STATIC REG: Line $\pm 0.01\%$, Load $\pm 0.02\%$. DYNAMIC REG: Line $\pm 50mv$ for inst. $\pm 10v$ line changes, Load $\pm 0.5v$ for FL change. RIPPLE RMS: $2.0mv$. RESPONSE: 50μ sec. CURRENT LIMITING REGULATION ACCURACY: $\pm 0.1\%$ or $\pm 30ma$. \$1120.

Only Perkin gives you these two big choices in 30a DC power supplies:

1. A supply that has true voltage regulation *and* current limiting with automatic voltage programming.
2. A supply that has both voltage and current regulation with automatic voltage and current programming.

Both these all-solid state units are transient-free. Both feature current limiting adjustable from 0 amps upwards, series and parallel operation, remote sensing, and immunity to short circuits. Off-the-shelf delivery, prepaid in U.S.

Write for complete technical information.

PERKIN
electronics

345 Kansas St., El Segundo, Calif., Spring 2-2171

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appointed Sales Manager, Capacitor Dept.; **H. E. Brown**—named Marketing Manager, Advanced Product Planning Operation; **William J. Kuehl**—appointed General Manager, Armament and Control Products Section, Light Military Electronics Dept., Utica, N. Y.; and **Karl W. Bizjak**—named Palo Alto, Calif., District Sales Manager for the Receiving Tube Dept.

Fielding G. Lucas—appointed General Manager, Minneapolis - Honeywell Ordnance Facility, Duarte, Calif.

Norman A. Lorimer—appointed Sales Manager at the Orange, Calif., plant, Anaconda Wire & Cable Co.

Borg-Warner Corp., Chicago, Ill., announces election of the following officers: **Maurice R. McLary**—named President and General Manager, Ingersoll Products Div.; and **Robert F. Schutz**—named President and General Manager, Ingersoll Kalamazoo Div.

Westinghouse Electric Corp., Pittsburgh, Pa., announces these appointments: **Douglas D. Danforth**—named Vice President. He is also General Manager, Control Div. **George W. Jernstedt**—appointed General Manager, Industrial Equipment Divisions; and **Paul D. O'Donnell**—named Westinghouse Manufacturing Planning Manager.

Robert T. Vaughan—appointed General Manager, Equipment Operations, Lansdale, Pa., Div., Philco Corp.

Radio Corp. of America announces the following appointments: **Clarence A. Gunther**—named Division Vice President, Technical Programs, and **N. Richard Miller**—appointed Division Vice President, Business Planning, both in RCA's Defense and Electronics Data Processing Operations Group; **Herbert A. Poole**—named Advertising and Sales Promotion Manager, RCA Service Co., Cherry Hill, N. J.; and **Vroman W. Riley**—appointed Sales Manager, Microwave Dept., Camden, N. J.

John G. Fitzpatrick—appointed Vice President of Autonetics Div., North American Aviation, Inc., Downey, Calif.

Don Cinalia—appointed Assistant Sales Manager, Industrial Products Div., Jerrold Electronics Corp., Philadelphia, Pa.

General Instrument Corp., Newark, N. J., announces these appointments: **Paul S. Heflin**—named Vice President, Newark Operations; and **William A. McCracken**—appointed to newly created post of Vice President, Operations, Capacitor Div.

International Telephone & Telegraph Corp., New York, N. Y., announces the following appointments: **John W. Lienhard**—named President, ITT Export Corp., ITT's new export subsidiary; **Mortimer Rogoff**—appointed Vice President, Program Planning and Development; and **Raymond L. Brittenham**—elected Vice President and General Counsel for the company.

Hoffman Electronics Corp., Los Angeles, Calif., announces these appointments: **John R. O'Brien**—appointed Vice President for Corporate Relations; and **Ray B. Cox**—named Vice President and Marketing Director, Military Products Div.

Christopher Buff—elected Vice President and Chief Engineer, American Cable & Radio Corp., New York, N. Y.

E. R. Wagner—appointed Vice President and Assistant to the President, Emertron, Inc., Silver Spring, Md.

Melvin A. Raney—elected President and Chief Executive Officer, The Lionel Corp., Hillside, N. J.

Oak Manufacturing Co., Crystal Lake, Ill., announces these appointments: **Stewart Pfannstiehl**—elected Executive Vice President; and **Earl Olenick**—appointed General Manager, Distributor Div.

REQUIRED

Excellence In Receiver Selectivity With Minimum Component Population

SOLUTION:

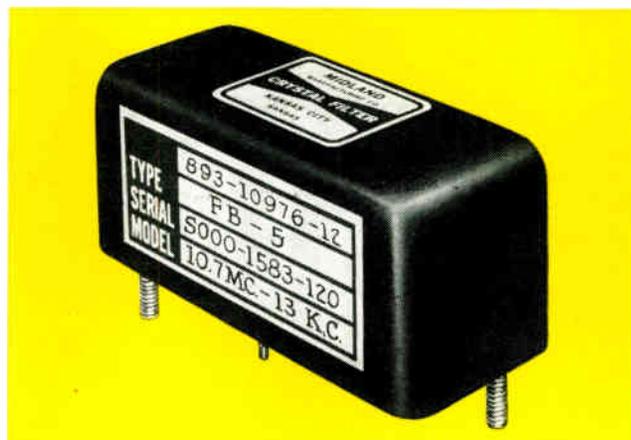
1 Midland filters with guaranteed ultimate discrimination of more than 100 db with 60db/3db BWR < 1.8 2 A low cost stock filter with virtually no insertion loss

FACT

Midland crystal filters are the result of exact design methods and real production knowhow.

Facts are facts and filters are Midland's business. Their filter and crystal engineering skills and facilities assure the user of top reliability and performance.* This is Midland's Type FB-5 crystal filter produced by the tens of thousands—the only sure proof of production ability. It is an 8 pole—6 zero precision network that incorporates no added dissipative elements in inband ripple control. Result: Superior selectivity with essentially no midband insertion loss. A quality production component with immediate delivery. Engineering Bulletin NBS-103 is available detailing complete technical information. Prices on request.

* Write for Midland's capabilities and facilities brochure, "Midland—in microspect".



SPECIFICATIONS

Center Freq: 10.7 MC ± 375 CPS
 Bandwidth @ 6 db: 13.0 KC Min. — 13.8 KC Max.
 60 db/6 db BWR: 1.8 Max.
 100 db/6 db BWR: 2.2 Max.
 Ultimate Attenuation: 105 db. Min., 8 MC to 14 MC
 Midband Insertion Loss: 0.5 db. Nominal, 1 db. Max.
 Inband Ripple: 0.5 db. Nominal, 0.8 db. Max.
 Operating Temp. Range: -55° C to +90° C
 Zin/Zout Req: 1100 OHMS ± 5% in parallel with adjustable capacitor 0-5 picofarads.
 Dimensions: 2 3/8" L x 1" W x 1 1/2" H

Midland MANUFACTURING COMPANY
 Division Pacific Industries, Inc.
 3155 Fiberglas Road Kansas City 15, Kansas

Circle 151 on Inquiry Card

The great paradox of our time, perhaps of all time, is that peace depends on our capacity to fight a war. Thus the person who contributes to our military strength, contributes to the cause of world peace.

MITRE's contribution is the design of command and control systems to give our military commanders the means to detect attack and retaliate.

The men who design these systems must think in terms of war and military operations — weapons, logistics, communications, intelligence, ability to destroy and ability to survive. They must be able to predict and solve the problems of future military command within the reality of existing or predictable electronic capability.

We call this "Military Command Technology."

MITRE's specific assignment is the design, development, evaluation, and integration of several interrelated, constantly evolving systems. It encompasses Command Systems (such as NORAD);

Control Systems (such as SAGE); Intelligence Systems (such as MIDAS); and Warning Systems (such as BMEWS).

The work involves important new areas of technology in such fields as communications, intelligence, space surveillance, survivability, computer applications, data processing and other electronic techniques.

MITRE is located in pleasant, suburban Boston. Requirements: B.S., M.S., or Ph.D. in these disciplines — electronics, physics, and mathematics. Rewards are competitive. Openings also available in Washington, D.C. and Colorado Springs, Colo.

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WAR

How would it be fought?

What would this nation's strategy be?

What kind of decisions would have to be made?

How would the commander command?

Who and what would survive?

MITRE is an independent, nonprofit corporation working with — not in competition with — industry. Formed under the sponsorship of the Massachusetts Institute of Technology, MITRE serves as Technical Advisor to the Air Force Electronic Systems Division, and is chartered to work for such other Government agencies as FAA.

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

GRADUATE WORK-STUDY PROGRAM STARTED BY NBS

The National Bureau of Standards has instituted a work-study program enabling Washington area graduate students to acquire advanced science degrees while earning 70% of a junior scientist's salary at a Bureau lab.

The plan, designed by the Bureau working with local universities, begins this month. Students may work in an NBS lab three days a week and take university courses Tuesday, Thursday and Saturday.

The Ph.D. program can generally be completed in 5 years under the plan. After finishing four years of course work, participants may complete thesis research at the Bureau or the university. The program may be expanded to include other research labs.

AREA RESEARCH CENTER FOR WILKES-BARRE, PA.

A \$400,000 public facility grant to Wilkes College, Wilkes-Barre, Pa., for construction of an area scientific research center to aid industrial expansion in the depressed surrounding region has been authorized by the Area Redevelopment Administration, U. S. Dept. of Commerce.

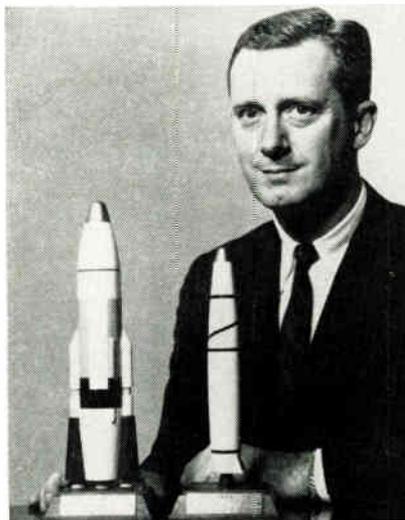
NSF ANNOUNCES GRANTS

The National Science Foundation has announced plans to provide \$3,730,634 in grants to 302 colleges and universities to use as they wish in strengthening their science departments.

These unrestricted grants were made in every state and Puerto Rico. Seventeen institutions received the maximum amounts of \$50,000.

FOR MORE INFORMATION . . . on opportunities described in this section fill out the convenient resume form, page 222.

NEW GE DIVISION HEAD



Hilliard W. Page, recently named General Manager of GE's new Missile and Space Div., is shown with models of Atlas and Thor missiles he helped develop. He directed nose-cone programs for both missiles. Page, previously GM of Missile and Space Vehicle Dept., has been with GE 17 years.

CALIF. TECH. SCHOOL GRADS NOW MAKE 20% MORE

June 1962 electronic engineering graduates of California State Polytechnic College were paid 20% more to start this year than their '58 counterparts.

The graduates of the San Luis Obispo school averaged \$603 a month, against only \$515 for June 1958 grads. Averages for the years between were \$541, \$572 and \$595.

Private industry paid an average of \$615 to graduates in June. The government average was only \$515.

Government agencies got 10% of the graduates this year, more than in 1961. This was largely due to the NASA recruiting program. The NASA "image" attracted academically better graduates than other government agencies.

The 1965 graduating class, which finished its first year this June, is smaller than previous years' classes.

CHANGE IN ROTC PROGRAMS ADVOCATED

The executive committee of the Engineering College Administrative Council has approved a proposed change in Army and Air Force ROTC programs. The plan is to condense and reduce these curriculums from four to two years.

The ECAC is a non-governmental body made up of the deans of all the engineering schools in the U. S. accredited by the Engineers Council for Professional Development.

Reasons for advocating this action, said Gen. Ralph A. Palladino, Military Executive for the Reserve Force Policy Board, include increasing enrollment and the expected establishment of many two-year colleges across the U. S.

The two-year elective program would provide more on-campus time for college subjects. It would permit two-year college graduates to enter ROTC programs on transfer to senior-level colleges without being penalized for not having started in regular four-year colleges as freshmen.

The council's eventual aim is to replace all current Army and AF ROTC programs with this new one, with the exception of military college programs.

SERIOUS SHORTAGE OF ENGINEERS FORESEEN

If the supply of engineers is not increased within the next 10 years, national technical and scientific progress will be seriously impeded. This was stated in "Demand For Engineers," a report by the Engineering Manpower Commission.

The report stated that in 1971, unless drastic changes are made, only 37,000 of the needed 48,000 engineers will be graduating yearly. This gap will have serious effects.

ELECTRONIC INDUSTRIES *Professional Profile*

The ELECTRONIC INDUSTRIES Job Resume Form for Electronic Engineers

Name _____ Tel. No. _____
 Street Address _____ Zone _____
 City _____ State _____

Single Married Citizen Non-Citizen Date of Birth _____
 Will Relocate Yes No. If Yes Another City Another State
 Salary Desired to Change Jobs in present area _____
 Salary Desired to Change Jobs and relocate in another area _____
 Professional Memberships _____

College or University	Major	Degree	Dates

RECENT WORK EXPERIENCE

Company	Div. or Dept.	Title	Dates

SIGNIFICANT EXPERIENCE AND OBJECTIVES

State any facts about yourself that will help a prospective employer evaluate your experience and job interests. Include significant achievements, published papers, and career goals.

Mail to: ELECTRONIC INDUSTRIES—Professional Profile—56th & Chestnut Sts.—Philadelphia 39, Pa.
 This resume is confidential. A copy will be sent only to those Companies whose number you circle below.
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A SHORTAGE OF ENGINEERS?

Many words have been written and said about the "shortage of engineers."

Is there really a shortage?

The author thinks not.

He says that they are being misused and offers 11 examples to prove his point.

FOR ABOUT A DECADE, in both the technical and lay publications, there have been many articles about the "shortage of engineers." As the cold war increased, the cries of "shortage" became more noisy, without any real remedy in sight. When the Soviet Union achieved success in a few scientific areas, such as atomic energy and the satellite program, our lag was blamed on the "shortage," under the premise that, if only more money were spent, and more people were put to work, the "gap" could be closed.

It never occurred to anyone to question this premise. We forgot that some of the greatest scientific "break-throughs" of the past were achieved by men working alone and without benefit of government subsidies. We failed to consider that perhaps the Soviet Union was able to succeed, not because of a vast supply of engineers, but because it could force placement of the right engineer in the right spot, and then demand performance from him, "or else."

Since we cannot resort to the use of coercion, a number of other approaches were tried.

Many scholarships were established by institutions, by individuals and some corporations. Advertising on radio and TV has been used to cajole students into taking up scientific studies. Toy makers, ever alert to future markets, have produced scientific kits that are more laboratory projects than toys. Formerly, such kits were given names that made them sound like games—"Crazy Atom Fiddlesticks," as an example. But now such items as the "Calculo Analog Computer" set, the "Solid Shapes Lab," transistor electronic kits, weather-recording stations, model plastics plants, etc., etc., are on the market.

Some companies have imported engineers from overseas, and many others have emigrated here, mainly by higher salaries. Other companies have transferred research work overseas to use the engineers in their native habitat. However, all of these attempts have not really dented the "shortage" problem.

Colleges have greatly expanded their facilities to increase their "output" of engineers. Whether quantity has been gained at the expense of quality remains to be seen. It is likely, at any rate, that the demand has grown faster than the number of qualified graduates.

Industry has responded by offering more money and other inducements. We keep reading about "gracious suburban living, academic atmosphere, pleasant climate," etc., etc. This could not appreciably increase the supply in an overall sense, although it did result in much pirating between companies. Many groups have sprung up for the express purpose of carrying out the search for engineers that can be pirated away from their jobs. This has now become a national industry, like lobbying in Washington. The tremendous funds spent in pirating might have been better spent to train more people. As it now stands, the turnover resembles a vast game of "musical chairs."

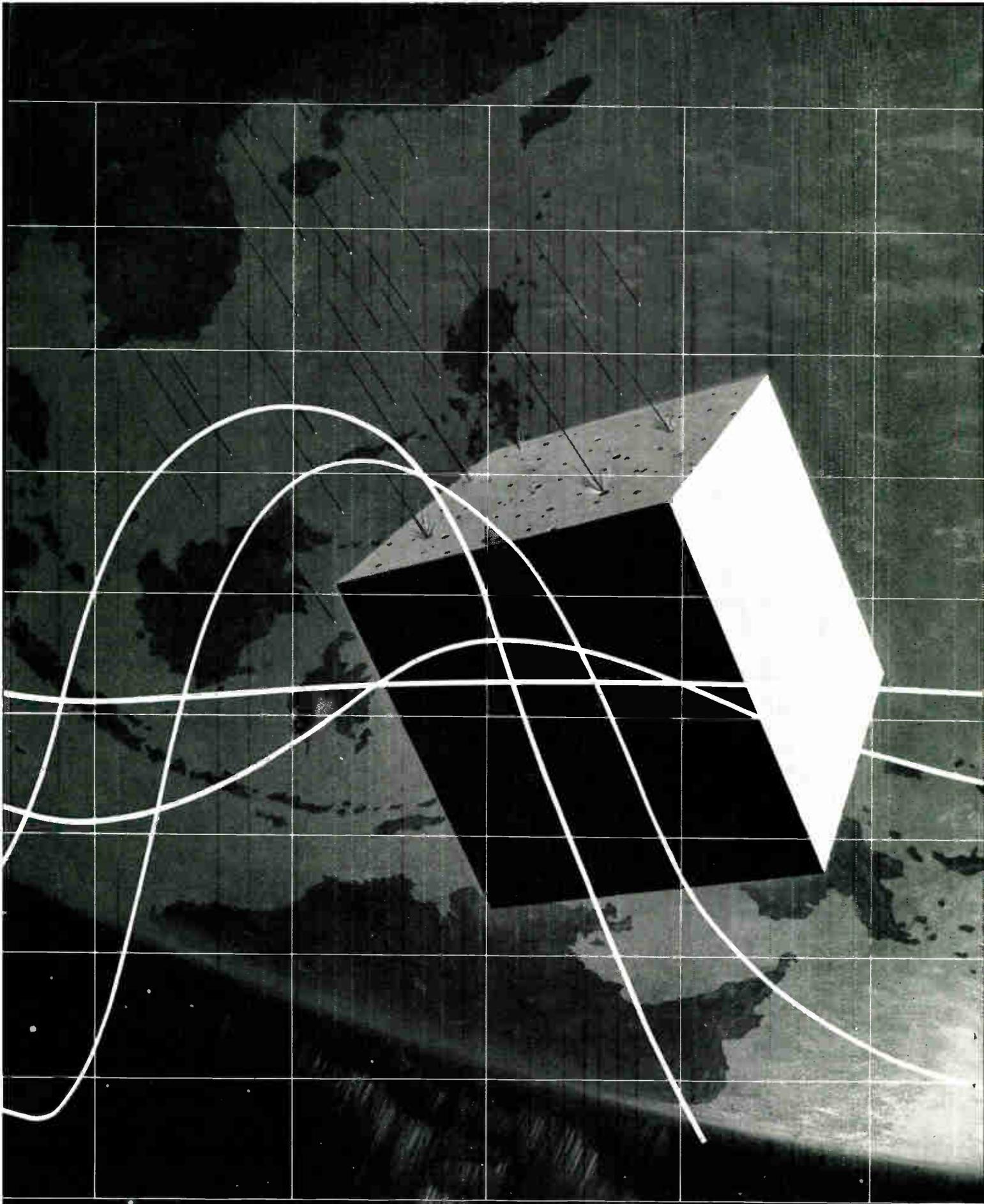
I am of the opinion that all of the above efforts have been misdirected, that there is no shortage of engineers. What we have, as a nation, is not a shortage of engineers, but rather an abysmal failure to use their services and talents properly. Instead of making frantic efforts to obtain more engineers, national cooperative study by industry (without government subsidy) should be made as to what actions should be taken that will result in:

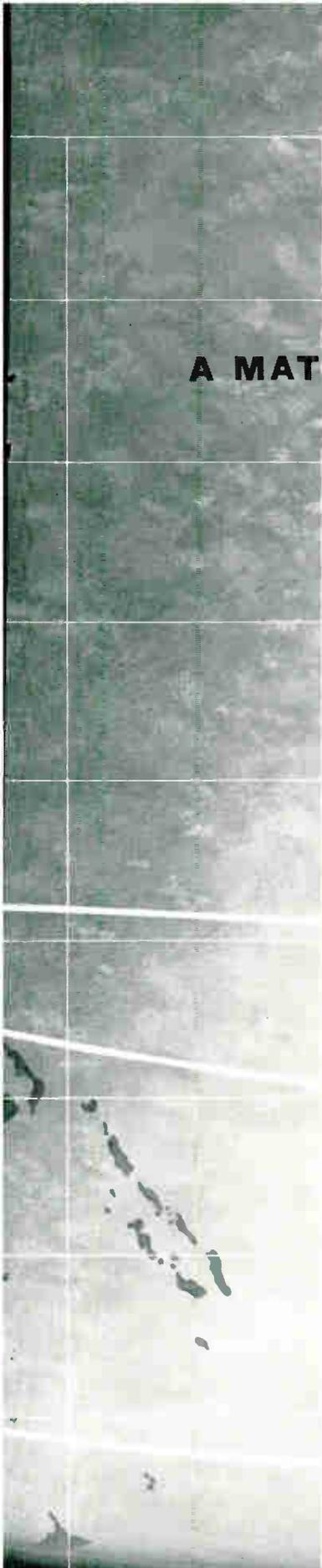
1. Placing the right engineer in the right job.
2. Getting him to do some work.

(Continued on page 226)

By Dr. HENRY WEISBECKER

Westrex Corp.
Div. of Litton Industries
540 W. 58th St.
New York 19, N. Y.





A MATERIALS LABORATORY IN SPACE

A comprehensive understanding of the reaction of materials to outer space is an important key to this country's space program. In their study of materials, scientists at Lockheed Missiles & Space Company found the problem could be most graphically depicted by showing the various environmental factors impinging on a simple cube-shaped vehicle. A cube, placed in a noon polar circular orbit, would allow unusual isolation of the effects of space on materials; make their measurement simpler and more accurate; and offer a built-in control of the results.

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Guided by engineers and scientists of outstanding calibre, Lockheed Missiles & Space Company has won its place in the forefront of many disciplines in missile and space technology. And such progress constantly creates key positions for others of proven ability. Lockheed's location in Sunnyvale and Palo Alto on the beautiful San Francisco Peninsula is ideal. So is the climate—physical and mental.

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ENGINEER SHORTAGE (Continued)

What follows shows that the failure to use engineers properly is taking place in at least 11 ways.

1. Engineers are forced to perform work not really requiring engineers. Many engineers are used as "sales engineers" where "salesman" would do. Actually a man does not need an engineering degree to sell a technical product. Engineers can acquaint him with the specifications and applications of the products. Difficult questions could be referred back to the engineers. Other engineers perform work which could be done by technicians.

Still other engineers do the work of technical writers, specification writers, administrators, parts listers, purchasing agents, testers, field men and servicemen, etc. All of these tasks do not require a full technical education. People can be used for these tasks who have a more limited education. The use of engineers on these jobs is an enormous waste of their talents.

2. Parallel with the above is the organizational setup of most companies. The only way these companies presently know of rewarding a good engineer is to promote him to a job where he is no longer an engineer, but an administrator. His technical talents remain unused in favor of his perhaps mediocre administrative abilities. Almost all of the engineers who did the important early development work in their fields are now in high executive positions. They are several levels removed from contact with actual equipment.

A method must be found to reward technical accomplishments without forcing a man into administrative work. The solution is not simple. A partial answer has been the creation of "staff" jobs as differentiated from "line" jobs. However, this has often led to the staff man considering himself a "prima donna," not required to produce anything. Furthermore, the staff positions are felt to be inferior due to the lack of authority attached to them.

What is needed is a complete reorganization so that each man is doing that, of which he is most capable (engineers doing engineering and administrators doing administration), each being rewarded according to his "market value."

3. Much development work is now carried out that is not really needed. The core of this problem is mainly the military specifications. The specification writers have become patrons of the state-of-the-art. These people are quite remote from the real needs of the military. Specifications have a tendency to stay one step ahead of the state of the art, instead of being tailored to the realistic field needs. It is assumed that this will goad industry into constantly advancing the state of

the art and it is beneficial toward that end. But actually, this approach causes much engineering effort to be expended towards developing equipment of a quality far beyond that necessary.

For example, equipment which must work at the North Pole need not be expected to work at the Equator, and the unit which must work in space does not have to work under water, yet specifications make no allowances for this. They insist that all equipment meet the same severe needs at all extremes.

The work of many engineers goes into the design of such equipment, when such work could be used for equipment really needed. As a result, some equipments perform far better than needed, while others are so poorly designed because of too little engineering effort, that they fail under normal conditions. To cure this, the military, instead of using general specs., must replace them by others, which are tailored to certain actual needs and individual equipments.

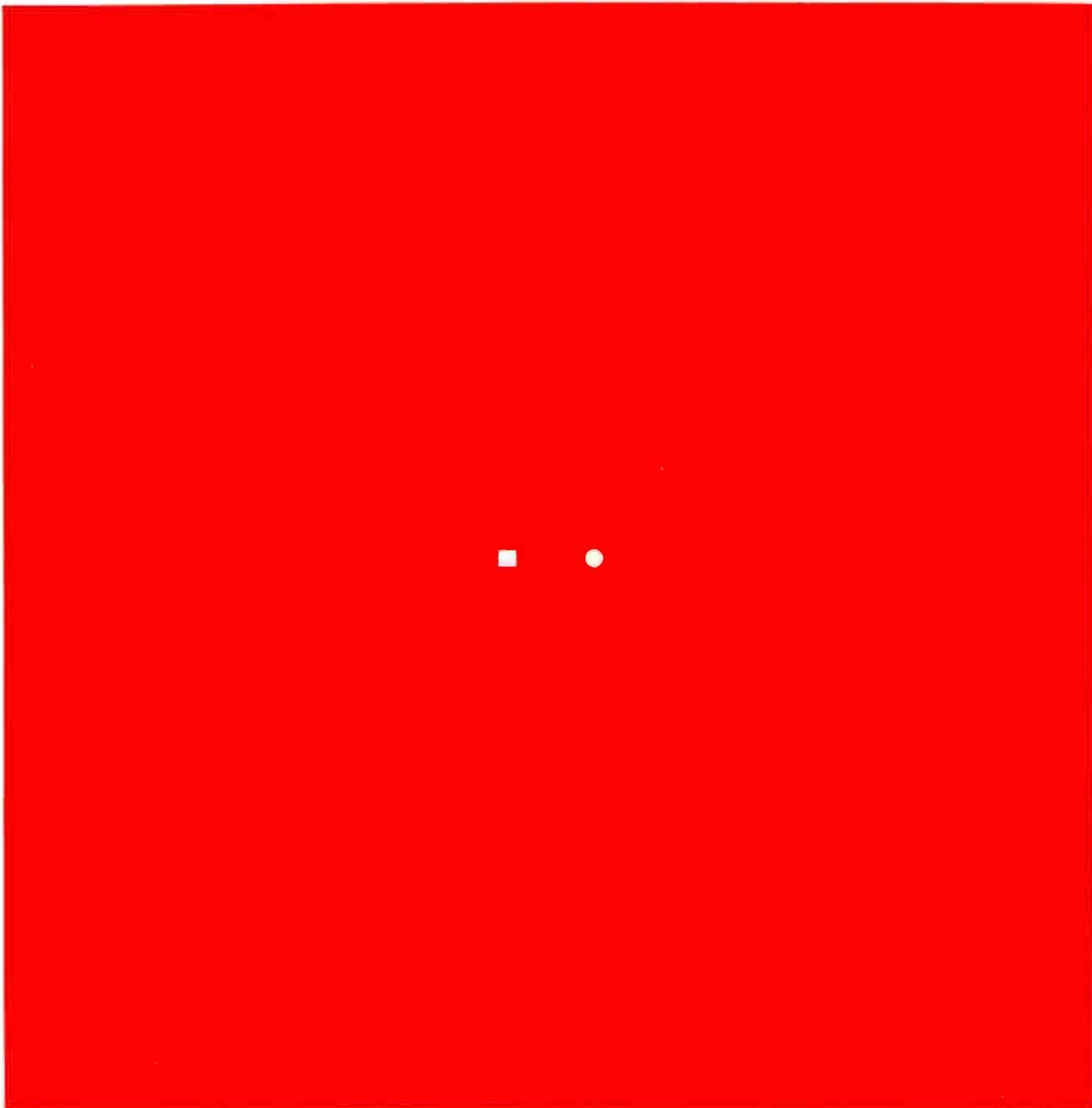
4. Many contracting companies assign more engineers to a project than are needed. This can be done without difficulty on a cost-plus type of contract. And, it can also be done on other types of contracts in that the original proposal is inflated as far as the number of engineers is concerned. This problem could easily be solved if the contracting officers began limiting the number of engineers that the contractor is allowed to use on a project.

5. There is no concrete demand made on the performance of engineers engaged in R&D work. Today, engineers are largely left to work at their own speed without pressure as to results. To a point, this approach is, of course, desirable, but there should be a limit, especially where the concern is not with research, but just with routine development.

Today there is a tendency, in this country, for people to demand as much as they can get and give as little as they can in return. The "day's work for a day's pay" has gone out of fashion. An Englishman who came to work in the United States was asked what he liked best over here. His reply was, "the fact that the coffee break lasts all day." A way must be found to reverse the trend, at least among "professional" men. Hand in hand with the tendency to loaf is a tendency among engineers to work on problems that interest them, rather than on those problems that have been assigned. This is not bad in itself, but, again, a limit must be placed on how much of this is allowed.

Finally, engineers often waste valuable effort in a search for an "elegant" solution to their problems, rather than to accept a well-known solution. We should all devote more effort just to produce serviceable and reliable equipment, without attempting to overdesign.

(Continued on page 229)



The small white rectangle above represents the approximate size of space required to contain one page of newspaper size document reduced for storage through NCR's **PHOTOCHROMIC MICRO-IMAGE** process. The small white dot on the right represents the area that would hold thousands of micro-capsules (cell-like structures containing useful materials) produced through NCR's amazing chemical process of **MICRO-ENCAPSULATION**.

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also have an active interest in the advanced work being done by NCR scientists and engineers.

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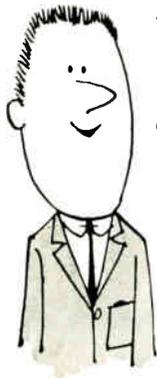
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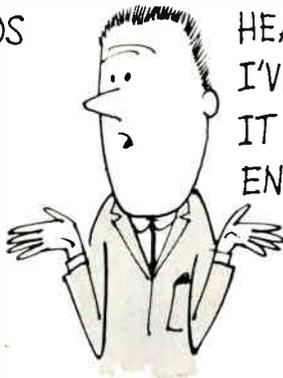


ARE WE
HUGHES ENGINEERS



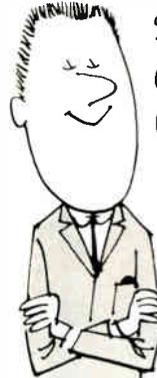
THE LEONARDOS
OF THE
SPACE AGE?

I CAN'T ANSWER
THAT QUESTION.

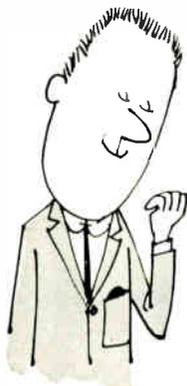


HEAVEN KNOWS,
I'VE DEBATED
IT OFTEN
ENOUGH

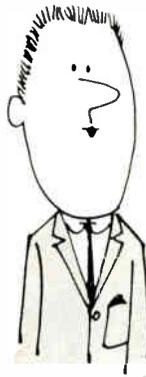
IT'S TRUE THAT
WE'VE WRUNG A FEW
SECRETS OUT
OF THE
UNIVERSE



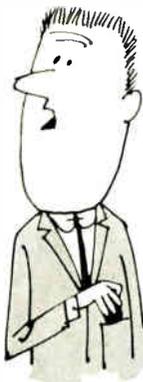
BUT WE'RE NOT ALL FLAIR
AND INSPIRATION. IT'LL
TAKE A LITTLE WORK
TO SOFT-LAND THE
SURVEYOR ON THE MOON



GUESS THAT'S
WHY WE HIRED
MORE NEW GUYS
TODAY



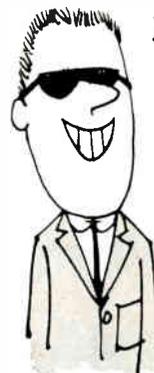
I HOPE THEY
REALIZE
THINGS ARE
GETTING TOUGHER
AROUND HERE



ALL HUGHES
ENGINEERS
ARE RESTRICTED
TO ONE
PLANET A PIECE



I WORRY ABOUT IT-
BUT YOU
CAN'T TELL
BECAUSE OF
MY SUN TAN



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CONTROLS ENGINEERS. Concerns airborne computers and other controls related areas for: missiles and space vehicles, satellites, radar tracking, control circuitry, control systems, control techniques, transistorized equalization networks and control servomechanisms.

CIRCUIT DESIGNERS. Involves analysis and synthesis of systems for: telemetering and command circuits for space vehicles, high efficiency power supplies for airborne and space electronic systems, space command, space television, guidance and control systems, and many others.

INFRARED SPECIALISTS. To perform systems analysis and preliminary design in infrared activities for satellite detection and identification, air-to-air missiles AICBM, infrared range measurement, air-to-air detection search sets, optical systems, detection cryogenics and others.

SYSTEMS ANALYSTS. To consider such basic problems as: requirements of manned space flight; automatic target recognition requirements for unmanned satellites or high speed strike reconnaissance systems; IR systems requirements for ballistic missile defense.

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6. Older engineers are not sufficiently used. It is becoming more difficult for older engineers to find jobs, despite the fact that they have the needed experience. Starting as early as 45 years of age difficulties appear, and toward 65 it becomes nigh impossible for them to find a position. According to one official of the United States Employment Service, "Major companies hire no one over 45." Older men have to resort to job shops or have to work for small companies. Statistics on how badly companies discriminate against older men are most elusive, since some will not admit to the practice. Others give a variety of excuses, such as pension plans, medical expenses and obsolescence of the experience of these people. But the last point is not valid, and the others could easily be overcome by the employees' waiving of the benefits. Some of our most valuable people thus go unused.

It is not recognized, in industry, that chronological age is not a determinant of ability. Sociological and psychological research has shown, however, that people age at different rates. One man may be more capable and alert at 80 than another is at 30. Examples of well-known octogenarians still performing at top capacity are legion. Furthermore, while some people would enjoy retiring at 55, 60 or 65, there are many others who would not. It is not only unfair but very wasteful of our intellectual resources to force everyone to retire at 65 years of age.

7. Not enough use is made of consultants or part-time help. If a company can only use, say, one day per week of a man's time, it should allow him to work elsewhere on the other four. It is sometimes less expensive to pay a consultant's fee for one day per week than to pay a full-time engineer's salary. Often the same results can be obtained.

8. The ratio of technicians to engineers is too small. One engineer should be able to delegate a large part of his work (testing, making measurements, de-bugging) to several technicians, thus making more use of his abilities. Instead, today, the ratio seems to be only one technician for every two engineers. (A study of the United States' and the Soviet Union's current yearly production of engineers and technicians indicates that we graduate 32,800 engineers yearly, while the Soviet Union turns out 120,000 (one third women), backed by two trained technicians for each graduate. The engineer also should have more clerical help to handle his administrative work, such as scheduling, requesting and giving information, etc.

9. Hiring techniques at present are faulty. Companies now recruit and pay high salaries to very specialized people. For example, a "radar man" is hired for radar work, a "communications man" for communications work, without attempting to find what the man really did and where this experience fits in with the company's work. Once on the job, the engineers generally have to adapt themselves to a new type of work anyhow, either immediately or at some later time. Thus nothing would have been lost if a less specialized man had been hired.

Furthermore, industry is inclined to employ people with far greater qualifications than the position really needs. Often 15 or 20 years of experience are demanded, even though the field of specialization may advance so fast that all but two or three years of this experience is obsolete.

It is often far better to employ someone whose previous work was in a different field and retrain him, than to pay excessively for a man with exactly the needed experience. But most employment people do not realize this. Of course, actual hiring is generally performed by engineers, but it is the personnel department which provides the engineers to be interviewed. The latter is not well versed in the needs of the job it is trying to fill to perform hiring tasks efficiently.

10. Company pay raises to old employees do not keep up with industry levels. Thus a loyal employee who is, in a sense, a captive, due to his own inertia, is penalized as against the man hired from outside. The latter must, in any case, be paid the salary prevailing at the time. No course is thus open to the old employee except to change jobs. Valuable company know-how is lost, and the man must be replaced at a higher salary by someone without this know-how.

On the other hand, the old employee goes on to a new company where he, in turn, has no company know-how and must relearn. For example, if a man had been hired right out of college in 1951, and had been paid at the then usual rate of \$60.00 per week, he would be earning, today, a salary of \$155.00, assuming annual increases of 10%. This is rather pitiful by today's standards, when an engineer just out of school can obtain, perhaps, \$120.00 and is able to rise very rapidly to the same level. Assuming, again, 10% annual raise, the young man would earn \$155.00 after only three years.

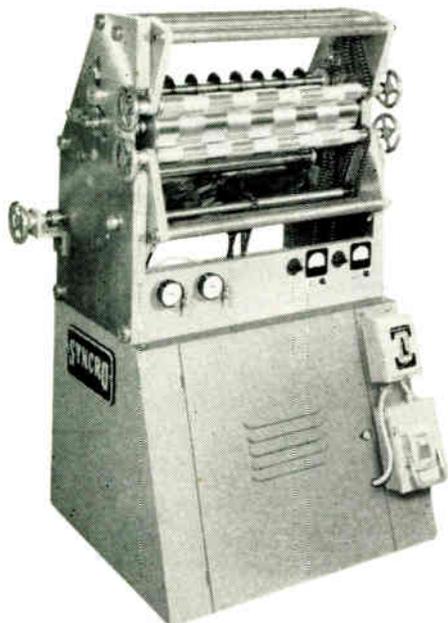
This shows the reason for the heavy turnover today. If salaries paid to present employees were equal to those paid to people hired from the outside, most of the turnover would cease.

(Continued on page 230)

A REPRINT OF THIS ARTICLE CAN BE OBTAINED
by writing on company letterhead to
The Editor
ELECTRONIC INDUSTRIES
Chestnut & 56th Sts., Phila. 39, Pa.

SYNCRO SLITTERS

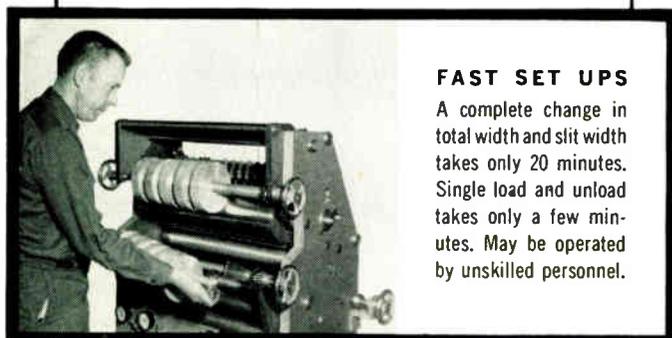
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A complete change in total width and slit width takes only 20 minutes. Single load and unload takes only a few minutes. May be operated by unskilled personnel.

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ENGINEER SHORTAGE (Concluded)

However, most companies, regarding their old workers as captives, fail to consider this point.

11. Security clearance regulations now in effect prevent many immigrants, who might otherwise be qualified, from doing R&D work until after they have obtained U. S. Citizenship (at least five years' residence). It is possible, in some cases, to obtain security clearance for non-citizens, but this involves so much red tape that most companies shy away from it. And, these men are not hired for non-classified projects, on the theory that the company might later want to switch the men and be unable to do so. Since a very large percentage of R&D work is for the military, and a great deal of this is classified, much valuable engineering talent is lost for five years. Where the man is forced by this situation to switch to other work, his talents are lost.

Due to all of these ways of poorly using engineering talent, a large waste of available resources results. If some of these defects were corrected, the "shortage of engineers" would soon disappear. Looking at the points above, and an adjustment of company and government policy to correct the situation, would provide a faster and better solution than the stopgap answers tried to date. In other words, instead of trying to obtain more engineers, let us properly use those we now have, they constitute one of our most important resources.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS is backing the proposed Federal Salary Reform Act now being reviewed before the House Committee on Post Office and Civil Service. NSPE feels the bill will restore a more proper differential between starting and top-level salaries of engineers and scientists. The flexibility provision built into the bill would, in most instances, be adequate to adjust Federal salaries on the basis of comparability.

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NEWS OF MFRS. REPRESENTATIVES

ERA OPPOSES FOREIGN EXCESS PROPERTY IMPORTS

Opposition to a Department of Commerce proposal to permit the importing into the U. S. of non-agricultural foreign excess property has been voiced by the Electronic Representatives Association, Chicago, Ill.

Henry Lavin, of Henry Lavin Associates, Inc., Chairman of the ERA Government Affairs Committee, has urged all ERA members to write their congressmen concerning this proposal. It is being advanced by the Foreign Excess Property Division of the Commerce Department.

The same proposal was before the House of Representatives in 1960 in the form of H.R. 9996, but failed to pass. ERA strongly opposed the measure at that time.

Lavin reports ERA opposition to importing foreign excess property is just as strong today as it was two years ago.

REPRESENTATIVES WANTED

Manufacturer of test instruments—including multimeters, voltmeters, and RF power meters—desires representatives throughout the United States. Box 9-1, Editor, ELECTRONIC INDUSTRIES.

Bivins & Caldwell, Inc., High Point, N. C., has sold its Florida assets to a new corporation which will continue the business under the name BCS Associates, Inc. Bivins & Caldwell will cease its Florida operations, but will continue to do business in nine other Southeastern states.

RKP Associates, Camp Hill, Pa.—appointed representative to cover Northern New Jersey and Eastern Pennsylvania by Industrial Control Co., Farmingdale, L. I., N. Y., manufacturer of servo amplifiers, servo systems, servo digitizers and precision mechanical assemblies.

R. H. Muenzer Co., Pacifica, Calif. — named Northern California and Northern Nevada representative by Computer Logic Corp., Los Angeles, Calif., digital instrument manufacturer.

A. V. Doran Co., St. Louis, Mo.— named Midwestern states representative by Thermionic Products Co., Plainfield, N. J., processor and fabricator of refractory metals for electronic and aerospace industries.

(Continued on page 232)

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& PHYSICISTS

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Design and develop space vehicle communications systems including telemetry, command and on-board data handling.

DATA HANDLING (ASGSE) — B.S., M.S.
Design and develop ground station and on-board data handling systems for re-entry and space vehicle applications.

COMMUNICATION TECHNIQUES — B.S., M.S.
Develop advanced communications techniques for aerospace and space craft, includes communications theory and network synthesis.

ADVANCED SPACE RADARS — B.S., M.S.
Develop concepts and components for advanced space radar including rendezvous, mapping, acquisition and tracking applications.

RADAR INTEGRATION — B.S.
Develop specifications, install and integrate advanced radar in hypersonic and space vehicles, including antennas, transmitters, receivers, displays, power supplies, controls

ANTENNA DESIGN — M.S.
Design and development of antennas for re-entry vehicles. Knowledge of wind effects and general re-entry radiation blackout problems.

RADAR TEST (GSE) — B.S.
Test, checkout and maintain ground radar systems. Make required circuit modifications including range gating circuits, modulators. No travel.

RE-ENTRY INSTRUMENTATION — B.S., M.S.
Design instrumentation for specific re-entry and space vehicles including telemetry systems.

MATHEMATICAL ANALYSIS CONTROLS — PH.D.
Theoretical analysis of noise effects and nonlinear mechanisms on automatic controls. Includes optimal control theory and generalized stability criteria.

ELECTRONIC INSTRUMENTATION — B.S., M.S.
Develop instrumentation for space vehicles. Knowledge of system integration and telemetry desirable.

SPACE GUIDANCE SYSTEMS — M.S., Ph.D.
Develop and analyze navigation and guidance systems using inertial and Doppler techniques and advanced nuclear gyros.

ECM REQUIREMENTS — B.S., M.S.
Mathematical analysis of ECM requirements for advanced aerospace and space craft, and specification of equipment.

FLIGHT CONTROL DESIGN — M.S.
Automatic flight controls, servo systems, nonlinear dynamic systems for space craft.

PYROTECHNIC CIRCUIT DESIGN — B.S., M.S.
Develop pyrotechnic missile circuits including safe arm, squib ignition and RFI elimination devices.

EXPERIMENTAL PHYSICIST — Ph.D.
Conduct experimental studies of the application of nuclear or electron resonance to gyroscopics.

ENVIRONMENTAL TESTING — B.S., M.S.
Undertake test programs to estimate component and system reliability using AGREE type methods; monitor offsite testing.

DESIGN REVIEW — B.S., M.S.
Perform mechanical or electronic design reviews, failure analyses, quantitative analyses and reports. Includes circuit analysis, component selection.

STATISTICAL ANALYSIS — B.S., M.S.
Apply statistical theory and method to prediction and analysis of aerospace component performance.

IDEP PRISM PROCEDURES — B.S., M.S.
Participate in "Interservice Data Exchange Programming" and "Program Reliability Information Systems for Management."

Interested applicants are invited to write in confidence to: Mr. George R. Hickman, Technical Employment Manager, Dept. 13J

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NEWS OF MFRS. REPRESENTATIVES

The Shephard-Winters Co., Los Angeles, Calif.—named representative by Harmon-Kardon, Inc., Plainview, N. Y., to market its digital logic products in Northern California.

Clarostat Manufacturing Co., Inc., Dover, N. H., manufacturer of resistors, potentiometers and switches, announces the following representative appointments: **Straube Associates**, Palo Alto, Calif., to cover Northern California and Nevada; and **R & D Sales Co.**, Denver, Colo., to cover Colorado, New Mexico, Wyoming, Utah, Idaho, Montana, El Paso, Texas, and Gering and Scottsbluff, Nebraska.

Electronic Contacts and Specialties Div., Fansteel Metallurgical Corp., North Chicago, Ill., announces the following representative appointments: **Andro Sales-Engineering, Inc.**, Philadelphia, Pa.; **Aironic Accessory Co., Inc.**, Brightwaters, L. I., N. Y.; **Electro Sales Co.**, Tarrant City, Ala.; **Dale Hjort Manufacturers Agent**, Dallas, Tex.; and **W. Ben Kimberly Co.**, Clearwater, Fla. The division manufactures semiconductor and metallic components.

Jim Morrow Sales, Highland Park, Mich.—named Michigan representative by Omtronics Manufacturing, Inc., Omaha, Neb.

J. A. Jancar Co., Dearborn, Mich.—appointed Lower Michigan representative by the Richardson-Allen Div., Kolsman Instrument Corp., College Point, N. Y., manufacturer of DC power equipment and special transformers.

Sorenson, a unit of Raytheon Co., South Norwalk, Conn., announces the following representative appointments: **Electro-Tec Marketers, Ltd.**, Vancouver, B. C. and Calgary, Alberta, to cover Western Canada; and **Alaskan Sales Co.**, Anchorage, Alaska, covering Alaska.

The following organizations have been selected by Sangamo Electric Co., Springfield, Ill., to market the company's line of servo and synchronous motors, PM generators and frequency converters: **L. A. Nott Co.**, San Francisco, Calif., covering Northern California and Nevada; **El-Kap Sales Co.**, Los Angeles, Calif., covering Southern California, Arizona, and New Mexico; **Datronics, Inc.**, Ft. Worth, Tex., to cover Texas, Oklahoma, Arkansas and Louisiana; **EAC Associates**, New York, N. Y., to cover that city; and **Grant Shaffer Co.**, Detroit, Mich., to cover Michigan.

Elcor, Inc., Falls Church, Va., announces appointment of the following representatives: **T. Whyhell Co.**, Los Altos, Calif., to cover Northern California; and **Milform Engineering Co.**, Van Nuys, Calif., to cover Southern California and Nevada. Elcor manufactures isolation power supplies and transformers, current indicators and integrators.

Computer Diode Corp., Lodi, N. J., manufacturer of diodes and rectifiers, announces the following representative appointments: **ABM Sales, Inc.**, Detroit, Mich., covering Michigan; **C. W. Floring and H. R. Murray, Inc.**, Syracuse, N. Y., covering New York; **Hile-Stitzer Co.**, Paoli, Pa., covering Virginia, Maryland and Washington, D. C.; **Ray Johnston Co., Inc.**, Seattle, Wash., covering Washington, Oregon and Montana; **Lightner Associates**, Chicago, Ill., covering Illinois, Wisconsin, Iowa and Indiana; **Massey Associates**, Orlando, Fla., covering Florida; **Micron Sales Co.**, Dallas, Tex., covering Texas, Oklahoma, New Mexico, Arkansas, Louisiana and Mississippi; **Mosher & Peyser Co.**, Needham, Mass., covering New England; **Malcolm Ross & Co.**, Los Angeles, Calif., covering Southern California, Nevada and Arizona; and **R. G. Sidnell & Co.**, Cleveland, Ohio, covering Ohio and Western Pennsylvania.

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U. S. FIRM ENTERS INTERNATIONAL MARKETS

Oak Manufacturing Co., Crystal Lake, Ill., has directly entered four international markets by acquiring a U. S. based company with three foreign operations, and by establishing a new company in Japan.

Oak, the electrical and electronics components manufacturer has agreed to purchase Hart Mfg. Co., Hartford, Conn., an electronic components company. It has also established a jointly-owned firm in Japan to supplement production of radio and TV tuners for U. S. markets. The new firm will be known as Noble-Oak, Ltd. Oak's partner in the venture is Teikoku Tsushin Ind. Co., Ltd.

Hart's international operation includes Diamond "H" Switches, Ltd. of London, Eng.; Hart Mfg. (Canada) Ltd. Aurora, Ontario, and Diamond "H" Switches of South Africa, Pty., Ltd.

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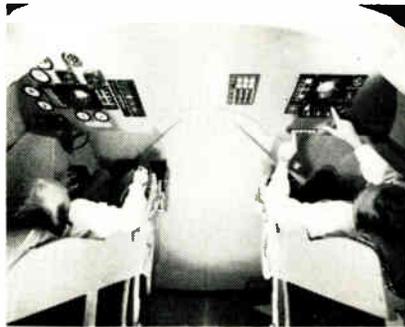
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AF STUDY AVAILABLE

Use of an optical model in determining behavior of electron beams is recommended in an Air Force study now available to the public. The study report (AD 267 507) is available through the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

The study "Electron Physics of Traveling Wave Tube Devices," was written by University of California scientists for the Aeronautical Systems Div. A second report, this one on optical methods of measuring plasma jet temperatures, is also available from OTS.

APOLLO MOCK-UP



Engineers in Honeywell's new Apollo mock-up test instruments for stabilizing and controlling the lunar vehicle. Instruments are controlled by analog computers that simulate space conditions. North American Aviation, prime NASA contractor for Apollo, assigned M-H responsibility for some Apollo systems.

DEEP-SEA VEHICLE

Westinghouse will build a deep-sea research vehicle that will let a three-man crew explore the ocean at depths below two miles. The self-propelled vehicle will be built in cooperation with its designer, Capt. Jacques-Yves Cousteau, world-famed French under-sea pioneer.

SUPER COMPUTER SYSTEM ORDERED

The Atomic Energy Commission has placed an order with Control Data Corp., Minneapolis, Minn., for a high-speed computer system to be installed at the Lawrence Radiation Laboratory. Amount of the order was \$5,574,000.

The system, called the Control Data 6600, is to be installed and ready for acceptance testing at the Livermore (Calif.) lab not later than Feb. 29, 1964. The lab is operated for the Commission by the Univ. of Calif.

The system, although faster than any existing machine, is not to be a specially designed computer. It is to be capable of high speed operation for use in the solution of broad complex scientific problems.

High speed in computing is obtained through the use of micro instructions and multiple transistor registers for temporary storage. Simple instruction can be combined optimally to execute complicated sequences without loss of time in referencing core storage temporary locations.

FIRST TENANT OCCUPIES INDIANA INDUSTRIAL PARK

The Advanced Engineering Development Laboratory of Wabash Magnetics, Inc., has been dedicated at McClure Park, Lafayette, Ind. Wabash thus becomes the first tenant of the industrial research complex established by Purdue University next to its campus.

Speakers at the dedication ceremonies were J. E. Jonsson, Board Chairman, Texas Instruments Incorporated; Douglas Howenstine, President Wabash Magnetics; and R. B. Stewart, Vice President and General Manager, Purdue Research Foundation.

ATLAS SITE PROTECTION

Launch-control communications consoles have been mounted on shock isolators at three semi-hard Atlas sites. The mass-spring system isolators, designed and developed by ITT Kellogg Div. engineers are to protect the equipment from nuclear shock waves. Korfund Dynamics Corp. built the isolators to ITT specifications.

The three sites are the Fairchild (Wash.), Forbes (Kans.) and Warren (Wyo.) AF Bases.

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even when the relay is continuously energized. Moreover, a dust-tight metal shell completely encloses the relay mechanism and contacts, providing dust-free protection for the structure. All the time delay intervals are preset at the factory so there is no chance of tampering in the field which might endanger associated equipment. And all Red/Line relays are directly and easily interchangeable with all other octal-size relays in the field. Among the many current applications for Red/Line relays are elevators, dry cleaning machines, automatic doors, flow control equipment, conveyor systems, photo copy equipment and heater controls.



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Red/Line relays are produced in both normally open and normally closed types, in the standard heater voltages and delay intervals listed below. All standard types are available from local G-V distributors.

SPECIFICATIONS

Contact arrangement: Single pole, single throw, either normally open or normally closed.

Contact rating:
AC-Non-Inductive: 5 amps to 125 volts and 3 amps to 250 volts.

AC-Inductive: 1 amp to 250 volts.

DC-Non-Inductive: 1 amp to 32 volts.

DC-Inductive: 1/8 amp to 32 volts.

For heavier loads, consult the factory.

Contact life: Over 100,000 makes and breaks at full rated load.

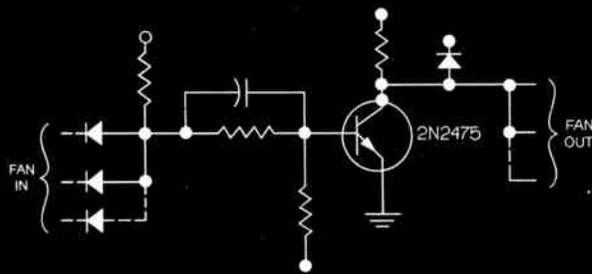
Operating conditions: Suitable for operation at ambient temperatures up to 185°F. Relay design compensates for the effect of ambient temperatures over a wide range. Operates in any position.

6.3 volts	26.5 volts	48 volts	115 volts	230 volts
0.5 sec.	0.5 sec.	—	—	—
1.0 sec.	1.0 sec.	—	—	—
1.5 sec.	1.5 sec.	—	—	—
2.0 sec.	2.0 sec.	2.0 sec.	2.0 sec.	—
5.0 sec.	5.0 sec.	5.0 sec.	5.0 sec.	—
10.0 sec.				
20.0 sec.				
30.0 sec.				
45.0 sec.				
60.0 sec.				
90.0 sec.				
120.0 sec.				
180.0 sec.				

G-V Regional Field Engineers throughout the United States are available for consultation on time delay problems. For complete literature and/or assistance, write to **G-V Controls Inc., Okner Parkway, Livingston, N. J.**, or call **992-6200** (Area code 201), Mr. George Compton.



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Now, RCA combines the latest silicon technology, including planar epitaxial structure and subminiature junctions, in the ultra-high-speed 2N2475. Check these outstanding features:

- Ultra-High Frequency Capability...Gain-Bandwidth Product—800 Mc typical
- High Beta At High Currents... Min h_{FE} of 20 at $I_C = 50$ ma
- Low Saturation Voltage... $V_{CE}(\text{Sat}) = 0.4$ volt max.
- Low Output Capacitance... (C_{ob}) = 3 pf. max.
- Low Charge Storage Time... (t_s) = 6 nsec. max.
- Short Turn-On Time... (t_{on}) = 20 nsec. max. at $I_C = 20$ ma
- Short Turn-Off Time... (t_{off}) = 15 nsec. max. at $I_C = 20$ ma

The exceptional stability and ruggedness of the planar epitaxial structure, and its combination of outstanding performance features make the 2N2475 an excellent choice for switching applications. This transistor is available for immediate delivery in production quantities.

Call your RCA Representative today for further information on the 2N2475, and ask him about RCA's broad line of Silicon Planar Epitaxial Transistors, now including the RCA

2N709. For additional technical data, write RCA Semiconductor & Materials Division, Commercial Engineering, Section CJ-9, Somerville, N. J.

ELECTRICAL CHARACTERISTICS AT 25°C			
	MIN.	MAX.	UNITS
h_{FE} ($I_C = 1.0$ ma, $V_{CE} = 0.3$)	20	—	—
h_{FE} ($I_C = 20$ ma, $V_{CE} = 0.4$)	30	150	—
h_{FE} ($I_C = 50$ ma, $V_{CE} = 0.5$)	20	—	—
I_{CBO} ($V_{CB} = 5V$, $I_E = 0$)	—	0.05	μa
$V_{CEO}(S_{us})$ ($I_C = 10$ ma, $I_B = 0$ Pulsed)	6	—	volts
C_{ob} ($V_{CB} = 5V$, $I_E = 0$)	—	3.0	pf
t_s ($I_C = I_{B1} = I_{B2} = 5$ ma)	—	6	nsec
t_{on} ($I_C = 20$ ma, $I_{B1} = I_{B2} = 1$ ma)	—	20	nsec
t_{off} ($I_C = 20$ ma, $I_{B1} = I_{B2} = 1$ ma)	—	15	nsec
h_{fe} ($I_C = 20$ ma, $V_{CE} = 2V$, $f = 100$ Mc)	6	—	—

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